

# THE TECHNOLOGICAL IMPERATIVE IN BRAZIL'S MILITARY MODERNIZATION

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## ABSTRACT

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This article addresses the technological imperative within recent modernization programs of Brazil's Armed Forces. This technological imperative implies the conduction of military equipment modernization programs to include the criteria of technology transfer, knowledge transfer and production integration within the country's defense industry. These serve to glimpse whether these projects have the capacity to favor both greater (i) autonomy and less dependence regarding import needs in arms and equipment, as well as to (ii) consider new alternatives for the country's scientific and technological development that aid in the rescue of the national defense industry.

**Keywords:** Brazil. Defence. Military Equipment. Armed Forces. International Security.

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## INTRODUCTION

In addition to favoring full sovereignty over essential means for a nation's defense requirements, developing expertise in war technology is of strategic value in putting forward plans aimed at increased productivity and enhanced international competitiveness. Access to advanced knowledge in cutting-edge technology has become a source of power in the international system. In this sense, non-traditional countries in R&D in the defense sector, particularly emerging countries such as Brazil, China, India and Turkey have intensified their scientific development programs associated with military equipment in the beginning of the 21st century.

In the case of Brazil, the latest Armed Forces modernization programs have been structured around autonomous prerogatives, which enable the operational upgrade of troops while allowing for the enhancement of national scientific-technological capabilities and expanding learning prospects for the defense industry. The search for new developments in the cyber, space and nuclear sectors are regarded as strategic for the country. This is so because of the possibilities offered by these sectors for the country's development plans based on a national innovation system that connects technical knowledge coming from these fields to other industries in what is the so-called dual use notion, addressing both the operational as well as technological shortcomings of the country's Armed Forces.

This article addresses the technological imperative within recent modernization programs of Brazil's Armed Forces, particularly those initiated during President Lula's second term. This technological imperative requires that military equipment modernization programs are put in place to include technology transfer, knowledge transfer and production integration within the country's defense industry. These serve to analyze whether such programs have the capacity to favor greater autonomy and less dependency regarding import needs in arms and equipment as well as to consider new alternatives for the country's scientific and technological development that can aid the reviving of the national defense industry (NDI).

The article is structured as follows. First, we address the political and strategic environment that led to management-level defense policy reforms during President Lula's administrations under the framework of the National Defense Strategy (NDS) that resulted in the Armed Forces

Strategic Projects. Next, we analyze the capacity for such modernization programs to come up with alternatives that reduce dependency on foreign equipment of high-technological content and how they can incentivize the restoration of the national defense industry through learning and the introduction of new technical capabilities into the military and civil sectors. From this, we look at how the Strategic Projects approach the autonomist criteria of transfer of technology, transfer of knowledge and defense industry integration.

## **NEW PATHS IN NATIONAL DEFENSE:**

### **TECHNOLOGICAL INDEPENDENCE AND AUTONOMY**

In a world where environmental issues are pressing and natural disasters intensify affecting human activities and survival, Brazil benefits from a relatively stable environment with bounty resources such as drinkable water, cropland and clean energy. The country is home to around 12 % of the world's fresh water reserves and to rainforests with different eco-systems. Most of these strategic resources, however, is yet unexplored and has promising energetic, biological and economic potential for the country. As pointed out in the National Defense Strategy (NDS), strategic resources such as freshwater sources need to be protected through deterrence strategies (BRASIL, 2008, p. 67). Disputes over natural resources, energy sources and food may generate conflicts (BRASIL, 2005, p. 16) requiring adequate defense strategies.

Moreover, Brazil's international ambitions are an element that calls for operational upgrades of its military power (BRASIL, 2008; BRASIL, 2012a). The country's standing internationally is linked to its development, security and national defense, with the technological and organizational restructuring of the Armed Forces playing a decisive role (BRASIL, 2008). In addition, the growing search for a closer link between foreign and defense policies can provide Brazilian diplomacy with hard power and logistical capacity that are key to the country's performance in the regional and international scenario (BRASIL, 2012, p. 31). In this sense, a joint evolution of the Brazilian defense policy with its performance in the international system since 2003 is clearly noticeable (CEPIL & BERTOL, 2016), from the beginning of president Lula's first term in office.

Within this context, Brazil's Armed Forces face the challenge of securing a minimal capacity in hardware that is appropriate for the

country to operate with autonomy and independence in the missions it engages in. It may well be that more adequate hardware could avoid unnecessary constraints to the country's foreign policy and image, as was the case with the 2004 earthquake in Haiti, when it became clear that Brazil was unprepared to act or to respond timely and adequately to events. Although Brazilian troops are leading UN operations in that country, US military were given voice and leadership roles due to their far superior capacity to respond to disasters and their much more structured military apparatus.

At the beginning of his first term, Lula's presidency gave rise to a new strategic planning policy with a view to foment infrastructure investment and technology-driven development (CORRÊA, 2009) with initiatives to facilitate investments in science and technology. Although the administration had provided the rhetoric foundations needed to unlock strategic projects in the Armed Forces, such as the Brazilian nuclear submarine and the upgrade in the fleet of fighter jets within Brazil Air Force (FAB), the financial conditions were not in place for such projects to be completed in President Lula's first term. The 'lack of a long-term strategic plan, the shortage of funds and their low priority given the country's scenario' (CORRÊA, 2009, p. 214) restricted the President's actions and his intentions of restoring the Armed Forces material capabilities.

This trend ended in 2007 with the announcement of the reactivation of Brazil's nuclear submarine program. The urgent need for an operational upgrade of the country's military power sparked reactions from the Executive and Legislative powers, leading to other older projects being kick started, as was the case with the space satellite launch vehicle and the purchase of new fighter jets by FAB (BERTONHA, 2010, p. 116).

Under President Lula important milestones were set aiming at a greater pragmatism in relation to defense issues. In 2005, the National Defense Policy (NDP) outlined the goals and strategic guidelines regarding the employment of military forces to pursue the national defense strategies. Another milestone for the industry under President Lula was the National Defense Strategy (NDS), which set the guidelines for the restructuring of the Armed Forces. Both documents, despite their shortcomings in terms of not discussing the full reasons supporting their contents, serve as parameters of an intended Brazilian strategic thought.

In this sense, the documents talk about an international environment that is filled with threats and vulnerabilities requiring

increased command over sensitive technologies that are key to a country's national development and to safeguarding technological systems that may otherwise make the national defense vulnerable (BRASIL, 2005). Among the NDP goals, the development of the country's defense industry is regarded as a fundamental element for the nation's technological independence and it should be geared towards innovation and scientific-technological production. The space, cyber and nuclear sectors, that would later gain relevance in the NDS as strategic sectors for national development and defense, were already part of the rhetoric of national defense since the beginning of President Lula's administration.

The prevailing idea in both documents revolved around the modernization of military equipment so that they could safeguard the country's sovereignty, respond to challenges imposed by securing its natural resources and advance Brazil's interests internationally through power projection. From this viewpoint, the NDS was the institutional instrument outlining the reorganization and reorientation efforts by the military in order to face the new demands posed by the South-American scenario and the possible threats coming from outside players.

The choice of the space, nuclear and cybernetic sectors as drivers of a technological restructuring was backed up by the view that the required equipment and weapons systems would allow the Armed Forces to considerably extend airspace protection, deal with new threats resulting from developments in information technology and, likewise, help build dissuasive capabilities across the Brazilian maritime territory. By understanding that dissuasion as a defense strategy could only efficaciously secure protection of the three national sovereignty spectrums (sea, land and airspace) through the combination of technological capabilities and efficient organizational features, the national defense policy was geared towards adapting the Armed Forces to the monitoring/control, mobility and presence tripod (BRASIL, 2008).

The National Defense Strategy (NDS) also promoted of a set of incentives to restore Brazil's defense industry. The design of a special legal framework of incentives and purchase preferences would allow national companies to offer products currently purchased from abroad. The NDS served as an umbrella under which promises and commitments were made to provide incentives for the advancement of science and technology in the field of defense equipment. These incentives were subject to a political and strategic review and were molded into the new goals and guidelines

for practice. This review included alterations to the Strategic Framework for Science, Technology and Innovation in Defense published in 2003, in which the goals already provided for integration and technological cooperation practices among civil and military institutions, as well as private and state-run companies.

The initiatives foreseen by the NDS, its guidelines, promises and commitments towards advancing the three strategic sectors (cybernetic, nuclear and space) led to greater involvement by the Brazilian government in research and development efforts in the field of defense technology, working as a key driver of the national defense industry. Companies manufacturing and exporting defense equipment could then rely on an increasing range of incentives.

The previous absence of guidelines and planning for the acquisition of defense equipment gave way to pledges for the establishment of a special purchasing department for defense products, a specific policy for acquisition of military hardware and a plan for employment of new hardware. These goals came to fruition in just a few years and sought to optimize resources channeled towards the technological upgrade of the Armed Forces and to meet the autonomist guidelines set forth by the NDS. While the creation of a government department for purchasing defense equipment in 2010 provided a single procedure for purchasing and investment in defense technology, the introduction in 2012 of a specific legislation regulating purchases, commissioning and development of products and defense systems sought to fulfill the requirements set out in the National Defense Strategy (NDS).

## **TECHNOLOGICAL IMPERATIVE AND STRATEGIC DEFENSE PROJECTS**

Joint efforts<sup>3</sup> by the Armed Forces, government and civil society sectors to overhaul the national defense policy and strategy and to reactivate the defense industry in the country led to the release of an Brazilian Defense White Paper (DWP) in 2012. This document has defined a set of new defense strategic projects as well as its objectives and deadline.

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<sup>3</sup> For a deeper understanding of the sectors that encouraged the reformulation of the Brazilian defense policy and the revitalization of the national defense industry we suggest reading Dagnino (2010). The author addresses what he calls the lobbying of the revitalization of the defense industry, which includes the military, business, journalists and academics. Explaining the participation of these sectors is not the focus of this article.

These projects included resuming old programs such as the development of nuclear-powered submarines which was started in the 1970s and the activation of new programs for the production, development, purchase of weapons, equipment and defense technologies. New laws for the defense industry and the National Defense Strategy (NDS) forced the Strategic Projects to include three autonomous criteria: technology transfer, knowledge transfer and defense industry integration.

In this section, we analyze the strategic defense projects designed in accordance with these criteria including technology transfer, knowledge and prospects for defense industry integration. As most of such modernization programs resulted from Brazil signing into technology cooperation agreements with foreign countries, identifying the benefits of technology transfer partnerships is an efficient way to understand the kind of outcome brought about by autonomist components in the National Defense Strategy (NDS) and other policies conceived to develop autonomous defense technologies within the Armed Forces under President Lula. Adding to this, the capacity to acquire knowledge and to have Brazilian companies engaged in manufacturing stages of military equipment provides input as to the need for new training of both military and civil personnel.

Technology transfer plays a key role in advancing modernization programs in technology and manufacturing of defense equipment that otherwise the country would not have the technical conditions to carry out without the aid of another country. It consists of providing legal authorization and technical expertise so that a given product, service or procedure can be manufactured, with the aim of meeting a desired end. Typically, this would be an economic goal and it happens in terms of developing and promoting new technologies from institutions that possess that technology (the supply-side) to those receiving it (the demand-side) (BRAGA JR; PIO; ANTUNES, 2009).

Taking a broader concept, Takahashi (2002) views technology transfers as processes that happen between two social players so that one of them may acquire, develop or employ technological knowledge by means of a transfer process of at least one component of that given technology. Here we analyze technology transfer agreements and partnerships, most of which entered by governments and companies directly involved in granting legal rights and transferring knowledge.

Transfers of technical and scientific knowledge are of fundamental

importance for successful technology transfers (TAKAHASHI, 2005). By knowledge transfers, we understand the passing on of all technical and scientific capacities needed for a technology transfer process to be completed, including training, on-site assembly, composition of technologies and components, engagement in R&D processes and support in managerial capabilities.

The extent to which strategic defense projects can integrate with the country's defense industry is the third criteria. This allows us to see if Brazilian companies can benefit from such technology modernization initiatives in the Navy, Army and Air Force by forging partnerships and engaging with other countries to manufacture and develop new defense equipment.

The following two-pronged impact can be seen for the defense industry in Brazil as a result of these three components found in the recent Strategic Projects: (i) it can pave the way for the re-emergence of a defense industry that in the recent past was one of the largest and most advanced in the world; (ii) it can build a technology basis and know-how enabling the country to become less dependent on arms producers and defense technologies.

Brazil was once the eighth largest exporter of military equipment in the world and suffered political and economic transitions that have affected and modified the environment and the possibilities of selling defense products abroad. Dagnino (2010) draws a link between the crisis in the national defense industry (NDI) and the end of the Iran-Iraq War, which caused a sharp decline in exports and in the number of exporting companies in the 1990s and 2000s. As democracy gained ground, social antipathy for military affairs and successive economic crises, it became impossible to save arms companies from bankruptcy (BITZINGER, 2003, p. 41). Therefore, by the end of the last decade, the country's defense industry consisted of around 300 companies, of which only 20 engaged in exports while only three of them (namely, EMBRAER, AVIBRAS and HELIBRAS) posted significant exports (DAGNINO, 2010, p. 98).

The changes that have been occurring in the defense industry and in the international arms industry can help restore the Brazilian defense industry. In the post-Cold War period, high costs of research, development, and production of defense technology led industries to enter into partnerships, joint production and development agreements with technology transfer and knowledge criteria becoming the main

assets to be negotiated (KURÇ & NEUMAN, 2017, p. 219). With the growth of companies and countries producing arms and weapon systems in the 21st century, cooperation and integration among producers seem to be a natural consequence (KURÇ & NEUMAN, 2017, p. 219).

In this sense, the Strategic Projects have the capacity to enable Brazil to chart ways and once again become an important player in the international arms industry and acquire know-how to become less dependent on major arms suppliers. As investment in local industries, technology transfer programs and the diversification of partnerships and imports grow so does the production capacity in emerging countries, doing way with technology dependence (ROSH, 1990; KURÇ & NEUMAN, 2017, p. 222).

Table 1 shows the 15 programs that were analyzed and classified with high or low adherence to the three autonomist criteria: (i) technology transfer; (ii) knowledge transfer; and (iii) integration of production in the national defense industry.

**Table 1. Brazilian Armed Forces Strategic Defense Projects**

ARMY	NAVY	AIR FORCE
<ul style="list-style-type: none"> <li>▪ Army's Operational Capacity Restoration Projects (Army's <u>Recop</u>)</li> <li>▪ Armored Vehicles (Guarani)</li> <li>▪ <u>Proteger</u> System</li> <li>▪ Strategic Monitoring and Surveillance Project (<u>Sisfiron</u>)</li> <li>▪ Cyber Defense</li> <li>▪ Counter-Air-Defense System</li> <li>▪ Missile and Rocket System (ASTROS 2020)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Navy Submarine Development Program (<u>Prosub</u>)</li> <li>▪ Management and Surveillance System of the Maritime Territory (<u>Sisgaaz</u>)</li> <li>▪ Combat, Escort and Patrol Ship Program (<u>Prosuper</u>)</li> <li>▪ Amphibious Assault Ship Program (<u>Proanf</u>)</li> <li>▪ Aircraft Carrier Subproject (<u>Pronae</u>)</li> </ul>	<ul style="list-style-type: none"> <li>▪ FX 2-Fighter Jets</li> <li>▪ Air Force's Operational Capacity Restoration Project (FAB's <u>Recop</u>)</li> <li>▪ KC 390 Cargo Aircraft</li> </ul>

Designed by the authors

### STRATEGIC PROJECTS WITH HIGH ADHERENCE TO THE THREE AUTONOMIST CRITERIA

The Army's Operational Capacity Restoration Projects (Army's Recop) sought to carry out modernization and restoration programs to replace outdated equipment, particularly the fleet of combat vehicles, old armored carriers, as well as to develop new hardware and weapons for troops (BRASIL, 2012a). Within this context, a multi-billion-dollar contract was signed with BAE Systems in 2011 to upgrade around 150 M113 BR

armored personnel carriers (APC). The performance of actions foreseen in this program was the responsibility of the international company, but it counted with considerable participation of Brazilian companies, to which BAE Systems provided technological resources<sup>4</sup>. In addition, direct engagement by the Brazilian Army with actions towards modernization and restoration allowed for a more robust exchange of experiences, knowledge and the transfer of technology required for future maintenance and upgrade of equipment.

Furthermore, Army's Recop included modernization of the outdated combat vehicles VBTP EE-11 Urutu and EE-9 Cascavel. The modernization contract awarded to Brazilian company Engemotors provided for the replacement of vehicle engines, introduction of automatic transmissions, new braking systems and new monitoring systems (BASTOS, 2010, p. 23). Regarding investments made by the Ground Forces in new artillery instruments led to the development of the first Brazilian made rifle. The IA2 assault rifle was developed and designed by Imbel, relying on national expertise. The acquisition of around 20,000 arms by the Brazilian Army injected R\$50 million in the company. In addition to introducing a lighter, more accurate weapon with greater fire per minute capacity, the purchase helped set in motion Imbel's restructuration, including renovation of plants and acquisition of new machinery and equipment<sup>5</sup>.

The Guarani Project was yet another Strategic Project run by the Army that satisfactorily included technology transfer, knowledge transfer and defense industry integration. Fiat-Iveco were in charge of development and manufacture the new armored, amphibious and air-portable combat vehicles. The proposal included project nationalization of over 60%, intensive engagement of military engineers, knowledge transfer and the possibility of running repairs in the country's territory.

In its original intention, the Guarani was a proposal for joint production that would allow Army engineers to benefit from technology and knowledge transfer programs along the many stages in assembling and manufacturing vehicle components. The engagement of Brazilian professionals would allow for an intensive transfer of knowledge and

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<sup>4</sup> See 'BAE Systems e Exército Brasileiro completam atualização do 100<sup>o</sup> viatura militar M113 BR'. Agência de Notícias Defesanet: <<http://www.defesanet.com.br/leo/noticia/17659/M113BR---100%C2%AA-Viatura-Entregue/>>. Accessed on: 05 dec. 2014.

<sup>5</sup> See 'Exercito testa novo fuzil que substituirá usado há 50 anos' Portal de Notícias G1 <<http://g1.globo.com/politica/noticia/2014/11/exercito-testa-novo-fuzil-que-substituira-o-adotado-ha-50-anos.html>>. Accessed on: 30 dec. 2014.

technology the country didn't yet have, in addition to making available funds of over R\$ 20 billion for research, development and production of components, systems and training (BRASIL, 2012a, p.200). The prospects for a stronger production chains for defense equipment was a decisive factor in choosing the providing company. The project was in line with the autonomist guidelines set forth in the National Defense Strategy (NDS) enabling defense capabilities to be improved by involving direct and indirect component suppliers.

For the Navy, prioritizing sea denial instruments and the prospects of strengthening their dissuasion, monitoring and controlling capabilities over the country's maritime territory, led them to choose to secure the upgrade of their conventional and nuclear-powered fleet of submarines. This is reflected in the adherence of Prosub to three autonomist criteria. This project, which involved the development of four conventional submarines and a nuclear-powered one, was reactivated in 2007. In the following year, a technology transfer agreement was signed with France that, among other things, sought to produce the nuclear submarine hull with French technology, in Brazilian territory, as well as to manufacture 4 conventional submarines (MARTINS FILHO, 2011).

The prevailing view within the Navy was that having the technology to produce conventional submarines would be critical for the development of nuclear-powered models as it would serve as an experimental and learning stage. In order for this to take place, entering into a partnership with a country that already possessed the means to develop and produce both would be fundamental. The contract signed with French company DCNS provided for the participation of over 30 national companies supplying thousands of items of medium-intensity technology such as electronic components, submarine hull valves, hydraulic pumps, electric engines, combat systems and batteries<sup>6</sup>. The Brazilian Navy hoped the project would bring benefits to both national defense, by allowing for the implementation of a maritime dissuasion strategy to defend its Atlantic borders, and the country's economic and technological sovereignty, translated as technology transfer, high levels of nationalization and creation of jobs in the submarine building complex<sup>7</sup>.

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<sup>6</sup> See 'Submarino brasileiro fortalece Indústria nacional' (2011) <<http://www.defesanet.com.br/prosub/noticia/1979/prosub---submarino-brasileiro-fortalece-industria-naval>>. Accessed on: 08 nov. 2014.

<sup>7</sup> See 'Marinha do Brasil assina contrato de submarinos (2008) <<http://www.defesanet.com.br/prosub/noticia/1928/marinha-do-brasil-assina-contrato-de-submarinos->>. Accessed on:

As a result, the purchase of national content for Prosub had an impact on companies in various industries, not only those linked to production of defense equipment, including Termomecanica and Nuclebrás supplying components for the submarine hulls. In the case of steel conical structures, the cavernas, a technology transfer agreement was required to engage Brazilian professionals in exchange programs<sup>8</sup>. As for the development of the reactor for the future nuclear submarine and construction of the laboratory for testing power generation nuclei that would feed the submarine, Brazilian company Atech, part of the Embraer group, was chosen. In building this laboratory, another 80 Brazilian companies were engaged in services related to the physical and mechanical parts of supplementary equipment and reactor softwares<sup>9</sup>.

The FX-2 Air Force Strategic Project, which also included the autonomist criteria, was revived by the National Defense Strategy (NDS) after being stopped for a long time. Modifications to the previous FX Program took place with a view to putting forward a plan for the restructuring of the fighter jet fleet, thus enhancing FAB capabilities, with the introduction of new aircraft requirements and specifications, as well as alterations to the purchasing process itself. This should now include technology transfer schemes and ensure benefits to local companies, leading to industry integration and the possibility of Brazil producing and exporting jets.

The final aircrafts manufacturers competitors in the bidding, FA-18 Super Hornet, Rafale and Gripen NG entered into a tough competition in which each company sought to offer more benefits, with commitments made to unrestricted technology transfers, industrial and technological compensations and the signing of scientific partnerships. Lobbying included visits and talks at the National Congress, with SAAB making a commitment to supply all requirements and components requested by FAB, with technology transfer and on the job knowledge from the production

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08 nov. 2014.

<sup>8</sup> See 'ICN homologada para fabricação de cavernas para cascos resistentes de submarinos' (2014) <<http://www.defesanet.com.br/prosub/noticia/17508/ICN---Homologada-para-Fabricacao-de-Cavernas-para-Cascos-Resistentes-de-Submarinos/>> Accessed on: 29 nov. 2014.

<sup>9</sup> See 'Atech vence licitação da Marinha e entra na área nuclear' (2012) <<http://www.defesanet.com.br/prosub/noticia/8632/atech-vence-licitacao-da-marinha-e-entra-na-area-nuclear>>. Accessed on: 25 nov. 2014.

stage<sup>10</sup>. The company sought to win the competition by indicating that Brazilian companies would enjoy high rates of participation, around 40%, in development activities and 80% in the aircraft production in the national territory.

The offers to engage in scientific and technological partnerships resulted in the Swedish-Brazilian Research and Innovation Center (CISB). This would be an institution devoted to joint-collaboration projects involving universities in Brazil and Sweden, as well as innovation companies in the aircraft industry. The center for advanced research was yet another bet by SAAB in the competition launched by the Brazilian Air Force. The Swedish company was faced with the challenge of exceeding the offers put on the table by other manufacturers, such as Super Hornets' easy maintenance and availability of components, and the partnerships offered by Rafale.

Overall, even before the final decision was made, it was clear that the shortlisted companies in the FX-2 were doing their best to propose the largest possible set of benefits to Brazil's defense industry. Be it through partnerships and direct engagement of Brazilian companies in producing and developing the aircrafts, or through scientific and technological compensations that had the capacity to help the country to achieve greater levels of independence in essential technologies. The final decision, then, sought to reward the widest range of benefits, both to companies with compensations and integration into joint production, research and development, and to government's funds. After all, the choice for Gripen was the least costly. The signing of the contract in 2014 certainly was encouraged by the prospects of total integration of NDI in the production stages of fighter jets and by the requirements of full technology and knowledge transfer, which explains the project was awarded with the highest index in our assessment.

With the same autonomist direction, the Army's Proteger sought to protect strategic ground structures such as hydroelectric plants, water supply networks, transport and bank systems that are critical for the country's economic survival. In this sense, providing the Ground Forces with the necessary technological resources was key to allow them to integrate intelligence, surveillance and defense preparedness actions in

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<sup>10</sup> See 'Palestra da SAAB AB proferida por Bengt Janer' (2009) <<http://www.defesanet.com.br/fx2/noticia/183/Palestra-da-SAAB-AB-proferida-por-Bengt-Janer/>>. Accessed on: 08 nov. 2014.

case of threats to such infrastructures as well as when faced with large-scale events. To this intent Integrated Command and Control Centers (CICCs) would be put to use. These facilities featuring advanced technological components were inaugurated in the 12 FIFA World Cup host cities. They were capable of monitoring events and promoting fast integration while providing input to decision making. In obtaining the required knowledge to carry out the full structural and physical project plus the technological know-how in data protection the Project promoted the engagement of a range of Brazilian companies in the Proteger System, making way for CICCs and their capabilities to be applied to national defense activities and in public security initiatives.

As for the Navy's Strategic Project *Sisgaaz*, the intention was to qualify Brazilian companies to become suppliers of high technology content components. Given the complex nature of the technological systems in *Sisgaaz*, a consortium of companies made up of a larger corporation and smaller subsidiaries that could supply supplementary components and technologies, was expected to win the bid. When the project plan and its progress are analyzed, regarding the possibility of strengthening the national defense industry, integrating production into the national defense industry and the chances of technology and knowledge transfers, *Sisgaaz* is on the way to invigorate, qualify and integrate manufacturers of strategic products in Brazil.

The chances of advancing such initiatives were greatly improved with the legal provisions foreseen in the 2012 law 12.598, which set a priority for national companies in bids launched by the Armed Forces, as well as lower taxes to a pool of companies registered by the Ministry of Defense as of strategic nature. Thus, the legal prerogative concerning the full incorporation by Brazilian companies of the manufacturing of products and technology, such as production nationalization, has a great potential to incentivize partnerships with large international conglomerates of manufacturers of defense products based on full technology transfers.

The Army's strategic monitoring and surveillance project *Sisfron* too incorporated the three criteria under analysis. The project's implementation rationale seeks to promote capabilities that allow for the merging of physical and virtual defense potentialities by upgrading fixed and mobile bases throughout the more than 16,000km of borders with an efficient and modern radar and sensor system that would facilitate the exchange of information required to support decision making.

Planning, development and implementation of the original Sisfron project was assigned to Savis Tecnologia and OrbiSat, which are Embraer's subsidiaries and helped Embraer saw a 44% increase in net revenue<sup>11</sup> in 2012. Generally, the technological imperative was found in the planning and execution phases of Sisfron's project. From the choice of contractors to the types of services, systems and technologies that would be employed. Industrial and technological compensations of the offset kind allowed for investments and the setup of production lines, development and technological qualification among the major companies involved.

ProsUPER was another Brazilian Navy Strategic Project with high adherence to the three autonomist criteria. The initiative aimed at designing a restructuration plan for the Navy's fleet and enhancing the mechanisms for protecting, surveilling and patrolling jurisdictional waters. In order to do so, ProsUPER foresaw the manufacturing of five escort ships, five offshore patrol vessels, patrol boats, as well as one logistic support vessel (BRASIL, 2012a, p. 194). As we will see, the program was conceived around technology transfers and integration to the national defense industry.

Unrestricted technology transfer and the possibility of producing ships in Brazil would come to be decisive factors in the bidding process for equipment suppliers. The goal was to forge strategic partnerships with other countries with a view to developing technological capacity which Brazil did not possess yet. ProsUPER's cost was estimated at around R\$ 10 bi, making it attractive to international companies such as BAE Systems, which submitted a proposal of joining with Brazilian shipyards and combat software developers<sup>12</sup>. As for the Spanish's major defense company Navantia, it sought to set up a joint production and development scheme that would include technological compensation to Brazilian companies, with technology transfer, as well as production and integration into the country's defense industry<sup>13</sup>.

Brazil's requirements of technological independence that the program should help facilitate led companies to mould their bids, which would always include opportunities for learning and expanding the

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<sup>11</sup> See 'EMBRAER – performance do segmento' (2013) <<http://www.defesanet.com.br/bid/noticia/10033/EMBRAER-%E2%80%93-Performance-do-Segmento--DEFESA-SEGURANCA-em-2012-//>> . Accessed on: 5 nov. 2014.

<sup>12</sup> See 'BAE Systems entrega proposta detalhada a Marinha do Brasil' (2010) <<http://www.defesanet.com.br/prosuper/noticia/8085/BAE-Systems-entrega-proposta-detalhada-a-Marinha-do-Brasil/>> . Accessed on: 13 oct. 2014..

<sup>13</sup> See 'Licitação de 3 bi atrai Navantia ao Brasil' (2012) <<http://www.defesanet.com.br/prosuper/noticia/8087/prosuper---licitacao-de-%E2%82%AC-3-bi-atrai-navantia-ao-brasil>> . Accessed on: 14 nov. 2014.

country's production chain. In this specific case, the aim was to foster the country's autonomy, with companies offering more than simply selling products or partnerships in construction but industrial associations, joint training and even shared production and export platforms.

The Air Force's Operational Capacity Restoration Projects induced the modernization and restoration of the Air Force's aerial warfare which were then found in a state of advanced technological lag in terms of components and systems. Modernization of the ground-attack aircraft AMX was part of a plan aimed at extending its lifespan of around 20-year-old, restoring its components permitting it to be used in more complex operations with improved manoeuvrability, reduced reaction time, radar inhibitors, greater perception of actions in the surroundings and of enemy-engendered attacks (LEITE, 2012).

The project set up investments into Embraer, resulting in training and learning by the company engineers and specialists. Besides Embraer, two other companies were directly engaged in the AMX modernization program as suppliers of supplementary aircraft systems and radars. Brazil-based Mectron developed the primary sensor in the weapon system and the air-based radar. Broadly speaking, this Project relied on the participation of Brazilian professionals in manufacturing and development within the national territory. As for AEL Systems, which belongs to an Israeli high technology company, their role was determined by the transfer of technology in avionic systems.

The two last Strategic Project including autonomist criteria were the Counter-Air Defense System and Cyber Defense. As for Counter-Air Defense, the goal of achieving technological autonomy was evident in the way bidding processes were to be conducted and in the priority that would be given to initiatives aiming to ensure greater levels of country independence in sensitive technologies. Thus, the Project's guidelines defined that the national defense industry ought to be the most benefited through growth in jobs and revenue and by means of training programs, trade, industrial and technological compensations<sup>14</sup>.

In the case of Cyber Defense, the Ministry of Defense invested in a training program for soldiers to enable them to react to cyber-attacks. The program developed by Brazilian company Decatron was aligned

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<sup>14</sup> See 'Diretriz para Implantação do Projeto Estratégico do Exército Defesa Antiaérea' (2014) <<http://www.defesenet.com.br/doutrina/noticia/14686/Projeto-Estrategico-do-Exercito-Defesa-Antiaerea-Nova-Diretriz/>>. Accessed on: 25 nov. 2014

with the autonomist drive sponsored by the National Defense Strategy, promoting integration of sectors that are not directly engaged with the military industry in conceiving technological solutions for defense.

## STRATEGIC PROJECTS WITH LOW OR UNCERTAIN ADHERENCE TO THE THREE AUTONOMIST CRITERIA

The KC-390 cargo aircraft, despite having allowed for high levels of integration of the Brazilian defense industry in development and manufacture, has performed poorly in terms of technology transfer and knowledge transfer criteria.

The prevailing view about the new cargo aircraft held that its project was based on National Defense Strategy (NDS) autonomist guidelines, giving priority to Brazilian companies and that foreign companies participation would be conditioned to the supply of technologies that were not available to Brazilian companies through technology transfers. It seems that the choice for acquisition of systems and components already available and imported was underpinned by the perception that, in the short-term, producing primarily in Brazil could hinder the execution of the project<sup>15</sup>.

As a result, the goal of achieving a minimum of 60% of local production was not accomplished. Most of the companies who supplied technological systems and advanced components were based in foreign countries. While they contributed with engines, aircraft and electronic systems, Brazilian-based companies would supply less sophisticated components, such as armoring solutions, seats and sealants.

Although production of the cargo aircraft relied on many foreign companies with high levels of participation in aircraft development and production, one can see how the project fostered the development of new capabilities in Embraer, given the aircraft's innovative dimension, its technological, electronic and manufacturing requirements<sup>16</sup>. The gains for Embraer's can be found in the computer software that would be developed in Brazil, as well as in an ongoing monitoring system of the aircraft

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<sup>15</sup> See 'HANGOUT - KC-390 e o Salto Qualitativo da Indústria Aeronáutica Brasileira I' (2014) <<http://www.defesenet.com.br/kc390/noticia/16205/HANGOUT--KC-390-e-o-Salto-Qualitativo-da-Industria-Aeronautica-Brasileira-I/>>. Accessed on: 26 dec., 2014

<sup>16</sup> See 'KC-390: Novo jato traz desafios para Embraer' (2012) <<http://www.defesenet.com.br/kc390/noticia/7316/KC-390--Novo-jato-traz-desafios-para-Embraer->>>. Accessed on: 1 dec., 2014

components<sup>17</sup>. The advantages associated with manufacturing the aircraft could also be understood through its export prospects resulting in a more robust and integrated national defense industry.

The three projects with the poorest adherence to the autonomist criteria were the Missile and Rocket System (Astros 2020), Proanf and Pronae. The most advanced of such projects is Astros 2020. This is complementary to the Counter-Air Defense System and seeks to ensure that the Ground Force has fire and missile means of up to 300 km reach (BRASIL, 2012a, p. 200). Although the project is structured around development and national production with acquisition of new technological capabilities for modern Avibras missile and rocket launcher, cuts in funding for defense in 2014 and the uncertainties regarding the Project have reduced the possibilities of a positive impact for Brazil's defense industry.

The Amphibious Assault Ship Program (Proanf) and the aircraft carrier subproject (Pronae) obtained lower criteria classifications, especially as they do not explicitly foresee technology and knowledge transfers in their preliminary execution plans. The former sought to purchase landing crafts for deployment of combat vehicles and dock landing ships, which are essential for the transport of vehicles, armored cars, helicopters, as well as for transporting troops and for use in disasters and for hospital needs (CARNEIRO, 2014). The absence of guarantees regarding transfer technology and transfer knowledge in their initial plans suggest that they would probably follow the same acquisition model of opportunity purchase used for former landing craft ships (Mattoso Maia, Garcia d'Ávila and Almirante Sabóia).

Although these projects were developed to enhance power projection capabilities and integrate national companies in the building of such ships, the absence of technology transfer guarantees by foreign companies coupled with political and economic uncertainties leading to budget constraints meant that keeping these projects running and meeting their technology transfer costs would be extremely onerous.

The consequences of this type of acquisition can be verified in scanty Armed Forces equipment programs carried out in the past that were not associated with a set of incentives translated into specific legislation, tax cuts and special legal and fiscal framework for defense equipment manufacturers. In this sense, the projects implemented in the 1980s, such as the one that involved construction of Tupi-class submarines and Niteroi-

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<sup>17</sup> KC-390: Novo jato traz desafios para Embraer' (2012).

class warships in partnership with other countries, failed to advance the country's technological capabilities that would lead to greater autonomy. The associations made with British shipyard Vosper Thornycroft, as well as with German Marine Technik and HDW aiming to develop and manufacture warship Niterói, corvette Inhaúma and Tupi submarines did not result in enhanced technology and within a few years led the Navy to make new demands that neither Navy engineers nor Brazilian companies were ready to meet.

## FINAL REMARKS

This article showed how recent modernization programs within Brazil's Armed Forces, advanced during President Lula's second term, were underpinned by an autonomist perspective, highlighting production, research and development processes. The goal was to analyze how such imperative - seen as the possibility of obtaining new technological capabilities through technology and knowledge transfer, as well as through incentives to the country's defense industry - has influenced the acquisition of new equipment, arms and weapon systems for Brazil's Armed Forces.

Unlike previous acquisitions guided largely by a rationale of keeping up current operational capacity within a Policy for Equipment Upgrade which made acquisitions relying on "opportunity purchase" strategy, the implementation of the new Strategic Projects was based on a national defense strategy that linked technological development to defense policy.

The introduction of a new technological paradigm, which was translated into developing strategic defense projects while tackling some of the Brazilian Armed Forces operational shortcomings and promoting new capabilities to both civil and military sectors, President Lula's administration started channeling more funds towards the Armed Forces modernization plans. In his second term in office, old projects such as the nuclear submarine and the FX-2 multi mission fighter jets program were reactivated.

These initiatives were followed by a set of sector-specific incentives and policies. The proposal to create a body within the Ministry of Defense that would be in charge of purchasing defense products came to life in 2010, making purchase procedures more smoothly. The Brazilian Defense White Paper set deadlines, outlined the scope and goals of the strategic projects. Law 12. 598/2012, known as the Defense Industry Law introduced a new legal and economic framework for the acquisition of defense products made by Brazilian companies and for tax breaks meant

to boost production of defense equipment. Special tax programs classified many companies and products as strategic for the defense sector. All these mechanisms led to signing into agreements with foreign companies that foresaw provisions regarding technology and knowledge transfer.

Likewise, integrating Brazilian companies, particularly those manufacturers of strategic defense equipment, was also integral to the national defense policy. Execution and acquisition projects brought along with it the national defense industry based on joint development schemes, supplying technological systems, components and supplementary services. Furthermore, the possibility of fostering the country's defense industry by integrating Brazilian companies throughout different project phases led to greater export prospects for the sector. Under the same logic, the international partnerships and gains stemming from technology and knowledge transfer initiatives hold the possibility of an increased share of the national defense industry in higher added-value Brazilian exports.

Policies aiming at fostering the country's defense industry should address the challenges posed by Brazil's Armed Forces operational modernization requirements, as well as external demands for high-technology intensity weapons systems. In light of this, one can notice the set of institutional efforts directed at carrying out action plans that would put forward a set of incentives working under the import substitution rationale.

The chances of having Brazilian companies competing with foreign ones in bidding processes launched by the Armed Forces are increasing as more tax incentives, special bids and general incentives are put in place, particularly in R&D and manufacturing of equipment falling into the Strategic Defense Products category. We therefore have been able to identify this technological imperative in strategic defense projects as it made way for technology modernization programs to be implemented anchored on technology and knowledge transfer criteria, as well as on national defense industry integration.

# O IMPERATIVO TECNOLÓGICO NA MODERNIZAÇÃO MILITAR DO BRASIL

## RESUMO

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Este artigo aborda o imperativo tecnológico nos recentes programas de modernização das Forças Armadas do Brasil. Tal imperativo tecnológico implica na condução de programas de modernização de equipamentos militares de modo a incluir os critérios de transferência de tecnologia, transferência de conhecimento e integração da produção na indústria de defesa do país. Esses critérios são úteis para identificar se os projetos têm potencial de favorecer uma maior (i) autonomia e menor dependência de importação de armas e equipamentos, quanto para (ii) considerar novas alternativas para o desenvolvimento científico e tecnológico do país que auxiliam no resgate da indústria de defesa nacional.

**Palavras-chave:** Brasil. Defesa Nacional. Tecnologia Militar. Forças Armadas. Segurança Internacional.

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