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Brazil Space: Military Dependency and the Case of the Geostationary Satellite of Defense and Strategic Communications

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In Brazil, there has been no transition model of space capabilities promoted by the military sphere (especially the Brazilian Air Force) for nurturing the civil one (Brazilian Space Agency). Drawing upon official documents and legislation as primary sources, the case study of the Geostationary Satellite of Defense and Strategic Communications (SGDC) is analyzed in light of the space strategic sector. Main factors that impede the PEB are related to military-technological dependence and poor resource management, with draconian budget cuts and projects canceled before having achieved realistic milestones.

Brazil is the largest economic power in South America and has one of the world's best places to launch rockets, the Alcântara Launching Center (CLA).[1] But when it comes to space operations via own satellites, it is Argentina that leads in the subcontinent.[2] Why, then, does the Brazilian Space Program (PEB) not take off?[3] Answering that question is the main goal of this article.

Many believed that, after Brazilian military rule (1964-1985) and the end of the Cold War, the PEB would be demilitarized, as had happened with other important programs and organs of the regime such as the Brazilian secret service. However, over the years, the military – especially the Brazilian Air Force (FAB) – continued to play a central role in Brazil's space activities.

With the Brazilian Space Agency's (AEB's) creation in 1994, it was also expected that PEB civil programs would gradually become more autonomous, and expertise in space accumulated during the military regime would transfer to the Agency. In practice, however, PEB languished in a comprehensively dependent relationship – in technological, operational, and human resource terms – with respect to FAB. The Brazilian logic of refusing to ween and strengthen their civil space activities goes against the current world trend: main counterexamples are the National Aeronautics and Space Administration (NASA), the European Space Agency (ESA), and Argentina's National Commission for Space Research (CONAE) here in South America.

Furthermore, an oft-made assertion, both by the National Policy for Development of Space Activities (PNDAE) and the PEB itself, is of the need to synchronously array and connect private, academic, and governmental sectors in order to attain space excellence. But, as this article shows, that is the theory, or, in legal terms, only the programmatic norm. The reality is that one of the major problems hindering the development of Brazilian space activities is precisely the fact that state policy to boost important variables such as domestic industry for this sector practically does not exist. Despite some tax exemptions, which are directed to the very few private Brazilian companies operating in the space sector, the current political and economic crisis facing the country can bring devastating consequences for PEB.

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[2] Alejandro G. Belluscio, "ARSAT-2: Argentina consolidates as Latin American satellite leader", *NASA SpaceFlight*, 21 September 2015, http://www.nasaspaceflight.com/2015/09/arsat-2-argentina-consolidates-latin-american-satellite-leader (accessed 22 September 2015).

[3] Formally and legally, the PEB is called National Program of Space Activities (PNAE). See: Brazil, *National Program of Space Activities (PNAE)* (Brasília: Ministry of Science, Technology and Inovation, 2012), 9.

This work examines the claim that even after the end of both the Cold War and military rule, as well as a broadening of the security concept in Brazil, there is still no transition model of space capabilities from the military sphere (FAB) to the civil one (AEB).[4] While the PEB, officially, is supposed to synthesize public policy (civil and military), there is no professional *esprit de corps* that can underwrite the development of independent civil space activities.

To corroborate such a thesis, a history of the AEB's public documents demonstrates strong military dependence for development of Brazil's space activities, with a crucial nexus being creation of the strategic space industry – by the Ministry of Defense. This paper also analyzes the case of Brazil's first geostationary satellite. Once live, the satellite will produce vital information for both the civil and military fields, providing on the one hand, Internet access for all Brazilian territory, and the other, safer ways to exchange strategic and meteorological information.[5] But for all that to happen, the Geostationary Satellite of Defense and Strategic Communications (SGDC) must arrive in space. That is where the AEB comes in.

With respect to the Brazilian military sector, it is worth emphasizing that important documents of the Brazilian Ministry of Defense (MD) – the National Defense Policy (PND), National Defense Strategy (END), and Defense White Paper (LBDN) – rank the space sector as a strategic sector for national development. As to the civil field, Brazilian legal documents spell out the role of space activities for development. This paper, then, illuminates the dialog between civilians and the military and how this relation shaped and ultimately hindered the Brazilian space program.

Despite the international context of Brazil space and the lingering likelihood of using force in the international environment, guiding documents of Brazilian defense and space policies lack, at many junctures, a sufficiently Hobbesian view of international relations.[6] A strong hint of liberal institutionalist aspirations lies in the fact that the two main END (National Defense Strategy) promoters were the former Minister of Defense Nelson Jobim (a non-military politician who was congressman, minister of justice, and minister of the Brazilian Supreme Court) and the then Minister of the Presidency of the Republic's Secretariat of Strategic Affairs (SAE) Mangabeira Unger (a professor of Law at Harvard University). Indeed, PEB's directive explicitly encourages a space culture in Brazil, and END asserts that national defense must not be military-restricted subject matter.[7]

THE BRAZILIAN SPACE PROGRAM (PEB) & AGENCY (AEB)

In order to analyze the Brazilian space program's (PEB's) strengths and weaknesses, today, it is essential to understand how the Brazilian Space Agency (AEB) was created and the distribution of space competences with other agencies and institutions, mostly military. Eyeing previous professional schools of the Brazilian Navy and Army (1910s), as well as the Brazilian Air Force's school for Military Aviation (1941), the PEB has its beginnings in the mid-1950s, with the creation of the Aeronautics Institute of Technology (ITA) and the Aeronautics and Space Institute (IAE), both belonging to Aeronautics Command's (COMAER's) Aerospace Science and Technology Department (DCTA).[8] Still, it

[4] Barry Buzan, Ole Wæver and Jaap de Wilde, *Security: a New Framework for Analysis* (Boulder: Lynne Rienner, 1998), 239; Brazil, *Política Nacional de Defesa (PND) e Estratégia Nacional de Defesa (END) (Brasília: Ministry of Defense, 2012)*, 13.
[5] Brazil. *Defense White Paper* (Brasília: Ministry of Defense, 2012), 208.
[6] Everett C. Dolman and Henry F. Cooper Jr, "Increasing the military uses of space," in *Toward a Theory of Spacepower: Select Essays*, edited by Charles D. Lutes et al. (Washington, DC: NDU Press), 99-101; Robert L. Pfaltzgraff, "International Relations Theory and Spacepower," in *Toward a Theory of Spacepower: Select Essays*, Edited by Charles D. Lutes et al. (Washington, DC: NDU Press), 47.
[7] Brazil, *PNAE, 8;* Brazil, *PND e END*, 7.
[8] Hermelindo Lopes Filho, *Nas asas da história da Força Aérea Brasileira* (Higienópolis: FAAP, [s/d]), http://faap.br/hotsites/asas-da-historia/livreto%20Nas%20Asas%20da%20Hist%C3%B3ria%20Da%20For%C3%A7a%20A%C3%A9rea%20Brasileira.pdf (accessed 22 September 2015), 20.

was only with NASA-FAB cooperation in the early 1960s that Brazil began to explore space in earnest.[9] Under military rule in Brazil, the PEB received the ambitious challenge of mastering the full access-to-space cycle through the Brazilian Complete Space Mission (MECB) although the initiative was subsequently abandoned without reaching its main goal.[10]

Returning to democracy in the late-1980s and 1990s, Brazil tried to deconstruct the whole repressive apparatus erected by military rule. Accordingly, Fernando Collor de Mello's first presidential act was extinguishing the main repressive organ of the old regime, the National Information Service (SNI). And his successor, Itamar Franco, tried to give civilian airs to the militarized PEB.

According to the Brazilian Constitution (1988), it is solely for the Union to legislate over Aerial/Space Law[11]. On 10 February 1994, using this legal premise, President Itamar Franco created the AEB, which succeeded the Brazilian Commission for Spatial Activities (COBAE), which in turn had been linked to the Armed Forces General Staff (EMFA).[12] Unlike its predecessor, AEB sat as a federal, civil, and independent body.[13] Originally reporting directly to the Presidency of the Republic, within less than a decade, that institutional bond was transferred to the Ministry of Science, Technology and Innovation (MCTI), which was formed to oversee, among other things, national space policy.[14]

As a comparison, Argentina's space activities followed a quite similar path: Argentina's National Commission for Space Research (CONAE) was also created in the early 1960s and incorporated into the armed forces, and at the beginning of the 1990s was recreated as a civilian body.[15] The difference was that CONAE received growing financial and political investments during the 2000s[16].

Like Argentinian CONAE, Brazil's space agency has the overall task of promoting development of space activities in the national interest.[17] Despite having its head office and forum located in Brasilia's Federal District, AEB is better known for using the world famous Alcântara Launching Center (CLA), which is tied to the COMAER (Aeronautics Command) in the state of Maranhão, in Brazil's Northeast Region.[18] This base's overarching function is to ensure satellite-launching vehicles (SLVs) can be safely sent to space.

The Agency's most important project in the SLV area is the *Projeto VLS-1*, which conveys the strategic import of producing a national vehicle of such kind – though for pacific ends.[19] Figuring as one of FAB's leading projects, it nevertheless aims to strengthen the national aerospace *defense*

Ivanil E. Barbosa, *Carta aberta do SindCT ao Ministro Aldo Rebelo* (São José dos Campos: SindCT, 4 September 2015), http://www.sindct.org.br/files/Carta%20Aberta%20Aldo%20Rebelo.pdf (accessed 22 September 2015), 1.

[9] Lopes Filho, *Nas asas da história*, 23.

[10] Barbosa, *Carta aberta*, 1.

[11] Brazil, "Federal Constitution" (Brasília: Presidency, 1988). Going further in the juridical field, Space Law is not a novel theme in Brazil; it is listed in the exhaustive hall of the traditional Brazilian Universal Decimal Classification of Law. *Vide*: Doris de Q. Carvalho. *Classificação Decimal de Direito,* 4th Ed (Brasília: Presidency, 2002), 10, 46.

[12] Brazil, "Law nº 8.854/1994" (Brasília: Presidency, 10 February 1994).

[13] Brazil, "Law nº 8.854/1994"; Brazil, "Decree nº 4.718/2003" (Brasília: Presidency, 4 July 2003).

[14] Brazil, "Law nº 8.854/1994." Brazil, "Decree nº 4.718/2003." Brazil, "Decre nº 5.886/2006" (Brasília: Presidency, 6 September 2006).

[15] Daniel Blinder, "Argentina Space: Ready for Launch," *Space & Defense*, Vol. 8, No. 1 (Spring 2015), 34-46.

[16] Blinder, "Argentina Space," 36.

[17] Brazil, "Law nº 8.854/1994"; Brazil, "Decree nº 4.718/2003."

[18] Brasil, "Decree nº 4.718/2003."

[19] The technicians that died in the CLA accident in 2003 were working exactly at this project. For more details: "Acidente em Alcântara começou com incêndio, diz Comandante", *Folha Online*, 23 August 2013, http://www1.folha.uol.com.br/folha/ciencia/ult306u9906.shtml (accessed 22 September 2015). Brazil, *PNAE,* 11.

industry.[20] Through VLS-1, the civil and military spheres coalesce more and more towards a single purpose: make a satellite and successfully place it in geostationary orbit, so it can provide across Brazil's regions broadband Internet access and secure military communications.[21] Even so, due to sizeable budget cuts in the PEB during 2015, VLS-1 runs the risk of being paralyzed.

It is worth noting that AEB is the central body in the National System of Space Activities Development (SINDAE)[22], being a coordinator of it and its titular leader.[23] This system exists to allow military and private institutions to participate actively in the development of Brazilian space activities. SINDAE comprises three formal classes of organs: central, sectoral, and participant.[24] Concerning the composition of that second class – responsible for sector coordination and execution of actions contained in the PEB – a strong demand for greater dialogue between the civil and military spheres can be perceived in national legislation, the military sphere being represented by DCTA (Aerospace S&T Department under the Brazilian Air Force).

Figure 1 presents SINDAE's composition, by which it can be observed that both launching centers – at Alcântara and Barreira do Inferno – and the IAE are organs attached to the Air Force Command's DCTA.

There are examples showing how SINDAE components relate to each other. Although the space and defense industries are suffering with high budget cuts, one of the Brazilian projects with potential for commercial use is the Microsatellite Launch Vehicle (VLM) project, as a result of the successful partnership between IAE and the German Aerospace Center (DLR).[25] Currently VLM seeks, in the national aerospace industry, companies able to manufacture the rocket to put it on the international market and increase the pace of production. As part of the Academy, the AEB sponsors some programs to encourage relevant space research, including scholarships and guided tours.[26]

As shown in **Figure 1**, AEB is SINDAE's central organ, and because of that it has in its basic structure a Superior Council, which is the deliberative organ responsible for approving the entry of participants in the system.[27] The relation between civil and military spheres is nominally strengthened here. However, despite the fact that SINDAE's central organ is an independent civil agency, the system's functioning depends on partnership with the military. In this vein, of nineteen representatives who are below the President of AEB on the Advisory Board, only two come from Universities and Industry, and five are related to the military sector. The Ministry of Defense (MD), the former Presidency of the Republic's Institutional Security Cabinet (GSI) – now called *Casa Militar* – and the commands of Navy, Army and Air Force are also present in SINDAE.[28]

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[20] Luiz Guilherme Sá da Silva, "Indústria de defesa aeroespacial e os projetos da Força Aérea Brasileira", *Revista ADESG,* Vol. 267, No. 2 (2012): 4-5.

[21] Brazil, *Estratégia Nacional de Ciência, Tecnologia e Inovação (ENCTI): 2012-2015* (Brasília: MCTI, 2012), 16.

[22] By the 4th article of the Law nº 8.854/1994, the former President Fernando Henrique Cardoso instituted – by Decree nº 1.953/1996 – the Brazilian space system, whose incumbency is to organize the execution of activities aiming at space development in the national interest. See: Adilson da S. Lemos Junior, *Implantação do Programa Estratégico dos Sistemas Espaciais Brasileiro* (Rio de Janeiro: ESG, 2014), 16; Brazil, "Law nº 8.854/1994"; Brazil, "Decree nº 1.953/1996" (Brasília: Presidency, 10 July 1996), http://www.planalto.gov.br/ccivil_03/decreto/1996/D1953.htm (accessed 22 Setember 2015); Brazil, "Decree nº 4.718/2003."

[23] Brazil, *ENCTI*, 120. Brazil, *PNAE,* 7.

[24] Brazil, "Decree nº 1.953/1996."

[25] Sergio Vieira, and Sylvio Guedes, "Crise pode causar perdas irreversíveis na Defesa, dizem especialistas," *Senado Notícias*, Brasília, 17 September 2015, http://www12.senado.leg.br/noticias/materias/2015/09/17/crise-pode-causar-perdas-irreversiveis-na-defesa-dizem-especialistas (accessed 22 September 2015).

[26] AEB, "Programas da AEB", http://www.aeb.gov.br/programas-da-aeb (accessed 22 September 2015).

[27] Brazil, "Decree nº 4.718/2003." Brazil, "Decree nº 1.953/1996."

[28] Brazil, "Decree nº 4.718/2003."

The law responsible for AEB's creation also foresaw the updating of the 1994 National Policy for Development of Space Activities (PNDAE).[29] PNDAE incentivizes public-private partnership, including closer exchanges with the military. As proof, primary directives of PNDAE are rather interesting: three of them address capacity training for strategic technology of dual usage – they emphasize employment of space technology in the solution of problems like *security and defense* of national territory.[30] Also, by accentuating that space activities must necessarily promote national development, PNDAE reinforces ambitions laid out in documents representing high political consensus – the National Defense Policy (PND) and the National Defense Strategy (END).[31]

PNDAE establishes the following conceptualizations that are indispensable to understanding development of PEB:

> *space systems*: devices meant either to operate in space or to permit space operating of equipment that will grant access to information or services;
>
> *space infrastructure*: installations, systems or surface equipment, plus associated systems that provide necessary support to effective operations and usage of space systems;
>
> *space activities*: systematic efforts to develop and operate space systems, as well as related infrastructure, to grant mankind expansion of knowledge about the universe; especially planet Earth and its atmosphere; and exploring, for employable ends, the availability of these new devices[32] [Emphasis in original, our translation].

Figure 2 shows how concepts elaborated by PNDAE recognize AEB's role in supporting the military *space strategic sector*. Putting concepts in **Figure 2** to work, the Geostationary Satellite of Defense and Strategic Communications (SGDC) can be defined as a space system of both military (defense) and civil (communications) uses, to be launched in Earth orbit (geostationary) by a space infrastructure – specifically an SLV launching-center – in order to develop space *activities* of strategic value to the Brazilian state and society.

By promoting the development of *space systems* and ground infrastructure, PNDAE endeavors to implement Brazilian space activities like SGDC that can only be put into practice via a national space program such as PEB, a long-term approach with projects spanning nearly a decade (2012-2021).[33] In order to support ambitions of PEB, Brazil invested an average of R$ 385 million (about U$ 96 million) per year in space activities thru 2012.[34] Planned investment over the next ten years is approximately R$ 900 million (about US$ 225 million) per year, an increase of nearly 250 percent.[35] The SGDC alone is anticipated to cost R$ 716 million (about US$ 179 million)[36].

In 2012, the fourth version of PEB was prematurely cast due to the fact that its authors understood the federal government at the time provided salient opportunities to rethink the space program.[37] Among these opportunities was the SGDC project. Of course, PEB reality is quite different from that provided by laws and official documents. PEB maintains very strong dependence on the military sector to pay for major projects in space. PEB still suffers from poor

[29] Brazil, "Decree nº 1.332/1994" (Brasília: Presidency: 8 December 1994).
[30] Brazil, "Decree nº 1.332/1994."
[31] Brazil, "Decree nº 1.332/1994."
[32] Brazil, "Decree nº 1.332/1994."
[33] Brazil, "Decree nº 1.332/1994."
[34] As a result of currency fluctuation which is currently in Brazil, the Real-Dollar parity reached in September 2015 the highest rate in its history (1: 4). Because of this unpredictable variation, it is reported the original amount in Reais (R$). Brazil, *PNAE,* 16.
[35] Brazil, *PNAE*, 17.
[36] Brazil's Federal Senate, *Em Discussão*, Year 3, No. 10 (2014), http://www.senado.gov.br/noticias/jornal/emdiscussao/Upload/201201%20-%20marco/pdf/em%20discuss%C3%A3o!_marco_2012_internet.pdf (accessed 22 September 2015), 64.
[37] The other three are from 1996, 1998 and 2005 (Brazil, *PNDAE*), 4, 7. Brazil, *PNAE*, 3. Such statements are echoed by the Brazilian Minister of S&T: "the current stage of the country's development has demands for space applications that only a bolder set of projects can attend" (Brazil, *ENCTI*, 66 [our translation]).

management and heavy budget cuts.[38] Regarding the lack of civilian technicians and bureaucrats dedicated to the space program, consider that the first AEB-sponsored public competition only occurred in late-2014, i.e., a full twenty years after its creation.[39]

One could hope that the more military space projects were boosted, the more AEB and PEB would also be boosted. But the Brazilian armed forces have their own Strategic Space Systems Program (PESE), of which AEB is not a part.[40] While implementation of the so-called space strategic sector engendered by PND and END has indeed helped PEB and AEB, it also increased the civil agency's dependency on the military sector, as the next section seeks to demonstrate.

THE (MILITARY) SPACE STRATEGIC SECTOR: FAIR WINDS FOR THE BRAZILIAN (CIVIL) SPACE PROGRAM?

National Defense was never a pulsating theme in Brazilian political discussions because, as the saying goes, "Defense does not generate vote" ("*Defesa não dá voto*"). In 2005, the first National Defense Policy (PND) was published, followed in 2008 by the first National Defense Strategy (END) in Brazil's history. It was the first time the Brazilian state – not only its government – thought in a formal, public, and strategic way about defense in the medium and long term.

The 2012 versions of PND and END designated three sectors as "strategic" to the national defense and *development* of Brazil: nuclear, cyber, and space.[41] These three interlinked strategic sectors, moreover, transcend the partition between civil and military boundaries.[42] When the strategy documents combine nuclear, cyber, and space sectors, then "visualizing *the country itself not [any longer] depending on foreign technology* is possible – and having the three forces working in synthesis, coordinated through *monitoring that is done, too, from space"* [emphasis added, our translation].[43]

Another example of synergy between strategic objectives and different actors is the making of the Geostationary Satellite of Defense and Strategic Communications (SGDC). Besides this project, Brazilian airspace control entails dialogue between space and cyberspace, especially for the modernization of the Air Defense Operations Center (CODA) and for aircraft upgrades to the new Communication, Navigation and Surveillance/Air Traffic Management (CNS/ATM) control system and satellite navigation.[44] Although these tasks have special significance for the Brazilian Air Force (FAB), END sets specific goals and milestones for each service in the Armed Forces.

For example, the Brazilian Army must modernize its brigade modules, which requires a broad spectrum of technological means, from the least sophisticated to *the most advanced means of communication between land operations and space monitoring*.[45] This is the first indicator that the SGDC will serve not only purposes of the FAB, but the other armed forces, too, reinforcing interdependency of the strategic sectors. The Brazilian Ministry of Defense, through END, establishes *four strategic goals* and *three strategic directives* to FAB. For space as a strategic sector, the first objective and the third directive are relevant, respectively, prioritizing aerial

[38] For an idea of AEB's annual budget, view the expected and settled values per year in: http://www.aeb.gov.br/programa-espacial/investimentos. Check also a criticism of this subject in: Barbosa, *Carta aberta*.
[39] AEB, "Concurso AEB", 2014, http://www.aeb.gov.br/concurso-aeb (accessed 12 September 2015).
[40] Lemos Junior, *Implantação*, 69.
[41] Brazil, *PND e END*, 93-7; Gills Lopes, "A emergência do tema ciberguerra: contextualizando a criação do Centro de Defesa Cibernética à luz da Estratégia Nacional de Defesa." In: *Concurso de Artigos sobre o Livro Branco de Defesa Nacional* (Brasília: Ministry of Defense, 2011), http://www.defesa.gov.br/projetosweb/livrobranco/arquivos/apresentacao-trabalhos/artigo-gills-lopes.pdf (accessed 22 September 2015).
[42] Brazil, *PND e END*, 49; Carlos Newton, "Três setores estratégicos: cibernético, espacial e nuclear," *Revista ADESG,* Vol. 273, No. 2 (December 2012), 6-7.
[43] Brazil, *PND e END*, 49; Newton, "Três setores estratégicos," 6.
[44] Brazil, *White Paper*, 203.
[45] Brazil, *PND e END*, 77.

surveillance and integrating space activities in FAB operations.[46]

With respect to the first strategic goal, END counts space as a domain – like its marine, terrestrial, and aerial predecessors – so Brazil, in order to surveil its national territory and jurisdictional waters, will have to rely on its own *platforms* and *systems* for monitoring.[47] Among other projects, here is where the SGDC enters the picture; in the absence of a one hundred percent national geostationary satellite, it is nearly impossible to exert effective surveillance.

Besides satellites, END anticipates other kinds of monitoring technologies such as satellite launching vehicles (SLVs) and intelligence aircraft.[48] These strategic tools form a "monitoring complex" by layers, called the Brazilian Aerospace Defense System (SISDABRA), administered under the Brazilian Aerospace Command (COMDABRA), with the mission of assuring sovereignty over Brazil's national airspace.[49] The development and refinement of SISDABRA will mark Brazil's bid for national autonomy, specifically as it relates to foreign systems such as the U.S. Global Positioning System (GPS).[50] Once operative, the SGDC should be a key element in SISDABRA.

As to its third strategic directive, END states that FAB's organic functions ineluctably depend on monitoring via space. In this sense, development of national SLVs shall serve as a broad instrument, not only to support foreign *space programs* but to develop national technology for the design and manufacturing of missiles.[51]

In geopolitical terms, the Ministry of Defense accepts that the possession of long-range missiles – derived from the use of rockets, for example – remains a crucial factor in international relations, sharply altering the calculus for national defense and security.[52] With this presumption, developing SLVs can cause a spillover effect in other policy areas as well as branches of the armed forces. This, indeed, makes the Brazilian Army's case; the Army is already developing the missile and rocket system *ASTROS 2020*, costing R$ 1.1 billion (about U$ 277 million).[53]

Now, since PND and END assign implementation of the strategic space sector to FAB, nothing is more logical than having information and technology sharing among sectors. But in proposing three strategic sectors (nuclear, cyber, and space) for both defense and national development, the Ministry of Defense assigned each of the three armed services responsibilities for boosting them.[54] There are historical and logistical reasons behind this distribution of competencies. For example, the Brazilian Navy has been developing the nuclear-powered submarine project since 1979.[55] So nothing is more reasonable than having the nuclear strategic sector borne by the Navy while the space strategic sector goes to the FAB's stewardship. Residually, then, the cyber strategic sector was awarded to the Brazilian Army, which in any case already possessed expertise with electronic warfare.

Figure 3 presents this distribution of roles and missions, identifying the three strategic sectors according to END. In implementing the national defense strategy, however, there were two major surprises, namely, the economic crisis and the relative lack of civil or business interest in the space area.[56]

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[46] Brazil, *PND e END*, 85-91.
[47] Brazil, *PND e END*, 85.
[48] Newton, "Três setores estratégicos", 7.
[49] Brazil, *PND e END*, 86. Brazil, "Decreto-Lei nº 1.778/1980" (Brasília: Presidency: 18 March 1980), http://www.planalto.gov.br/ccivil_03/decreto-lei/1965-1988/Del1778.htm (accessed 22 September 2015).
[50] Brazil, *PND e END*, 86.
[51] Brazil, *PND e END*, 91.
[52] Brazil, *White Paper*, 38.
[53] Brazil, *White Paper*, 200. For more information about ASTROS 2020, visit: http://www.epex.eb.mil.br/index.php/projetos/astros-2020.html.
[54] Brasil, *White Paper*, 68-9; Newton, "Três setores estratégicos", 7.
[55] "Submarino nuclear brasileiro: Quo Vadis?", *Poder Naval*, 29 December 2008, http://naval.com.br/blog/destaque/submarinos/submarino-nuclear-brasileiro-quo-vadis (accessed 22 September 2015).
[56] There are some rare exceptions, such as Embraer, the Grande ABC Local Productive Arrangement (APL) of

With regard to the political and economic crisis, it can be said that its harbinger occurred in late 2014 – an election year in Brazil – with serious budgetary consequences in mid-2015. This caused many investment losses and subsequent cancellation of governmental programs and projects, including strategic ones.

For example, budget cuts in the Defense Ministry were 25%.[57] Specifically in regard to PEB, the most important sign of the economic crisis appeared in July 2015, when the Federal Administration waivered a ten-year agreement with Ukraine, extinguishing thereby the binational company Alcântara Cyclone Space (ACS), which was intended "to launch satellites aboard Ukrainian Cyclone-4 rockets from Brazil's Alcântara spaceport..."[58] It is noteworthy that the Brazilian-Ukraine partnership had already consumed R$ 1 billion (about U$ 250 million).[59]

Besides its own organizational budget cuts, PEB had to adjust to space strategic sector cuts because, as seen, the interrelationship is very close. However, among space strategic sector priority projects – SLVs; satellites; satellite-based communications, command and control technologies; and satellite-driven geographic information systems – if there is one that should *not* be canceled amid the crisis, it is precisely the SGDC. This is justified by reasons analyzed in the following section.[60]

CASE STUDY: THE MAKING OF THE GEOSTATIONARY SATELLITE OF DEFENSE AND STRATEGIC COMMUNICATIONS (SGDC)

This case study of the making of Brazil's first geostationary satellite has two main objectives, namely: i) to demonstrate the need for a fully national satellite for Brazilian strategic communications; and ii) to support the main hypothesis that there is no functioning transition model of space capabilities from the military to civil sphere in Brazil.

Brazil decided to manufacture the Geostationary Satellite of Defense and Strategic Communications (SGDC) in 2011 in order to address the national security demand for strategic – civil and military – communications.[61] As its name foretells, it is a *geostationary* satellite, that is to say, its operating orbit – navigating above Earth's equator – is almost 36,000 km.[62] This kind of satellite contrasts with the so-called low earth orbit ones on altitudes between 500km and 800km.[63]

According to France and Sellers, a general rule for this type of satellite is that geostationary constellations employ three or more satellites with ground infrastructure and cross-linking to accomplish global coverage.[64] This is not the case for SGDC as it is only one satellite that can map a portion of the globe (across the longitudinal range of Brazil) without the process of triangulating. This ends up being one of the SGDC's best advantages: provision of independent strategic and civil communications for Brazil without the cost of a full constellation borne by other space powers.

In light of PEB, the SGDC was a structuring and mobilizing project the implementation of which was on schedule until the last day of 2014 when it

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Defense (http://www.industriadefesaabc.com.br) and the Brazilian Association of Defense and Security Industries Materials – Abimde (http://www.abimde.org.br).

[57] Roberto Godoy, "Corte na Defesa é a metade do previsto," *O Estado de S. Paulo*, 6 July 2015, http://politica.estadao.com.br/noticias/geral,corte-no-ministerio-da-defesa-e-a-metade-do-previsto,1701021 (accessed 22 September 2015).

[58] Brazil, "Decree nº 8.494/2015" (Brasília: Presidency: 24 July 2015). "Brazil's space programme: ten, nine, tem," *The Economist*, São José dos Campos, 8 Aug. 2015, http://www.economist.com/news/americas/21660572-rocket-science-hard-rocket-diplomacy-harder-ten-nine-ten (accessed 22 September 2015).

[59] Barbosa, *Carta aberta*, 1.

[60] Brazil, *PND e END*, 93.

[61] Brazil, *PNAE, 9.*

[62] Federal Senate, *Discussão*, 64.

[63] Newton, "Três setores estratégicos," 7.

[64] Martin E. B. France and Jerry Jon Sellers, "Real constraints on spacepower." In: *Toward a theory of spacepower: select essays*, Edited by Charles D. Lutes et al. (Washington, DC: NDU Press, 2011), 91.

was postponed to 31 December 2016.[65] In 2012, all forty geostationary satellites operating in Brazil were actually foreign. Brazilian enterprises were limited to supplying ground equipment and antennas for control stations serving television, telephony, tracking, and broadband Internet, as well as *military activities* and image generation.[66] The independent creation of a satellite with strategic attributes – combined with the custom that international technological cooperation is usually not marked by bountiful sharing of valuable information – would benefit Brazil, granting it autonomy in monitoring its sovereign territory.[67]

Though the Brazilian Space Agency (AEB) foresees the possibility of international cooperation, it is only plausible by means of working through the Ministry of Foreign Affairs and taking into account MCTI (Ministry of Science, Technology & Innovation).[68] For example, one of the main AEB initiatives for international cooperation was the Brazilian-Ukranian enterprise ACS, demonstrating that international cooperation is – or was until July 2015 – vital to the development of PEB, with or without SGDC.[69]

As to management, the SGDC project deals with two organs: the steering committee and the executive group. The former is led by Brazil's Ministry of Communications (MC) and includes the Ministry of Defense (MD) as well as MCTI.[70] The executive group is comprised of the following entities: Telebras, MD, MC, AEB, and the National Institute for Space Research (INPE).[71] Telebras, beyond presiding over the executive group, is also responsible for running, jointly with MD, the SGDC operation after its launch while AEB – specifically its Satellite Directorate, Applications and Development – will retain intellectual property rights on the satellite's technology transfer.[72]

For SGDC's manufacturing *per se*, a new enterprise called Visiona Tecnologia Espacial emerged in 2012 from the cooperation between Telebras and Embraer Defense and Security.[73] Once again, the civil-military component is highlighted here in order to demonstrate how Brazilian space aspirations are indeed dependent upon high profile projects connected to the military and national defense.

As shown in **Figure 4**, the public/government sector – represented by Telebras – oversees arrangements with private enterprise to implement SGDC's manufacturing. The present idea is that Brazil's Defense Industrial Base (BID) will be stimulated and rewarded in the production of d*efense products* (PRODE).[74] Indeed, it is a

[65] Brazil, *ENCTI*, 119; Brazil, *PNAE, 12.* Brazil, "Decreto nº 7.769/2012" (Brasília: Presidency, 28 June 2012), http://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2012/Decreto/D7769.htm (accessed 22 September 2015); Brazil, "Law nº 12.598/2012" (Brasília: Presidency, 21 March 2012); Brazil, *ENCTI*, 68; Federal Senate, *Discussão*, 64. Brazil, "Decree nº 8.153/2013" (Brasília: Presidency, 12 December 2013), http://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2013/Decreto/D8153.htm (accessed 22 September 2015).

[66] Brazil, *PNAE,* 9. Federal Senate, *Discussão*, 63.

[67] Brazil, "Decree nº 1.332/1994."

[68] Brazil, *PNDAE*, 11. Brazil, "Decree nº 4.718/2003." Brazil, *ENCTI*, 12.

[69] Brazil, *ENCTI*, 66.

[70] Brazil, "Decree nº 7.769/2012."

[71] Attached to MC, the "new" Brazilian Telecommunications S.A. (Telebras) is a mixed economic society reinstated in 2010, after being privatized in 1998. INPE "is fit to do scientific researches, technological development, operational activities and the training of human resources in the fields of Space and Atmosphere Sciences, Earth Observing, Weather Forecast and Climate Studies, and Space Technology and Engineering." See: Brazil, "Decree nº 5.886/2006," (Brasília: Presidency, 2006), Art. 21 [Our translation]).

[72] Brazil, *ENCTI*, 67-68. Brazil, "Decree nº 4.718/2003", Art. 13, II.

[73] Embraer Defense and Security is a segment of Embraer S.A. – former Brazilian Aeronautic Enterprise S.A. – privatized in the Itamar Franco administration. It is "the only national enterprise amongst the hundred greatest in the industry of defense ranking" (Federal Senate, *Discussão*, 72 [Our translation]). Brazil, *PNDAE*, 10; Federal Senate, *Discussão*, 64; Visiona Espacial, "Quem somos," http://www.visionaespacial.com.br/sobre.html (accessed 22 September 2015).

[74] PRODE is "every good, service, work or information, including weaponry, ammunition,

necessary action, considering that according to the Brazilian Senate, "since Embratel's privatization, satellite services used by the Armed Forces are supplied by private enterprises".[75] Visiona's creation directly addresses three of PEB's strategic lines of action, namely, commit industry at all stages of space project development; encourage the creation of integrator enterprises; and stimulate critical technologies.[76] Nevertheless, the joint venture, Visiona, is being widely criticized – especially by the Brazilian Union of Federal Civil Servants in Aerospace Sector Science and Technology (SindCT) – in the sense that it "is acting only as an intermediary in the acquisition, entirely abroad, of SGDC, throwing out of its development not only INPE, but the whole domestic industry which serves PEB."[77]

Unlike most Brazilian space programs, the SGDC project might yet survive threats of cancelation and reach its goals. However, negotiations for acquisition of both components and satellite launch are in train with foreign powers: Franco-Italian Alenia Space (TAS) and the French enterprise Arianespace.[78] If the SGDC project was designed, among other purposes, to strengthen the incipient Brazilian space industry, in practice it is doing the opposite: strengthening foreign defense companies by providing stimulative contracts at the expense of national enterprises central to the future autonomy of Brazil.[79]

CONCLUSION

Brazil is part of a select group of nations in possession of a strategic space program, but there are several factors that limit this program short of a viable strategic space *capability*, which comprises satellite operations, manufacture, and launch.[80] Among the obstacles, this article highlighted the following: strong technological and logistical dependence in relation to the military sector and consequent deficiencies in human capital, particularly among Brazilian Space Agency (AEB) personnel; PEB mismanagement of resources, especially those dedicated by law to development of the national space industry; premature project cancellations before an endeavor can reach useful milestones; and substantial recurring budget cuts. Added to this are deficiencies in regional cooperation – even interest – for pooling resources to advance space programs during times of economic crisis in South America.[81]

After the demise of the ACS agreement with Ukraine, Brazil should consider a medium-term strategic partnership with any country at a more advanced stage in the space strategic sector. One possible candidate is Argentina, which, while facing political and economic crises for years, nevertheless shepherds a more organized space program than Brazil's and already operates its

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transport means, uniforms, and materials of individual or collective usage for activities intended for defense, with a caveat for those of administrative usage" (Brazil, "Decree nº 7.769/2012").

[75] Federal Senate, *Discussão*, 63.

[76] Brazil, *PNDAE*, 11. In the realm of PEB, the so called critical technologies are split in: leveling, being the ones already dominated by the nations, and hence easily obtained; the advanced, being currently developed by nations and thus hardly obtained; and disruptive, being those sprung from revolutionized technological innovations, yet to be pursued by the PEB (Brazil, *PNDAE*, 12), under AEB's coordination (Brazil, *ENCTI*, 66).

[77] Barbosa, *Carta aberta*, 2 [Our translation].

[78] Embraer, "Geostationary satellite will ensure the security of Brazilian communications", 28 November 2013, http://www.embraer.com.br/en-us/imprensaeventos/press-releases/noticias/pages/satelite-geoestacionario-vai-garantir-a-seguranca-das-comunicacoes-brasileiras.aspx (accessed 22 September 2015).

[79] Isso se torna ainda mais notório ao analisar o recém-publicado Edital de Seleção Pública encabeçado pelo MCTI e pela AEB, que prevê a contratação de empresas brasileiras para apoiar projetos referentes à transferência das tecnologias previstas no Acordo de Transferência de Tecnologia Espacial firmado entre a AEB e a TAS. Cf.: "Edital de Seleção Pública MCTI/AEB/FINEP/FNDCT – Subvenção Econômica à Inovação – Transferência de Tecnologia do SGDC – 01/2015" (Brasília: FINEP, 15 September 2015).

[80] Lopes Filho, *Nas asas da história*, 24.

[81] To get an idea of this lack of South American interest, just remember that the UNASUR considered the creation of a regional space agency, but the project was not even drafted. See: http://www.infoespacial.com/latam/2011/11/13/noticia-los-ministros-de-defensa-de-unasur-plantean-crear-una-agencia-espacial-conjunta.html.

own geostationary satellite.

Major powers are working behind the scenes to fill the vacuum left by Ukraine. For example, Russia has been angling to launch its new *Angará* rocket from the Alcântara Launch Center (CLA). Similarly, China wants to expand its ongoing partnership with Brazil through the China-Brazil Earth Resources Satellite (CBERS), in order to build a binational partnership for its *Longa Marcha* family of launchers. Despite good intentions toward PEB as well as the desire to launch satellites from Brazil, a regulatory agreement on technological cooperation with the United States remains to be signed so that satellites with U.S. components may be launched from Brazilian soil; without agreement, there is no hope of a commercial joint project in the space sector.

Now, with the Brazilian Complete Space Mission (MECB) abandoned, it is expected that the SLV-1 Project is on a slower development path than SGDC. In the midst of the current economic crisis, the German-Brazilian Microsatellite Launch Vehicle (VLM) can be considered the design with the greatest commercial potential. Aspirations of stimulating a Defense Industrial Base (IDB), and specifically a robust space industry, conflict with economic demands now facing the country. But this financial reality is not exactly new, as "It is easy to see that the Brazilian government does not have available funds for years when compared with other major centers of space programs."[82]

Given the current crisis and lack of public investment, academic-university partnerships present an excellent opportunity, not only to reduce research and development (R&D) costs but to create a space culture among future Brazilian scientists and produce homegrown technology. Of course, this is not a solution to the PEB barriers, but it is a medium-to-long-term alternative that Brazil needs to seriously consider.

As seen, two major initiatives of PEB concerned (i) launching satellites from national soil and (ii) aligning the National Policy for Development of Space Activities (PNDAE) with broader priorities of the national budget. Only after these accomplishments can it be said that there is genuine geopolitical and strategic enthusiasm for augmenting Brazilian autonomy through space exploration.[83] Building Brazil's first geostationary satellite (SGDC) coheres with this sympathetic interpretation of PEB and also with the National Defense Policy (PND) and the National Defense Strategy's (END's) convergence on the Brazilian space strategic sector. Ironically, reducing space dependency on Brazil's own military programs, as well as foreign corporate champions, can go a long way toward supporting Brazil's national autonomy through independent strategic monitoring and communications.

As SINDAE's central organ, AEB endeavors, through space activities, to integrate and *coordinate* civil and military interests. In practice, authentic coordination is hampered by AEB's near total dependence on the military. SGDC exemplifies Brazil's imbalanced civil-military relations when it comes to the strategic space sector – crucial for national development as well as national defense. The space program is codified in official documents under both priorities of the Brazilian government, but SGDC, like other large projects in technological and budgetary terms, is spearheaded by a defense company.[84] In addition, AEB presides over Brazil's space complex by contracting with foreign companies for acquisition and, more ominously, for the very launch of SGDC.

Space is indispensable for Brazil; it "is, and will continue to be, a critical environment for both civilian and military operations."[85] In Brazil's case, however, the strategic space sector is out of balance. Given the current state of affairs, the perplexing underperformance of Brazil space is likely to continue beyond the economic crisis, that is, until lawmakers can address the political-institutional causes of its arrested development.

[82] Lemos Junior, *Implantação*, 23 (our translation).

[83] Brazil, *PNDAE*, 10.
[84] Brazil, *ENCTI*, 65.
[85] Brazil, *PNDAE*, 9. Stephen Shea, Mathew Johnson, and Alfredo Zurita, "Terror on High: Deterring ASAT," *Space & Defense*, Vol. 8, No. 1 (Spring 2015): 60-8.

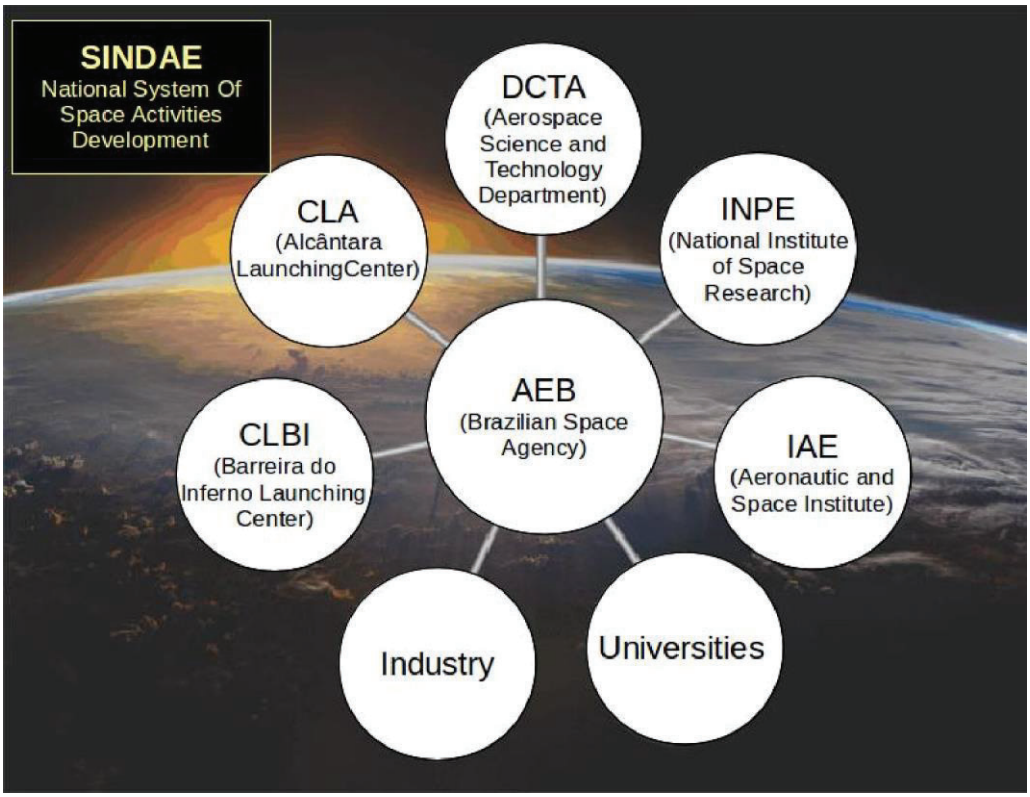

Figure 1 – SINDAE's composition
Source: http://www.aeb.gov.br/wp-content/uploads/2013/03/manual_identidade.jpg (with adaption).

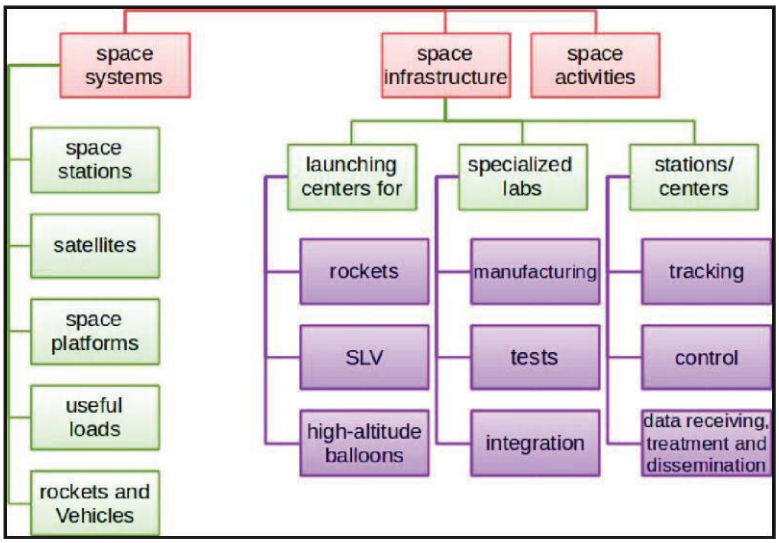

Figure 2 – Arch concepts held by PNDAE
Source: Vilar Lopes, "To Infinity and Beyond", 183.[1]
Legend: SLV = satellite-launching vehicle.

[1] Gills Vilar Lopes, "To Infinity and Beyond! AEB and the Case of Geostationary Satellite in Light of the Space Strategic Sector," *Coleção Meira Mattos – Revista das Ciências Militares*, Rio de Janeiro, Vol. 9, No. 34 (Jan./Apr. 2015): 177-88.

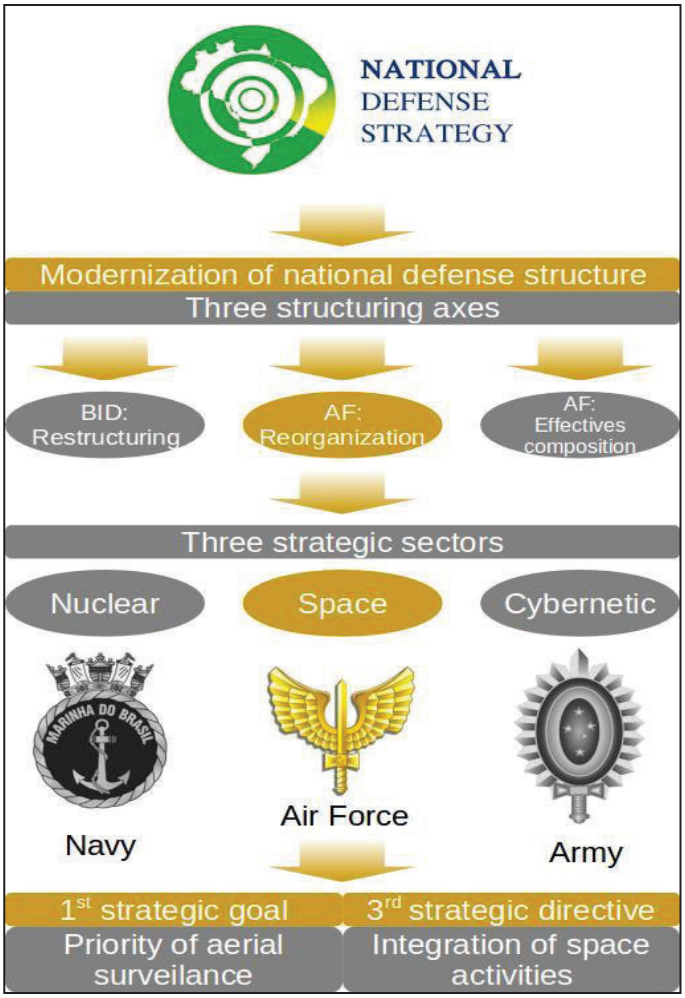

Figure 3 – Strategic Sector (END)
Source: Vilar Lopes, "To Infinity and Beyond," 181 (with adaptation).[2]
Legend: BID = Defense Industrial Base; AF =Armed Forces.

[2] Gills Vilar Lopes, "To infinity and beyond," 177-88.

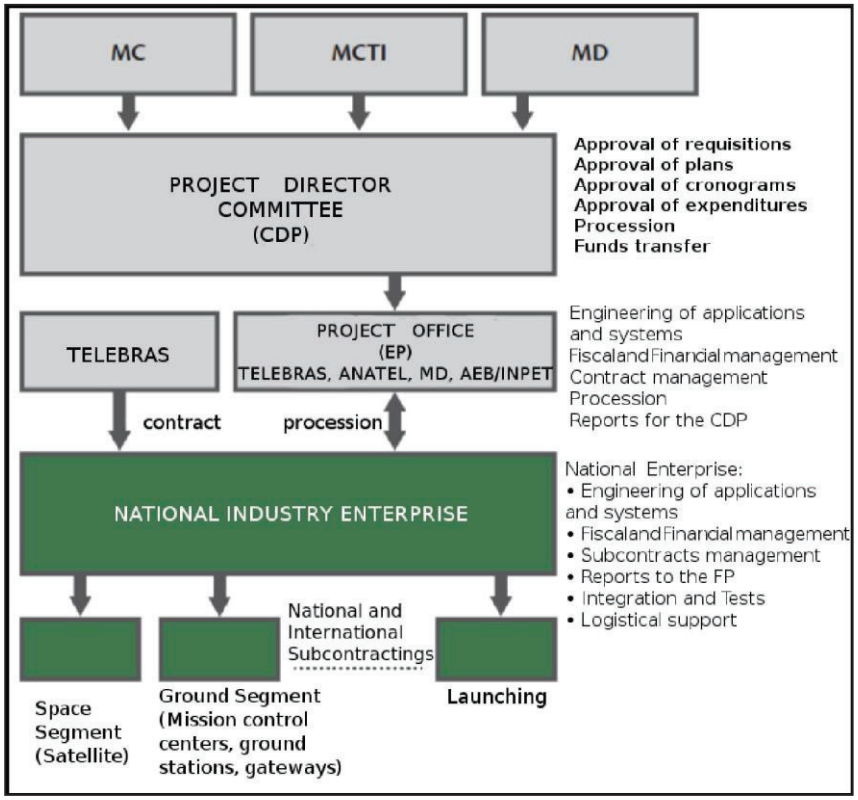

Figure 4 – Project and attribution structure on the SGDC Program
Source: Brazil, *ENCTI*, 206.

APPENDIX A - Acronyms and Abbreviations

Acronym/abbreviation	Meaning (in English)	Translation (if applied)	Nature
Abimde	Brazilian Association of Defense and Security Industries Materials	Associação Brasileira das Indústrias de Materiais de Defesa e Segurança	civil
ACS	Alcântara Cyclone Space		civil
AEB	Brazilian Space Agency	*Agência Espacial Brasileira*	Civil
BID	Defense Industrial Base	*Base Industrial de Defesa*	military
CBERS	China-Brazil Earth Resources Satellite	*Satélite Sino-Brasileiro de Recursos Terrestres*	Civil
CLA	Alcântara Launching Center	*Centro de Lançamento de Alcântara*	military
CNS/ATM	Communication, Navigation and Surveillance/Air Traffic Management		military
Cobae	Brazilian Commission for Spatial Activities	*Comissão Brasileira de Atividades Espaciais*	military
CODA	Air Defense Operations Center	*Centro de Operações de Defesa Aeroespacial*	military
COMAER	Aeronautics Command	*Comando da Aeronáutica*	military
COMDABRA	Brazilian Aerospace Command	*Comando de Defesa Aeroespacial Brasileiro*	military
CONAE	National Commission for Space Research	*Comisión Nacional de Actividades Espaciales* (Argentina)	Civil
DCTA	Aerospace Science and Technology Department	*Departamento de Ciência e Tecnologia Aeroespacial*	military
DLR	German Aerospace Center	*Deutsches Zentrum für Luft- und Raumfahrt*	Civil
EMFA	Major-State of Armed Forces	*Estado-Maior das Forças Armadas*	military
END	National Defense Strategy	*Estratégia Nacional de Defesa*	military
ESA	European Space Agency		civil
FAB	Brazilian Air Force	*Força Aérea Brasileira*	military
GPS	Global Positioning System		civil

GSI	Presidency of the Republic's Institutional Security Cabinet	*Gabinete de Segurança Institucional da Presidência da República*	civil-military
IAE	Aeronautics and Space Institute	*Instituto de Aeronáutica e Espaço*	military
INPE	National Institute for Space Research	*Instituto Nacional de Pesquisas Espaciais*	civil
ITA	Aeronautics Institute of Technology	*Instituto Tecnológico de Aeronáutica*	military
LBDN	Defense White Paper	*Livro Branco da Defesa Nacional*	military
MC	Ministry of Communications	*Ministério das Comunicações*	civil
MCTI	Ministry of Science, Technology and Innovation	*Ministério da Ciência, Tecnologia e Inovação*	civil
MD	Ministry of Defense	*Ministério da Defesa*	military
MECB	Complete Brazilian Space Mission	Missão Espacial Completa Brasileira	military
NASA	National Aeronautics and Space Administration		civil
PEB	Brazilian Space Program	*Programa Espacial Brasileiro*	civil
PESE	Strategic Space Systems Program	*Programa Estratégico de Sistemas Espaciais*	military
PNAE	National Program of Space Activities	*Programa Nacional de Atividades Espaciais*	civil
PND	National Defense Policy	*Política Nacional de Defesa*	military
PNDAE	National Policy for Development of Space Activities	*Política Nacional de Desenvolvimento das Atividades Espaciais*	civil
SAE	Secretariat of Strategic Affairs of the Presidency of the Republic	*Secretaria de Assuntos Estratégicos da Presidência da República*	civil
S&D	search and development		civil-military
SGDC	Geostationary Satellite of Defense and Strategic Communications	*Satélite Geoestacionário de Defesa e Comunicações Estratégicas*	civil-military

SINDAE	National System of Space Activities Development	*Sistema Nacional de Desenvolvimento das Atividades Espaciais*	civil-military
SindCT	Union of Federal Civil Servants in Aerospace Sector Science and Technology	*Sindicato Nacional dos Servidores Públicos Federais na Área de Ciência e Tecnologia do Setor Aeroespacial*	civil
SISDABRA	Brazilian Aerospace Defense System	*Sistema de Defesa Aeroespacial Brasileiro*	military
SLV	satellite-launching vehicle		civil-military
SNI	National Information Service	*Serviço Nacional de Informações*	military
TAS	Thales Alenia Space		civil
Telebras	Brazilian Telecommunications S.A.	*Telecomunicações Brasileiras S.A.*	Civil
VLM	Microsatellite Launch Vehicle	*Veículo Lançador de Microssatélite*	civil-military