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Defense logistics: fundamentals of logistical process management and the transformation of the Brazilian Army.

Logística de la defensa: fundamentos de la gestión de procesos logísticos y transformación en el Ejército Brasileño

Abstract: The article discusses the theme of defense logistics, presenting the fundamentals of logistics process management. Considerations are presented on the logistic doctrine and the transformation process of the Brazilian Army, as well as guiding questions on the socioeconomic evaluation of logistic projects through the application of integrated models of actions in the territory, to be conceived and evaluated according to their capacity to attend the project needs. Important challenges stand out in the work, from the conception and implementation, to the operation and evaluation of logistics projects, aiming to produce a certain goal of satisfactory economic growth to fund and remunerate them. Regarding logistics and transportation factors, the importance of expanding the State's presence in more distant regions is emphasized, aiming to make the most of the advantages gained by the flexibility inherent to the mode of transport evaluated. The public policies and governmental actions based on land in the area are crucial to promote the region's development.

Keywords: Defense Logistics. Process Management. Brazilian Army.

Resumen: El artículo analiza el tema de la logística de defensa, presentando los fundamentos de la gestión del proceso logístico. Se presentan consideraciones sobre la doctrina logística y el proceso de transformación del Ejército Brasileño, así como preguntas orientadoras sobre el tema de la evaluación socioeconómica de los proyectos logísticos a través de la aplicación de modelos integrados de acciones en el territorio, para ser concebidos y evaluados de acuerdo con su capacidad de asistencia de las necesidades del proyecto. Se destaca un trabajo importante, desde la concepción y la implementación, hasta la operación y evaluación de proyectos logísticos, con miras a producir un cierto objetivo de crecimiento económico satisfactorio para financiarlos y remunerarlos. Con respecto a los factores de logística y transporte, se enfatiza la importancia de expandir la presencia del estado en regiones más distantes, con el objetivo de aprovechar al máximo las ventajas obtenidas por la flexibilidad inherente al modo de transporte evaluado. Las políticas públicas y acciones gubernamentales basadas en la tierra en el área son consideradas fundamentales para promover el desarrollo de la región.

Palabras clave: Logística de la Defensa. Gestión de Procesos. Ejército Brasileño.

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1 Introduction

This article addresses issues related to a relevant Defense theme. Aspects of logistic process management that are of interest to the Brazilian Army are addressed and related to the Force's ongoing transformation. In the second section, dedicated to theoretical foundations, we discuss considerations on the management of defense logistics processes and on the Logistic Doctrine, the Brazilian Army's process of transformation, and the importance of the Transport subsystem for Army Logistics.

The third section deals with concepts and approaches for the socioeconomic assessment of projects in the area of logistics and transport, highlighting the territorial engineering approach – a model that can be applied to the Brazilian Army's logistical operations, as analyzed in the case studies presented here.

The article's final considerations debate the importance of intermodal integration as a means of consolidating the state's presence in remote regions, aiming to take full advantage of the inherent benefits of different modes of transportation. Aspects regarding the possibility of integration with territory-based governmental policies, programs and projects are considered fundamental in assessing the Brazilian Army's actions within the Logistics subsystem.

2 Theoretical foundations

2.1 Initial Considerations on defense logistics process management

Logistics is an area of knowledge that addresses the problem of planning for and providing supplies and services needed to ensure the smooth functioning of an organization's systems of operation. According to Ballou (2010, p. 27), the dictionary definition[1] of the term 'logistics' refers to the branch of military science that deals with the procurement, maintenance and transportation of material, personnel and facilities – which places logistics in their military context. A broader definition of the discipline is also provided: it is the process of planning, implementing and controlling the efficient and effective flow of goods, services and related information from the point of origin to the point of consumption, for the purpose of meeting customer requirements[2]. Ballou also notes that the first textbook to suggest the benefits of coordinated logistics management was published in 1961[3].

On the importance of logistics, specifically in relation to the dimension of logistics value, Bowersox *et al*. (2014, p. 37) emphasize that "logistics should be managed as an integrated effort to achieve customer satisfaction at the lowest total cost", and also propose that "the modern [logistical] challenge is to create value." In the field of defense, logistics has an outstanding strategic value, being considered an "art of preparation for war." It possesses all the

1 MERRIAM-WEBSTER. **Webster's new encyclopedic dictionary**. New York: Black Dog & Leventhal Publishers, 1993. p. 590.

2 According to the definition by the *Council of Logistics Management – CLM* (www.clml.org).

3 SMYKAY, EW; BOWERSOX, J.; MOSSMAN, FH **Physical distribution management**: logistic problems of the firm. New York: Macmillan, 1961.

characteristics of military science, except for combat. In fact, it emerged as a subject of scientific study in the military field, approached by notable scholars of War Sciences such as Klaus von Klausevitz and Antoine Jomini, among others.

The classic work by Sun Tzu (*The Art of War*) has a prominent place for logistics, which appear in several excerpts. One example is in Chapter X (Terrain):

> [...] a power of estimating the adversary, of controlling the forces of victory, and of shrewdly calculating difficulties, dangers and distances, constitutes the test of a great general. He who knows these things, and in fighting puts his knowledge into practice, will win his battles. He who knows them not, nor practices them, will surely be defeated (SUN TZU, 2014, p. 122).

And in chapter XI of the work (The Nine Situations):

> When you leave your own country behind, and take your army across neighborhood territory, you find yourself on critical ground. When there are means of communication on all four sides, the ground is one of intersecting highways. [...] On serious ground, I would try to ensure a continuous stream of supplies. On difficult ground[4], I would keep pushing on along the road. (SUN TZU, 2014, p. 135).

Several current works, dealing with the theme of business logistics, present historical citations that highlight logistics and supply chain management as an important discipline, considered in the area of Military Science as a strategic factor for success. Christopher (2001, p. 1) illustrates the importance of logistics by referring to a the United States independence process, commenting that it "has been argued that the defeat of the British in the American War of Independence can largely be attributed to logistics failure," and adding that in the first six years of the war, the administration of vital supplies (equipment and food) was "totally inadequate, affecting the course of operations and the morale of the troops."

The military man and writer Euclides de Cunha, author of famous work "Os Sertões", comments in his *Diário de uma Expedição* ("Diary of an Expedition") (CUNHA, 1897, our translation):

> Still no news about the fighting. Yesterday another convoy left. It should be escorted in the climb by the 33rd Jueté battalion, as it enters the danger zone. General Carlos Eugênio has not yet departed and his delay may linger. Our situation, the fates of war now rest on the thousand or so donkeys indispensable for the transport of ammunition. This bizarre circumstance sums up the campaign's special conditions. Even if we had a hundred thousand men here in Monte Santo, our luck would hardly improve. One might even say it would worsen considerably.

4 Difficult terrain (mountainous forests, stony steppes, marshes and swamps).

> We are not short of men who are willing to die, riddled with bullets, for the Republic. But the Republic cannot demand from them the sacrifice of death by starvation. All of these difficulties arise largely from the adopted base of operations, wedged in the desert and in and of itself painful to gain access to. The ongoing convoys are the daily bread of our forces, and are insufficient. By a remarkable reversal of events, the two thousand men who stand ready to depart will be fighting not as auxiliaries, but rather as competitors in a deaf struggle against penury [Monte Santo, September 9–10, 1897].

Christopher (2001, p. 2) describes how logistics played an important role in World War II, especially in the Allied troops' landing operations in Normandy. As a matter of fact, Ballou (2010) characterizes the Allied invasion of Europe during World War II as the most complete and well-planned logistics operation in history. It is sufficient to note that, in this battle, the military alone held resources valued at about 1/3 those of all US manufacturing companies. Christopher also quotes German Marshal Rommel as reportedly having said that "... before the fighting proper, the battle is won or lost by quartermasters". Logistics were also particularly important in the Vietnamese resistance during the protracted Vietnam War (1952–1958), not to mention the "Desert Storm" American campaign in Kuwait and Iraq (1990–1991) (CASTRO, 2003).

Saudi Arabia was centrally located in the Persian Gulf Theater of Operations[5], with several ports and airports being used for US troop disembarkation. However, this apparatus lacked sufficient road and rail systems, the logistical infrastructure needed to support US troops (by transporting supplies to advanced positions). This led to the establishment of a Logistics Command in the Theater of Operations, known as the 22nd Support Command (SUPCOM) in Saudi Arabia. The SUPCOM coordinated logistical actions and was used to support the displacement of forces in the region, preparing for the arrival of massive amounts of troops and equipment from Southeast Asia[6].

Braz (2004, p. 50–51) states that logistical performance in the first Gulf War was satisfactory, citing, for example, that the first wave of 200,000 men and their equipment was displaced in a month and a half. For a point of comparison, in the Vietnam conflict the same displacement took nine months. The Gulf operation made abundant use of several current logistical concepts, such as customer service.

However, it should be note that organic US resources were insufficient for the transport of forces in the Theater of Operations. The local infrastructure lacked resources to meet the intended logistical effort, which led to the need to mobilize new material resources and

5 Encompassing Iraq, Kuwait and northern Saudi Arabia – about 1.5 million km^2 – an area equivalent to that of the state of Amazonas. Most of it is uninhabited desert.

6 Creation of the 22nd Support Command (SUPCOM) in Dhahran (Saudi Arabia), which took place on August 10, 1990. The Command was positioned approximately 940 km from Baghdad (Iraq), and became responsible for logistical operations within the Theater of Operations. Its mission was to coordinate the arrival of major units and the logistical support provided by the Allies and by the host nation, reducing the need to relocate multiple US Army units, and establishing the logistical infrastructure needed to feed, house and supply the large number of troops arriving in Saudi Arabia.

personnel. Thus, a procurement section had to be established, responsible for the registration of suppliers and outsourcing of local service companies. Contracts were signed with local commerce companies and the Saudi Public Transport System, by means of a leasing system and by employing drivers of various nationalities to assist in the transportation of supplies and personnel within the Theater of Operations. This contract system met with several obstacles. Contractors had difficulty adapting to military standards, and there were communication problems due to the diversity of languages as well as the companies' non-compliance with the agreed upon deadlines. This caused delays in cargo delivery and hampered coordination and control, negatively affecting the logistics system (CASTRO, 2003).

According to Braz (2004, p. 57), the origins of Brazilian Army military logistics activities – especially those dedicated to supply services – date back to Imperial Brazil, with the creation of the Army's Royal Board of Armories, the Military Commissariat, and the General Headquarters. All were executive agencies charged with providing the necessary material to the Armed Forces, whether general supplies, ammunition, weapons, animals, or transport carts.

Regarding the Supply Service, Braz (2004) explains that Logistics is a key component of organizational success, directly related to cost reduction and increase in the level of service provided to customers. The author points out that, for the achievement of the objectives of the Ground Forces, a constantly improved and updated logistics doctrine has to be a priority – especially regarding the need to integrate logistical activities in order to optimize the use of available resources, reduce costs, and prioritize actions.

Thus, seeking an integrated approach to logistics, the Brazilian Army created a central body with the task of coordinating its Units' entire supply chain: the Logistics Department (D Log), responsible for the centralized coordination of most of the Force's logistical deployment functions. Moreover, the development of such a mentality, favoring the internal integration of activities, allows for the rationalization of management processes, increasing the material availability indexes of military organizations, and consequently netting an operability gain for the Brazilian Army (BRAZ, 2004).

Lopes (2009) discusses some of the impacts of the National Defense Strategy – END (*Estratégia Nacional de Defesa*) on the Brazilian Army Logistics System, arguing that, if the Institution's response to the underlying concepts of the END is to receive adequate logistical support, ground military logistics doctrine has to be updated. The author emphasizes the unfavorable conditions in the Brazilian Army – which is hampered by budgetary constraints on investment in new technologies and equipment – leading military ground doctrine (which encompasses military ground logistics doctrine) to severely lag behind.

The modernization opportunity offered by the National Defense Strategy creates the need for policies focused on the improvement of logistic structures and doctrine systems, with an aim towards the adaptation of logistic values, principles, concepts, norms, methods and logistical processes to the future reality of a modernized Brazilian Army (LOPES, 2009).

2.2 Logistic doctrine and the Brazilian Army's process of transformation

Currently, the Brazilian Armed Forces, in accordance with Manual MD 42 M–02 (BRASIL, 2001) – which deals with the theme of military logistics doctrine – consider the following as fundamental success factors:

- Resources should be provided in the appropriate quantity and quality, and at the appropriate time and location;

- The execution of logistical activities assumes that financial resources can be allocated as needed. If these resources are insufficient, adjustments should be introduced;

- The peculiarities of each Force do not condition the separation of Military Logistics into autonomous logistical systems; they may, however, dictate specific procedures and actions that will be reflected in the respective organizational systems without, however, conflicting with doctrinal foundations;

- Due to its outstanding and important role in solving complex problems of support to military forces, Logistics has acquired a prominent position in the operational context, and can be rightfully called one of the pillars of the art of war;

- Faced with a situation in which the resources allocated by Logistics are insufficient, Mobilization will fulfill and supplement the existing needs; hence the demand for a perfect dialogue between Logistics and Mobilization, and

- Logistical planning, regardless of level and scope, should have feasibility as its basic premise, grounding itself on the existence of immediately or eventually deployable assets, given the conditions such planning is based on.

Within the scope of the Brazilian Army and from a doctrinal standpoint, logistics are dealt with in the C 100-10 Campaign Manual (BRASIL, 2003), which aims to guide the actions of military ground logistics. The manual regards these actions as having outstanding strategic importance, and presents the following fundamental definitions:

- Military Logistics: the set of activities associated with the forecasting and provision of human and material resources as well as services necessary for the execution of Armed Forces' (AF) missions;

- Ground Military Logistics: the set of activities associated with the forecasting and provision of the necessary means for the organizational functioning and operations of the Ground Force (GF);

- Logistic function: an umbrella term designating a set of related or similar logistic activities. There are seven logistic functions: Human Resources, Health, Supply, Maintenance, Transport, Engineering, and Salvage;

- Logistic activity: a set of related logistical tasks, combined according to relationship, interdependence or similarity criteria.

- Logistic task: specific and time-limited work, which groups together interconnected steps, acts or movements according to a certain sequence and aiming to obtain a definite result.

Importantly, the ongoing process of transformation of the Army involves dimensions related to the logistical management of processes. Among the main logistical challenges that must be overcome by the Brazilian Army, we could highlight the need to supply detached platoons in distant corners of the Brazilian territory and in humanitarian missions in different regions of the world. Another noteworthy challenge lies in managing the logistics for maintaining investments in technologically complex systems and products of high strategic value, such as systems for monitoring and surveilling the Brazilian border.

According to Lopes (2009), new strategies, new technologies and new threats create needs for the modernization or transformation of the Armed Forces and their doctrine.

Referring to the launch of the National Defense Strategy, the author states (2009, p. 3, our translation) that "the initiative and participation of the National Power's political expression in the conception of the National Defense Strategy confers this document with a broader support, beyond the military sphere." As he notes, the document prescribes the modernization of the national defense structure by reorganizing the Armed Forces, as well as restructuring the national defense industry and the composition policy of Armed Forces personnel. This has significant repercussions on the logistics management system.

Lopes (2009) also points out that, since the end of the Cold War and the Desert Shield and Desert Storm operations, the United States Army (US) has sought to put into practice a transformation process that was initially known as Revolution in Military Affairs (RMA). The term "Transformation" was later adopted to substitute "Revolution." The Revolution in Military Logistics (RML) is considered part of this process, aimed at integrating new concepts and technologies into the US Army.

Discussing the transformation process underway in the Brazilian Army, Maia Neto (2011) considers the demands of the "Age of Knowledge" to point out that information management has been a permanent concern for organizations, making them unceasingly look for ways to manage a huge range of information, analyzing and transforming it into knowledge and actions. Having initiated a broad process of transformation, the Brazilian

Army, he points out, has sought to adapt to this new stage, seeking to qualify its staff and rediscuss its paradigms.

Maia points to some central conditions that are starting points for this process, namely: a personnel of approximately two hundred thousand members; a large number of military organizations (about 650); a high turnover of career personnel; discipline and hierarchy as fundamental principles of organizational culture; and Brazilian society's demands for a strong performance by the Brazilian Army in several areas – especially security, infrastructure and social actions. The responsibility for finding answers to these challenges would rest squarely on the shoulders of the country's Institutions.

Fully aware of these unsettling challenges, Maia Neto analyzes (2011, p. 01, our translation):

> ... It is believed that Brazil's new situation as an international protagonist will be accompanied by fresh demands in various areas, from economy to defense. In this novel context, military institutions must be prepared for the challenges ahead, improving their agility and responsiveness to the needs of the population and to the global aspirations of this new Brazilian state.

The meeting of demands for the supply of a variety of inputs, therefore, should be the object of careful analysis, with a view to ensuring supply in military operations – both in peacetime and wartime – for the defense of sovereignty and the guarantee of law and order.

Regarding the National Defense Strategy – END, Lopes argues that (2009, p. 10–11, our translation):

> The imperatives of flexibility and elasticity culminate in the preparation for an asymmetric war against an enemy of far superior military power, especially in the Amazon Region. Asymmetric warfare requires an effective doctrine, suited to a conjuncture of national-resistance war. In this context, the all-important mission of maintaining and building a capability for providing logistic support to the combatant forces – even under adverse and extreme conditions – rests on military ground logistics. Thus, parallel to the fact that it applies to the Brazilian Army as a whole, the END's premises of flexibility and elasticity are essential in the Amazon Region, where they offer a strong doctrinal foundation for the training currently being conducted by the Amazon Military Command (CMA) as part of the Resistance Strategy. Similarly, military ground logistics should organize itself and its action on the basis of the concepts of flexibility and elasticity ... Such characteristics will require the specific development of the military ground logistics doctrine, with the conception of tailored solutions adequate to the needs of ground troops in the varied operational environments of the national territory.

We should emphasize the importance the END places on these two aspects (flexibility and elasticity) – they must genuinely underpin the Force's logistical systems. In terms of flexibility, this assumes the adoption of modular organizations capable of providing tailor-made support

to various missions. In terms of elasticity, it points to the need for advanced mobilization tools and means of interaction with the Mobilization System, so as to increase combat and support effectiveness. There are also important aspects that are specifically linked to logistics in the Amazon Region. Currently, doctrinal studies on logistics support in the jungle operating environment are predicted to continue, taking into consideration both the conventional warfare scenario and the asymmetric resistance one.

The Brazilian Army is included in the Defense Transport System (STD). Under normal conditions, it is responsible for maintaining the Brazilian Army Transport System, a set of transportation structures and logistics organizations for providing the Army with organic support or, when thus determined, provide support to other Armed Forces, as well as governmental and non-governmental agencies and civilian agencies.

In situations of crisis or armed conflict, joint transport structures may be activated according to strategic, operational and tactical planning. The execution of joint transportation logistics activities should be coordinated by the Center for Coordination of Logistics and Mobilization (CCLM), in order to streamline actions and spare resources, particularly when involving the hiring or mobilization of civilian assets (SILVA, 2007).

2.3 Importance of the transport component in Army logistics

As Bowersox *et al*. (2014, p. 200–203) observe, transportation is usually the largest logistics expense. Transportation represent more than 60% of total logistics expenses. The authors further emphasize that the cargo transportation structure consists of physical infrastructure, vehicles and carriers operating within five basic transportation modals[7]. In a logistics chain, functional activities are repeated several times throughout the process, causing the raw material to effectively become a final product. The goal is for it to reach the customer while providing the highest level of satisfaction (BALLOU, 2006).

Bowersox *et al*. (2014) add that the main functions of Logistics are information, transportation, storage, material handling, and packaging. Its goal is to make products and services available where they are needed, when they are needed, achieving a high standard of customer service at the lowest possible total cost.

In regards to logistical planning in its tactical dimension, the evaluation of infrastructure conditions – needed for the mobility of troops and supply systems, a necessary condition in the case of a prolonged resistance conflict – is of particular importance in the prospective assessment of armed conflict scenarios.

In this respect, strategic decisions related to transport logistics should consider this function as a

> set of activities aimed at the displacement of human, material and animal resources by various means, in a timely manner and successfully reaching their intended

7 A modal is a basic method or form of transport. The five basic transportation modals are rail, road, waterway, pipeline and air (BOWERSOX *et al*., 2014).

> destinations ... Military transport must be carried out under military direction, with the purpose of meeting the needs of the Armed Forces. Depending on the route, military transport encompasses four modalities: waterway, land, air, and pipeline ... Waterway transport includes oceanic travel, short sea shipping and the use of inland waterways (LOGÍSTICA..., 2017, our translation).

The success of military operations is directly related to the effectiveness of the transports intended to support them. In this sense, lackluster transportation limits the execution of operations. Moreover, the "Ground Force will prioritize the use of its organic means of transport to meet its transportation needs." (LOGÍSTICA..., 2017, our translation). Although the Ministry of Defense has no such thing as a joint body to conduct operational-support logistics, it recommends that cooperation and mutual support between the single forces should be pursued as the primary objectives for maximizing the efficiency and effectiveness of transportation logistics. Besides, if organic resources or the support provided by other forces does not meet a force's transportation needs, these must be complemented by mobilizing or contracting civil services (LOGÍSTICA..., 2017).

The activities of the transportation logistics function are the following:

- Needs assessment – results from a detailed examination of the proposed plans and, in particular, of the proposed actions and operations. Users periodically present the planning of their needs in the upcoming period to the pertinent support bodies.

- Selection – fulfilling the necessary priorities and choosing the adequate transportation modal and means, based on the knowledge of the possible transportation means and routes.

It should be noted that transport management should pursue optimal returns from the use of the available means, minimizing transfers, employing the most flexible means of transport, and ensuring the speed, safety and flexibility of logistics operations. It should also establish measures for coordinating and controlling the movement of material or personnel, ensuring the systematic and orderly execution of traffic.

In order to meet the requirements of the Transportation Functional Group in armed conflict scenarios – which are associated with the displacement of human, material and animal resources by various means, in a timely manner, successfully reaching the intended destinations – the Brazilian Army has organic transport support structures and logistic organizations. In situations of crisis or armed conflict, joint transport structures may also be activated, according to strategic, operational and tactical plans.

Particularly when hiring or mobilizing civil assets, there must be a constant reassessment of the rationalization of logistic transport actions, logistics chain and mobilized resources. This is necessary in order to achieve the desired economy of means, considering that

transport capacity is a strong limiting component of the operating range and freedom of action of the supported forces.

It is important to remember that, in situations of armed conflict, several transport resources may be mobilized, including vehicles, personnel and physical infrastructure (highways, railways, waterways, pipelines, ports, airports, terminals and others) in the National Territory.

3 Socioeconomic evaluation of logistics projects

3.1 Prospective assessment of the territorial approach to system investment

According to Aragão, Yamashita and Pricinote (2010), Territorial Engineering is a form of engineering whose object is the conception and implementation of Territorial Programs. On the basis of the public and private projects within a given reference area that are already being discussed by civil society, territorial engineering builds an initial programmatic outline. This is done in a cooperative manner, inclusive of public and private actors, who are the projects' protagonists. It must also consider the economic and fiscal impacts of its programs, so as to ensure that private projects are profitable and that all public projects (including projects comprised of public support for private projects) are fiscally sustainable.

It is our belief that the adoption of Territorial Programs aimed at implementing logistics-related projects could successfully gather the resources necessary to fund these projects. A logistics territorial program should contain plans and projects regarding the general configuration of the territory of interest, aiming at accessibility and mobility in that territory. It should also plan for other types of infrastructure (energy, water, sanitation, and communications, among others).

As proposed by Aragão, Yamashita and Pricinote (2010, p. 21, our translation):

> This entire transformation is made possible by the scientifically based coordination of the complex of actions, which is based on the image of a logically consistent and effective artifice. This artifice concerns not only objects and actions (the subset of elements we have provisionally called a 'program'), but also the control of their effects, the process of power building and the definition of social rules (i.e., the definition of their jurisdiction); the process of coordination of work, from which the project is materialized based on organized resources (material, human, financial) and on learning itself. We call this artifice a Territorial Engineering Project. Therefore, the territory is configured partially as a network, but also as a contiguity of areas in the form of basins, especially due to concern regarding the economic, social and environmental risks of the program. The consideration of contiguity is reflected above all in the [program's] landscape project and in the [program's] systematic promotion of economic growth. Risk considerations, in turn, imply that network configurations will expand, increasingly encompassing other activities and their respective territorialities.

The premise here is that the use of models that evaluate logistical projects from a territorial perspective – notably projects for financing infrastructures and systems with high complexity and technological value (while also financing regional development) – can promote the implementation of important territorial structures and programs.

Thus, investment decisions should not be based on the gains of indirect users and beneficiaries, but rather on the investment's ability to boost economic growth in the area of influence. Tax earnings can be used to measure the effects of such an investment. This proposal is an answer to the limitations of current approaches to public and private financing. However, we should note that the object of funding cannot be limited to isolated infrastructure. It must be seen as a complex system, including infrastructure, productive projects and integrative policies.

Investments in logistics systems and transport infrastructures of interest to Brazilian Army operations can be modeled and analyzed as a set of productive actions carried out by a dispersed number of actors. In this sense, the economic results, wealth generation and social benefits of programs and projects cannot be attributed directly and exclusively to infrastructure. Therefore, what we have here is an innovative proposition for the analysis of infrastructure and logistics investments, which enables a complex treatment of the problem of financing – regarding it as a "territorial program" and resorting to the Territorial Engineering method. The Territorial Engineering project, derived from this territorial program, is a set of infrastructure projects, production plants, integrative policies, and project management actions (technical project management, financial management, political management, legal management, and cognitive management). The program's goal is to produce the controlled result of a regional economic growth significant enough to offset the tax authorities' contribution by providing a positive cash flow comprised of tax revenues, which arise from growth directly attributed to the territorial program itself.

According to this territorial approach, projects should be chosen according to their integrative potential to cause significant technological impacts. These impacts should spill over to other sectors. The aeronautics industry exemplifies this spillover effect: technologies and skills developed in this sector can be used in the development of a new family of next-generation commercial jets, for instance.

According to Aragão, Yamashita and Pricinote (2010, p. 26, our translation), a project's integrative potential is not only dependent on the availability of financial, human, material and technological resources, but also on political initiative, since "territorialization does not follow instrumental logic alone, but also cultural logic, especially that of local reaction to supralocal initiatives." Furthermore:

> The state will never be absent in territorialization processes ... it may lose the monopoly of power, but will remain an essential force – an orchestrator, global agent and risk manager. Its action ensures the necessary combination of competition and cooperation.

> For Brazil in particular, recent government documents[8] call for the return and strengthening of integrative planning as a tool to reduce regional disparities, focusing on regionalization, economic consolidation and creation of growth poles, rationalizing the infrastructure network.

It is important to consider the socioeconomic feasibility of logistics projects by applying integrated territorial-action models. These should be designed and evaluated according to their ability to meet the project's needs. The construction and, above all, the management of such a project leads to important technical and political challenges, from the conception and implementation to the operation and evaluation, in a given territory, of overarching initiatives consisting of feasible public and private subprojects. These should aim to produce a satisfactory economic growth, which shall be used for funding and remuneration. Thus, public contributions should mostly be funded by the increase of fiscal resources collected from the achieved economic growth (ARAGÃO; YAMASHITA; PRICINOTE, 2010).

3.2 Socioeconomic evaluation of projects and the "Army Aviation" program

In the manual "Programa Avaliação Socioeconômica de Projetos: Oficina Socioeconômica de Projetos de Defesa" (RAMALHO *et al*., 2010), a case study involving the KC-390 aircraft proposes the following criteria for evaluating alternatives in the acquisition of such aircraft:

a. technical, economic and financial aspects and deadlines, with their various associated risks;

b. technological and industrial capacity of the domestic industry, and particularly Embraer's, to develop a military transport aircraft;

c. political and social aspects of the program (desired degree of independence in regards to aircraft operation and maintenance, technological development, preservation of work hours in the national industry, among others);

d. the country's desire to retain intellectual property derived from the program's execution, so that the aircraft can be updated, operated and maintained autonomously throughout its operating life;

8 Documents from the Ministry of Planning, Budget and Management (2008) entitled "Estudo da Dimensão Territorial do Planejamento. Volume 2: Visão Estratégica Nacional," "Estudo da Dimensão Territorial do Planejamento. Volume 3: Regiões de Referência," and "Estudo da Dimensão Territorial do Planejamento. Volume 4: Estudos Prospectivos. Escolhas Estratégicas," as well as the document "Subsídios para a definição da Política Nacional de Ordenação do Território – PNOT. Versão preliminar." The latter is a study with the participation of the Inter-American Institute for Cooperation on Agriculture, the Brazilian Association of Technological Research Institutions, the Ministry of Planning, Budget and Management, and the Ministry of National Integration, Universidade de Brasília (2006).

e. the guidelines established in the National Defense Strategy, which ensure that purchase decisions are made according to the primacy of commitment to the development of national technological capabilities in defense products, and of the socioeconomic benefits brought to Brazil.

In order to meet the needs of the Brazilian Army, as well as that of civilian humanitarian aid, the Army Staff presented the Army Aviation Program (EXÉRCITO, 2017)[9], a part of its Strategic Portfolio. It includes tests and studies to support the Force's acquisition of 16 transport and 12 attack aircraft.

The Brazilian Army's evaluation of attack and transport aircraft included the following transport aircraft models: Leonardo AW139M and Leonardo AW149 (Italy), Bell UH-1Y "Venon" – US Marines (USA) and Leonardo AW101 Merlin (England). The evaluated attack aircraft were the following: Leonardo T-129 "Mangusta Modernizado" (Italy); Leonardo A-129D "Mangusta" (Italy); Rostvertol MI-28NE (Russia); Bell AH-1 "Viper" US Marines (USA). Troop-transport and multi-purpose helicopters have a top speed of 300 km/h, with a range of up to 1000 km, while combat helicopters have a range of up to 800 km, operating at top speeds between 300 and 365 km/h.

In addition to its weapons systems modernization project and flight simulator project, the Army Aviation Program includes the projects known as "Maintenance of Operative Capacity of Transport Aircraft,"[10] "Expansion of Logistic Transport Capacity,"[11] and "Obtaining Attack Capacity."[12] The attack aircraft will also enable electronic warfare, intelligence, armed reconnaissance, surveillance and target acquisition missions. The Project provides for the acquisition of 12 (twelve) aircraft, fully equipped with weapon systems (machine guns, cannons, rockets and missiles) and optronics (color camera, night vision and infrared), simulators, crew training and maintenance.

The process of modernization and fitting of aircraft within the scope of the Army Aviation Program should consider as operational requirements the aircraft's availability and operating cost, with emphasis on aspects related to the integrative capacity of investments that have a strong technological base. This is certainly the case for the installation of bases geared towards airborne logistical support, which have several effects on the economy, creating value in the form of patent-market value and in the form of new products and projects, generated by the obtained knowledge.

9 Available at: https://bit.ly/2Y4kzNI. (Primary source: Brazilian Army Communication Advisory. Access on: Mar. 20, 2018)

10 To provide the Army with new medium-sized aircraft to replace the current transport aircraft that are in the obsolescence phase. Provides for the acquisition of 16 (sixteen) aircraft.

11 To acquire fixed-wing aircraft will enable the Ground Force to fulfill its Immediate Strategic Response (although in a limited way), Command and Control (command liaison) and Logistics Support missions, particularly at the border strip, supporting the Special Border Platoons.

12 To enable the Ground Force to develop its combat capabilities, support the Ground Forces (Surface Action and Maneuver operative capabilities) and act upon compensating targets with precision, lethality, depth and appropriate effects (Fire Support operative capability).

3.3 Transport logistics projects and the Defense Industrial Base

The positive effects of investments in Defense Industrial Base (DIB) defense projects are referred to in the literature as "spillover" or "spin off" effects. These terms are related to the civil-environment benefits of an ongoing technological development, even if this development was originally intended to meet strictly military demands:

> The notion of economic spillover or spin-off effects is based on the assumption that the resources employed for the development of defense systems, as well as the resulting new technologies, may have applications in civilian environments. This assumption peaked during World War II, when the enormous war effort boosted research and development aimed at finding new ways to surprise the enemy. This spawned a large number of weapon-system technologies that were later directly or indirectly applied in the civil environment. Examples are the radar, sonar and synthetic rubber (FIELD, 2008; *apud* ALCOFORADO *et al*., 2016, p. 105).

As for the potential to leverage the country's development, the better-structured among defense projects stand out. According to Alcoforado, Braga and Vilela e Silva (2016), they have significant impacts on the high-tech field, creating skilled jobs in one of the most growth-shy sectors of the Brazilian economy. The authors also point out that, as the production chain as a whole develops, the Brazilian aerospace sector will be able to increasingly absorb investments in the aerospace defense industry. However, to make companies globally competitive, socioeconomically viable projects are necessary, including a regular cadence of orders and research investments.

In the case study "Desenvolvimento da aeronave KC-390 da Embraer," Alcoforado, Braga and Vilela e Silva (2016) studied the socioeconomic impacts of the 2009 Brazilian government's procurement of Embraer for developing and producing two prototypes of a 20-tonne-class, multi-mission military transport aircraft (the KC-390)[13]. The authors evaluated the aircraft's socioeconomic impacts, technological spillover effects and broader socioeconomic benefits according to the methodology proposed by Hartley (2013, apud ALCOFORADO; BRAGA; VILELA E SILVA, 2016).

According to them, the benefits brought by the development of defense programs should, whenever possible, be evaluated against possible existing alternatives, including market-ready products and joint development with other countries. Moreover, such analyses should go beyond development/acquisition, considering the project's life cycle in its entirety.

13 Aims to replace the KC/C-130 Hercules Aircraft unities currently in operation, all over 30 years old. It was the first FAB project to be evaluated and approved in its technical and socio-economic feasibility by the Technical Chamber for the Evaluation of Major Projects of the Ministry of Planning, Budget and Administration. The approval was published in DOU Section 1, Issue No. 188, of 10/01/2009, p. 72.

Thus, the authors list several benefits of the project, such as job creation during its development, production and support; technological advantages; contribution to a positive trade balance; compliance with pre-established requirements such as interoperability across different Armed Forces, independence in the management of the aircraft's life cycle, etc.

The correct identification of the benefits and costs of a project stems from comparing the no-project-needed scenario to the project-development scenario. Both scenarios can have positive or negative consequences.

In the preliminary analysis on the feasibility of a project for the implementation of aerial logistic-support bases using helicopters, a comparative assessment including the alternatives of other forms of air transport or of multimodal transport would be performed. This assessment would consider the user's needs and performance expectations for the system, and each alternative's respective operation costs.

Discussing the current Defense Industrial Base scenario in Brazil, Alcoforado, Braga and Vilela e Silva state the following (2016, p. 47, our translation):

> In any case, reversing the current situation is not an easy task, as the defense industry, due to its peculiar characteristics, is subject to low government demand, high project-maturity time and strong international competitiveness. To counteract this reality, the DIB needs adequate public policies and incentives able to remedy this market's shortcomings, ensuring that Brazil can produce its own defense material, within a scope plausible for obtaining the political-strategic stature society desires the country to have. Project KC-390, due to its peculiarities and expectations of promising results, could serve as a model to improve studies on the economic impacts and societal gains of major defense projects.

4 Final Considerations

Infrastructure determines various human activities in a decisive way. The planning of the Brazilian Army's personnel mobilization activities, specifically in the Border Area (BRASIL, 2009), is an activity of remarkable strategic value.

The ongoing process of Army transformation involves dimensions related to the logistical management of processes. As we pointed out, among the main logistical challenge that must be adequately faced by the Brazilian Army is the need to supply detached platoons in distant corners of the Brazilian territory, as well as humanitarian missions in different regions of the world. Another challenge is to manage the logistics necessary to maintain investments in technologically complex systems and products of high strategic value, such as monitoring and surveillance systems to be used in the Brazilian border.

As indicated by Lopes (2009), new strategies, new technologies and new threats create needs for the modernization or transformation of the Armed Forces. This process was leveraged

by the launch of the National Defense Strategy, an important component of the National Defense Policy. It is noteworthy that the document's scope goes beyond the military sphere.

Lopes (2009) also notes that the document prescribes the modernization of the national defense structure, by reorganizing the Armed Forces and restructuring the national defense industry as well as the Armed Forces' composition policy. This has significant consequences for the logistic management system, since, for some time now, new technologies have been creating pressure in favor of the modernization of the Brazilian Armed Forces and its logistic doctrine. This article presented doctrinal and conceptual aspects of transport logistics applied to the military, pointing to the logistics behind support for the US offensive in the Gulf War as a paradigmatic situation. However, we should point out that are significant doctrinal differences between the US Ground Forces and the Brazilian Ground Forces. Lopes (2009) notes the differences in the economic potential of the two countries, which are reflect of their respective conceptions for the employment of the Military Expression of National Power. The US is characterized by the projection of power wherever its interests are threatened, in contrast to the provisions of the Brazilian Federal Constitution, which establishes that the Armed Forces' goal is the defense of the country.

In the Gulf War, the actions to ensure the concentration of military assets were planned and executed well in advance, and only after they were concluded did the offensive phase begin. This was the mission of the 22nd SUPCOM[14], which implemented a large overseas logistics structure in an inhospitable TO[15] and with scarce resources, considering the humongous demands of a full Allied deployment. In the case of the Brazilian Army and according to its conception of deployment, a preexisting military structure should be present even during peacetime. This structure would be capable of evolving to CLTOT, an equivalent to the 22nd SUPCOM (CASTRO, 2003).

It should also be noted that the organizational structure deployed in the Arab territory was assembled from other command units located both in the US and outside its territory, in addition to having the strong support of Saudi Arabia (host country) and various other nations, in the form of a coalition. Brazil does not have to depend on such external displacements or on the use of foreign labor, whether military or civilian. The US logistical bases were established to pre-position supplies in support of strategic vectors, proving fundamental in the 22nd SUPCOM logistics system. In Iraqi territory, some of the planned logistics bases were not installed due to the operations' short time span. However, in others, complementary and small-scale health and maintenance logistic activities were carried out.

Benvenutti Castro (2003) argues that:

> The Brazilian Doctrine does not provide for the establishment of logistical bases in anticipation of the Army's campaigning effort. However, the unfolding of Advanced Supply Stations from the most important classes to the ongoing operations is a possibility.

14 *Supply Command* [Comando Logístico – Suprimento].

15 Theater of Operations.

> The Brazilian Army logistical base is a large Logistic Command for holding Military Logistics Organizations created during peacetime. They may be complemented by the mobilization of civilian resources. ... The US logistical bases were predominantly areas for resource pre-positioning, which was coordinated by a Logistics Command. Thus, it would be more appropriate to compare them with a large logistical support area.
> In the Brazilian Army, Logistics remains relegated to a secondary plan, in spite of the intensification of its study in schools and the creation of the COLOG, fathered by the new Army Basic Organization (*Organização Básica do Exército* – OBE) ... Integrating logistics with the planning and execution of maneuvers at the various levels of command, starting from peacetime, equates to having learned the lessons of military history that have been made increasingly relevant by the Gulf War.

Regarding the logistic and transport factors related to the Case Study under discussion, we emphasize the importance of expanding the state's presence in remote regions by means of airborne support with helicopter vehicles, aiming to take full advantage of the benefits inherent to the flexibility in this mode of transportation. Public policies and governmental actions with a territorial basis are also fundamental for the promotion of regional development in the Amazon.

It is also noteworthy that the presence of the Brazilian Army in the region is fundamental for the execution of state actions and Public Policies. The implementation of bases for helicopter support has to be improved at a managerial level, especially in the Amazon area, with emphasis on the dimensions related to logistics and transportation systems. These are necessary measures to favor the flexibility of military operations therein.

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