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WASHINGTON, DC

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This letter provides an interim response to your Freedom of Information Act (FOIA) request to the Defense Intelligence Agency (DIA), dated 18 September 2017, requesting 18 specific theses written by students at the National Intelligence University. As previously noted by DIA, DIA transferred these cases to the Office of the Director of National Intelligence (ODNI) in 2022.

ODNI processed this request under the FOIA, 5 U.S.C. § 552, as amended and located 17 of the theses requested. Note, despite a thorough search, "Rationing the IC: The Impact of Private American Citizens on the Intelligence Community" was not located.

This interim response provides a response on ten of the theses. During the review process, we considered the foreseeable harm standard and determined that certain information must be withheld pursuant to the following FOIA exemptions:

- (b)(3), which applies to information exempt from disclosure by statute. Specifically, the National Security Act of 1947, as amended:
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Sincerely,

Erin Morrison
Chief, Information Review and Release Group
Information Management Office

CHASING TECHNOLOGICAL AUTONOMY: BRAZILIAN DEFENSE POLICY AND DEFENSE INDUSTRIAL PURSUITS 1995-2006

by

GG-14, DIA
MSSI Class 2007

Unclassified thesis submitted to the faculty
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The views expressed in this paper are those of the author and
do not reflect the official policy of the
Department of Defense or the U.S. Government

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and for my daughter, who will be born shortly after this study's completion, I dedicate this effort.

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CHAPTER 1

DEFENSE POLICY AND THE PURSUIT OF TECHNOLOGICAL INDEPENDENCE

If we never have technology and a modern military industry, we will never be able to assume the positions that are of interest to the nation.

– Former CTA Director Hugo de Oliveira Piva

This study seeks to determine if defense policy, developed in Brazil from 1995-2006, delivers on the defense leadership's stated goal to create a more autonomous defense industry and provide Brazil's military services with the technology needed for their missions. The study will explore the relationship between policy and industry, which has essentially gone untreated in the academic literature during this period. The intelligence interest addressed is Brazil's desire to independently develop a number of technologies that either fit DoD's category of disruptive capabilities or that involve other proliferation concerns. During the course of this study, the basic research question I seek to deal with is: What relationship exists between Brazil's defense policy and its defense industry's activities?

Why Study Brazil?

Former French President Charles de Gaulle was once alleged to have been quoted saying that "Brazil is not a serious country." Statements like this, whether accurately cited or not, often find their way into the Brazilian popular milieu and are parroted by Brazilian elites as a reason to pursue ambitious political goals or dramatic, sophisticated technological undertakings that in their view equate with a country of Brazil's stature. As Vanderbilt University historian Marshall

Eakin, a specialist on Brazil, once noted, "Any Latin American specialist who has lived and worked in both Spanish America and Brazil becomes acutely conscious of the vast cultural divide between the two halves of Latin America."[1] Unhappily, many U.S. decision makers get caught in the costly error of treating Brazil as just another Latin American country, believing it should fit neatly within regional policy constructs, and should be dealt with in the same manner as any other country in the region. But Brazil has a stature that by regional standards completely dwarfs all of its neighbors in most measures, and natural assets that several envy.

The U.S. Department of Commerce's estimate of Brazil's population was 188 million as of 2006, which is the fifth largest in the world behind China, India, the United States, and Indonesia. The next closest Latin American nation is Mexico at 107.5 million. As of 2000, Brazil also had the 4th and 13th largest cities in the world according to United Nations estimates. Brazil owns the fifth largest land mass in the world at nearly 8.5 million square kilometers – behind Russia, China, the United States, and Canada – and its area is nearly one half (48 percent) of the whole South American continent. The Brazilian economy's gross domestic product, measured in terms of purchasing power parity in 2005, ranked the tenth largest in the world at US$ 1.556 trillion, and nearly half a trillion larger than its nearest Latin American counterpart, Mexico. According to *The Military Balance 2005-06,* the Brazilian Armed Forces ranked 15th in the world in terms of active duty troop strength, by far the largest in Latin America. In almost all measures of demographic, economic, and geographic importance, Brazil is Latin America's dominant entity.[2]

Accompanying Brazil's physical, demographic, and economic size is its status as the world's fourth largest democracy. As the leading democracy in the southern hemisphere, Brazil's

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[1] Marshall C. Eakin, *Brazil: The Once and Future Country* (New York: St. Martin's Press, 1997), 129.

[2] All demographic, economic, and geographic figures cited come from *The World Almanac and Book of Facts 2007* (New York: World Almanac Books, 2007), 137, 846-849.

behavior easily falls under the global spotlight, and Brazil has prided itself on its ability to maintain peace with its neighboring countries for over 130 years. Brazilian leaders have expressed in their own 2005 National Defense Policy, however, that the nation aims at expanding its global status:

> 4.7. Brazil upholds an international order based upon democracy, multilateralism, cooperation, the prohibition of chemical, biological, and nuclear weapons, and the search for peace among the nations. In that direction, it supports the reformulation and democratization of the decision making bodies of international organizations as a way to strengthen the peaceful solution of disputes and its confidence in the principles and standards on International Law. However, it is not prudent to conceive of a country without a defense capability compatible with its stature and political aspirations.[3]

Brazilian global political aspirations are matched, however, by a tendency to behave as a nation from the developing world, complete with its own deep-seated self-doubts. Brazilian scholars and statesmen, as well as external observers, have noted through the years that buried deep in the Brazilian elite psyche is an inferiority complex vis-à-vis the developed world, particularly with Western Europe and the United States. The complex is accompanied by a tendency to value things from the developed world more than those of national origin, but also a hypersensitivity to external criticism and a defensive nationalistic reaction whenever legitimate criticisms are made by Western nations.[4]

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[3] "Brazil's Lula Approves Decree Launching New National Defense Policy" (text), Brasilia *Presidency of the Federal Republic*, 30 June 2005, 7. (b) (3) [redacted]

[4] Alberto Carlos Almeida, "O Brasil no Final do Século XX: Um Caso de Sucesso," *Dados* vol. 41, no. 4, 1998: x-xx; Humberto Mariotti, "O Complexo de Inferioridade Brasileiro: Fantasias, Fatos e o Papel de Educação," *Revista BSP* (online ed.), Aug/Oct 2006, URL: <http://www.revistabsp.com.br/0608/ensaio1.htm>, Accessed on 10 April 2007; Amazônia.org, "Entrevista com Roberto Smeraldi, Diretor de Amigos da Terra – Amazônia Brasileira: 'Aposto no pato, na adiroba, no feijão, na manteguinha...'," *Diário do Pará*, 22 October 2001, URL: <http://www.amazonia.org.br/opiniao/editorial.cfm?id=15005>, Accessed on 11 April 2007; Eliane Lobato, "Em Busca do Brasil," *IstoÉ* (online ed.) 1630, 20 December 2000, URL: <http://www.terra.com.br/istoe/1630/brasil/1630_em_busca_brasil.htm>, Accessed on 11 April 2007; O Estado de São Paulo, "Notas & Informações: A Politização do Itamaraty," *Ministério das Relações Exteriores Website*, 18 February 2007, URL: <http://www.mre.gov.br>, Accessed on 11 April 2007; CEBRI, *Relatório Sobre os Estados Unidos da América* (Rio de Janeiro: Centro Brasileiro de Relações Exteriores, 27 August 2002): 10.

Brazilian anthropologist Roberto DaMatta has studied this behavior closely, especially with Brazilians living abroad who are often ashamed by how Brazil is caricatured in the international media. From mistaken beliefs that Buenos Aires is Brazil's capital to perceptions that Brazil (and Latin America at large) is a region where nothing ever changes, DaMatta portrays the Brazilian elite as simultaneously disgusted with external ignorance about their country as well as with a self-loathing for Brazil, which gives the international press an easy target to criticize.[5] As a recent *BBC News* article pointed out in the wake of deeply negative Brazilian reaction to an American B-list film set in Brazil and portraying Brazilians as thieves, kidnappers, and organ traffickers, "behind the carefree exterior is a nation deeply concerned, perhaps even paranoid, about what outsiders think."[6]

One of the Brazilian government elite's hot buttons is its concern over sovereignty of its national territory, and the Amazon region in particular. Critical press about Brazilian stewardship of the rain forest and occasional developed world public statements, such as former EU Trade Commissioner Pascal Lamy's February 2005 proposal to the UN for collective international management of rain forests like the Amazon basin, are interpreted by the Brazilian Foreign Ministry and the Armed Forces as a direct threat to Brazilian sovereignty.[7] Defense of Brazilian

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[5] Roberto DaMatta, *Tocquevilleanas: Notícias da América* (Rio de Janeiro: Editor Rocco Ltda., 2005): 52, 57, 249; Roberto DaMatta, *Torre de Babel: Ensaios, Crônicas, Críticas, Interpretações e Fantasias* (Rio de Janeiro: Editor Rocco Ltda., 1996): 113, 115, 117.

[6] Steve Kingstone, "No Stereotypes Please – We're Brazilian" *BBC News* (online ed.), 22 February 2007.

[7] Senado Federal, *Nota Taquigráfica da Quarta Reunião Ordinária da Terceira Sessão Legislativa Ordinária da Quinquagésima Segunda Legislatura da Comissão De Relações Exteriores e Defesa Nacional, Realizada no Dia Trinta e Um de Março do Ano de Dois Mil e Cinco, Às Dez Horas*, (Brasilia, DF: Secretaria-Geral da Mesa/Subsecretaria de Taquigrafia, 07 April 2005), URL: <http://www.senado.gov.br>, Accessed on 29 August 2006; Samuel Pinheiro Guimarães, *Desafios Brasileiros na Era dos Gigantes* (Rio de Janeiro: Contraponto Editora Ltda., 2006): 175, 199-206.

sovereignty and territorial integrity, as defined in the Brazilian Constitution, is the military's charter mission, which supersedes all others.[8]

These deeply seated fears broadly manifest in Brazilian elite sectors carry a latent potential for conflict over resources in the future. The Amazon basin, while not an area of high-intensity conflict, does possess considerable concentrations of the earth's mineral wealth, biological diversity, and fresh water sources. A 2002 survey of Brazilian foreign policy elite thinking sponsored by the Brazilian Center of International Relations (CEBRI) found that out some 150 executive branch leaders, congressmen, entrepreneurs, academics, business and union leaders, journalists, and Brazilian NGO leaders, 49 percent thought that internationalization of the Amazon region was a threat.[9]

As other nations begin to exhaust their own resources and seek access to those outside their borders or regions, Brazilian strategists in the military and their supporters in political circles are trying to prepare the Armed Forces for defense of its Amazon region, where most of the nation's strategic resources are concentrated. In recent testimony to congress, the chief of Brazilian intelligence and representatives from the Defense Ministry and the Federal Police all claimed that many of the 100,000 NGOs operating in the Amazon region are directed by foreign interests with international capital behind them who have hidden interests, including influencing Brazilian public policy, pirating Amazonian biodiversity, and laundering money. The hearing convinced the congress to install another probe to investigate the involvement of NGOs in bio-piracy on behalf of U.S., European, and Japanese financiers.[10]

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[8] Brasil, *Constituição da República Federativa do Brasil – Promulgada em 5 de Outubro de 1988*, 24th edition (São Paulo: Editora Saraiva, 2000): 83.

[9] Amaury de Souza, *A Agenda Internacional do Brasil: Um Estudo sobre a Comunidade Brasileira de Política Externa* (Rio de Janeiro: Centro Brasileiro de Relações Exteriores, 2002), 42.

[10] Rodrigo Bittar, "Entidades querem controle de ONGs que atuam na Amazônia," *Agência Câmara*, 20 March 2007, URL: <http://www2.camara.gov.br/internet/homeagencia/materias.html?pj =99791>, Accessed on 22 March 2007; Rodrigo Bittar, "Relatório da Abin não vê cerco Americano ao Brasil," *Agência Câmara*, 20 March 2007, URL: <http://www2.camara.gov.br/internet/homeagencia

Periodic expressions of distrust of U.S. military motives bubble to the surface on occasion. A 2006 Brazilian intelligence assessment leaked to news daily *Jornal do Brasil* that was produced by an interagency working group made up of Brazilian Intelligence Agency, military intelligence service, and Federal Police intelligence personnel, indicates that even with good current bilateral relations, deep suspicions persist in some parts of the bureaucracy:

> As far as the U.S. military presence in Amazônia, a relatively new component in the question of Brazilian Amazon regional security is the growing presence of U.S. military advisors and the sale of sophisticated equipment to the Colombian armed forces, with the pretense of supporting drug eradication programs, but which can be used in combating the FARC (Revolutionary Armed Forces of Colombia) and the ELN (National Liberation Army). The U.S. military presence, which extends itself to Guyana, to Ecuador, to Peru, to Bolivia, and, recently, to Paraguay – taking advantage of the emptiness of our foreign policy in relation to that country – by means of utilizing military bases, will be able to expand itself to other South American countries to transform the struggle against drugs (and against the FARC and ELN) into a South American military venture, not only U.S.-Colombian one. The plan is probably part of a U.S. strategy to secure direct military presence in the Andean-Amazonian region and in the Southern Cone, around Brazil.[11]

Accompanying Brazilian distrust of developed world motives in the Amazon basin is a perception that many of the same nations, particularly the United States, seek to limit Brazilian access to technology as well as stem subsequent economic benefits that result from commercialization of advanced technology. Former director of the Brazilian Air Force's Aerospace Technological Center (CTA), Hugo de Oliveira Piva, stated to Brazilian newsweekly *IstoÉ* in December 2000 that, "The Americans boycotted our space program, as much as the other powers, and we had to learn to dominate technology with the intelligence of Brazilian engineers, civilian and military."[12] Another former CTA director, Sérgio Xavier Ferolla, testified earlier in

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/materias.html?pj=99790>, Accessed on 22 March 2007; Jornal do Senado, "Papaléo alerta ONGs estrangeiras na região Amazônica," 10 April 2007, URL: <http://www.senado.gov.br/JORNAL /arquivos_jornal/arquivosPdf/070410.pdf >, Accessed on 14 April 2007.

[11] Tales Faria, "Militares apontam ameaças," *Jornal do Brasil*, 29 January 2007, NOTIMP No. 29, URL: <http://www.fab.mil.br/Imprensa/enotimp/2007/01-JAN/enotimp029.htm#jb>, Accessed on 23 March 2007.

[12] Cláudio Camargo and Hélio Contreiras, "Segurança Nacional: Voz na contramão – O polêmico brigadeiro Piva defende a indústria bélica nacional e critica a dependência do mercado americano," *IstoÉ* No. 1630 (online ed.), 20 December 2000, URL: <http://www.terra.com.br/istoe/1630/brasil/1630_voz_ na_contra_mao.htm>, Accessed on 19 June 2007.

1995 to congress on the same point, indicating that for 15 years the Air Force's satellite launch vehicle program was blocked by the international community and Brazil suffered tremendous pressures from supposed "friends" who were actually competitors looking to deny Brazil a market niche, because of Alcântara Launch Center's privileged location.[13]

More recently, during a 1999 interview, former Aeronautics Minister Lélio Viana Lôbo argued that developed nations used episodic media exposure of the Air Force's nuclear research as diplomatic ammunition to try to inhibit any technological gains the CTA civilian programs were making. Lôbo suggested the pressure was really based on defending developed countries' commercial interests, although they cloaked their arguments in security rubric.[14] While most Brazilian claims of blocked technological access refer to projects falling under Brazil's space program, then presidential candidate Luiz Inácio Lula da Silva argued in a September 2002 opinion piece that Brazil should not consider a U.S. bid to sell F-16 aircraft to Brazil because the U.S. government would not permit full transfer of the requested weapons systems technology (referring to missiles) to Brazil.[15] One year earlier, Defense Minister Geraldo Quintão made the same point regarding the U.S. F-16 bid for the Air Force's F-X program, stating, "The Americans sell the hardware but in general do not turn over the weapons system for the aircraft. This is of no interest to the Brazilian Air Force. I always say, in jest, that an aircraft of this nature without a weapons system is a toy airplane."[16]

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[13] Câmara dos Deputados, *Projeto SIVAM: Audiências Públicas 1995 Volume I* (Brasilia: Câmara dos Deputados/Coordenação de Publicações, 1996), 154.

[14] Celso Castro and Maria Celina D'Araujo, *Militares e Política na Nova República* (Rio de Janeiro: Editora FGV, 2001), 229.

[15] Câmara dos Deputados, *Comissão de Relações Exteriores e de Defesa Nacional – Audiência Pública 2232/03* (Brasilia, DF: Departamento de Taquigrafia, Revisão e Redação, 9 December 2003), 8.

[16] Câmara dos Deputados, *Comissão de Relações Exteriores e de Defesa Nacional – Audiência Pública 000880/01* (Brasilia, DF: Departamento de Taquigrafia, Revisão e Redação, 5 September 2001), 117.

Brazilian perceptions of the Western nations' fickleness in providing unrestricted access to technology for Brazil's defense needs has swayed the bulk of the defense establishment to prefer domestic options over the headaches that accompany foreign acquired weapons systems and their logistic consequences. This is by no means a new development. Brazilian Aeronautics Commander Carlos de Almeida Baptista recounted to the Senate in September 2001 that from the moment the Air Force was born in 1941, and as early in his career as he could remember (1949), the service's pursuit of technology was continual, but the Air Force never gained concessions for technology transfer graciously.[17] Gerald Haines, a senior historian at CIA, captured this Post-World War II challenge in his 1989 study of American influence on Brazil, indicating that Brazilian military personnel felt neglected by the U.S. for its failure to supply significant arms transfers in conjunction with pledges and agreements to help Brazil militarily from 1945 up until the U.S. and Brazil signed a military assistance agreement in 1952.[18]

Brazil needs to protect vast expanses of territory and resources and the country's inability to depend on weapons technology and logistic support from external suppliers has pushed the defense leadership to increasingly seek domestic industrial solutions to support the military's technological needs. Many of the Brazilian leadership's deepest fears revolve around how the U.S. can influence or negatively affect Brazilian interests. Given the resources, weight, and potential Brazil has in the Latin American region, Brazil could be considered the region's "key state" as conceptualized in the Department of Defense's (DoD) National Defense Strategy.[19]

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[17] Senado Federal, *Nota da Comissão Permanente do Senado Federal Referente a 22a Reunião Extraordinária de 18/09/2001 da Comissão: CRE - Comissão de Rel. Exteriores e Def. Nacional* (Brasilia: Secretaria-Geral da Mesa/Subsecretaria de Taquigrafia, 18 September 2001), 32.

[18] Gerald K. Haines, *The Americanization of Brazil: A Study of U.S. Cold War Diplomacy in the Third World, 1945-1954* (Wilmington, DE: Scholarly Resources, Inc., 1989), 43-53.

[19] Department of Defense, *The National Defense Strategy of the United States of America*, (March 2005). Keyword search for "National Defense Strategy 2005." URL: <http://www.defenselink.mil/news/Apr2005/d20050408strategy.pdf>. Accessed 18 September 2006. Hereafter cited as "Department of Defense, *The National Defense Strategy.*"

Why Study Brazil's Defense Policy?

Department of Defense strategy holds that, "Several key states face basic decisions about their roles in global and regional politics, economics, and security, and the pace and direction of their own internal evolution. These decisions may change their strategic position in the world and their relationship with the United States. This uncertainty presents both opportunities and potential challenges for the United States."[20] The strategy also holds that, "Disruptive challenges may come from adversaries who develop and use break-through technologies to negate current U.S. advantages in key operational domains."[21]

Only by close and careful examination of expressed policies provisions and their relationship to concrete actions can a nation's intentions and capabilities be adequately assessed. Brazil has been increasingly transparent with the national policies and other sector level guidance that ostensibly directs how its defense establishment functions. Without doubt, this is partially a function of its status as the world's third largest democracy as well as a deliberate strategy to assuage the concerns of neighboring countries that it poses no threat to them. The Brazilian defense policies issued in 1996 and 2005 represent a statement of national will and provide a map for understanding Brazil's aims in terms of regional security and the potential areas of convergence or divergence in terms of shared bilateral interests. Examining consistency of the words in the policy with Brazilian deeds provides U.S.-based analysts, planners, and policy makers with insight into how seriously Brazilian leaders hold to their declared positions.

Why Examine Defense Industry There?

This thesis is focused on how Brazilian determination to develop or obtain advanced technologies for application to national defense has been a key goal for several consecutive

[20] Department of Defense, *The National Defense Strategy*, 4.

[21] Department of Defense, *The National Defense Strategy*, 3.

administrations and how such activities contribute to new industrial capabilities. This is relevant to the Department of Defense in two ways.

First, Brazil's desire to develop certain critical technologies and establish an industrial capacity to reproduce them implies not only application to the nation's defense needs, but also intent to seek external customers for the products developed. Brazilian leaders have shown a proclivity to give greater weight to economic factors than political factors in many arms transactions, and in some cases, a desire to export weapons systems to nations of concern to U.S. interests. Second, the qualitative improvements in Brazilian scientific and technological research and development which has been generated by the processes of technology transfer, industrialization, and innovation in the military and civilian spheres present new opportunities for bilateral cooperation.

The Brazilian government's document *Strategic Concept: Science, Technology, and Innovation in the Interest of National Defense* identifies a number technologies that Brazil wants to develop independently, or acquire through technology transfer, which fit the DoD's categories of disruptive or catastrophic technological capabilities or which entail other proliferation concerns.[22] Most of these categories of technology fall outside the scope of this study.[23] The technological cases examined in this study address Brazilian development or procurement of technologies which are listed among the Brazilian Defense Ministry's list of critical technologies falling into the following categories: systems integration, measurement and identification of signatures, active and passive sensors, composite materials, arms systems environments, high

[22] Ministério da Defesa/Ministério da Ciência e Tecnologia, *Concepção Estratégica: Ciência, Tecnologia e Inovação de Interesse da Defesa Nacional* (Brasilia, DF: Ministério da Defesa/Ministério da Ciência e Tecnologia, 2003), URL: <https://www.defesa.gov.br/ciencia_tecnologia/palestras/cti.pdf>. Accessed 18 September 2006.

[23] The technologies of interest to the Brazilian defense sector that will not be addressed here are: microelectromechanical systems and nanotechnology, high density energetic materials, hypervelocity, directed energy, automated precision navigation, computational fluid dynamics, photonics, robotics and artificial intelligence, nuclear energy, space systems, vacuum air propulsion, biological processes and materials, nuclear/biological/chemical defense, superconductivity, and renewable energy resources.

sensitivity radar, information systems, and data fusion. In all of these categories, the study identifies Brazilian activity to either develop systems with these capabilities for defense purposes, to exploit systems and technology gained through technology transfer for follow-on research, or to produce and commercialize such systems with the intent to export them.

In most cases, the U.S. reaction to this Brazilian activity has been measured, demonstrates an appropriate level of awareness, and has exhibited constructive discourse with Brazilian interlocutors. Interest expressed by two consecutive U.S. defense secretaries during visits to Brazil has sought increased technological and scientific cooperation and sharing between the U.S. and Brazilian defense establishments.[24] Underscoring the interest in cooperation is the ongoing establishment of a U.S. Air Force Office of Strategic Research international S&T office in Brazil, which aims to foster S&T collaboration in basic research (math, physics, nanoscience, advanced materials, biotechnology) and applied research in alternative fuels, advanced sensors, unmanned systems, and body armor, among others.[25] Such an office will likely provide a mechanism to perpetuate constructive relations and to help ensure Brazil's status and ambitions as a "key state" remain transparent to the Department of Defense.

The Problem and the Research Question

Brazil's defense policy has not been systematically examined by either the Intelligence Community or academia for its impact on defense industry activity in Brazil or for how it shapes, or does not shape, the Brazilian Armed Forces' interaction with Brazil's defense industrial base. This knowledge gap needs to be addressed because few in the U.S. Government devote time or

[24] Department of Defense, Office of the Assistant Secretary of Defense for Public Affairs, "News Transcript: Secretary Cohen Press Conference at the U.S. Embassy, Brasilia, Brazil," 15 November 1999, URL: <http://www.defenselink.mil/transcripts/transcript.aspx?transcriptid=313>, Accessed on 7 June 2007; Department of Defense, Office of the Assistant Secretary of Defense for Public Affairs, "News Transcript: Secretary of Defense Rumsfeld Remarks at Joint Press Conference in Brazil," 23 March 2005, URL: <http://www.defenselink.mil/transcripts/transcript.aspx?transcriptid=2477>, Accessed on 7 June 2007.

[25] United States Southern Command, "Science & Technology," 25 January 2007, URL: <http://www.southcom.mil/appsSC/pages/scienceTech.php>, Accessed on 7 June 2007.

resources to examining these issues. Identifying how the 1996 and 2005 National Defense Policies, and their derivative guidance, have shaped the military's activities in scientific and technological research and development, as well as the services' requests for corresponding arms and weapons systems from Brazil's defense industrial sector, may provide insight into whether Brazil can successfully develop an autonomous capacity for technological innovation that can either undermine or, alternatively, create opportunities for U.S. military and economic interests in South America. By answering the question, "What relationship exists between Brazil's defense policy and its defense industry's activities?" we can get to the heart of this issue.

Hypotheses

Hypothesis 1: Brazil's defense policy compels the Armed Forces to seek war materiel solutions from national industry in order to stimulate autonomous development of military technology, before the military services can turn to external sources.

Hypothesis 2: Brazil's defense industrial sector influences the shape and content of the nation's defense policy through its interaction with the defense and political leadership.

Key Questions

In order to break down the two hypotheses into more manageable units that get at the core of the overall research question, this study's empirical chapters are devoted to answering 5 key questions. By answering these questions, the study aims at determining whether the hypotheses above can be supported or refuted.

1. What explicit rules and mechanisms derived from the defense policy help or hinder the national defense industry's ability to secure military orders and pursue R&D opportunities?
2. How closely do the military services follow defense policy directives in defining their technology needs for mission accomplishment?

3. What range of supply options do the military services and the defense leadership consider when planning to acquire weapons systems and technology for military operational needs?

4. How does defense industry influence the defense policy process or key policy actors in Brazil?

5. What national and international resources are available to Brazil's defense industry to develop military technology?

Definitions and Assumptions

Each hypothesis begs further explanation of what its key terms mean and how they can be made operational for measurement purposes. Within this study I define "defense industry" as the conglomeration of state-owned and private firms, as well as civilian and military organizations, that participate in one or more stages of research, development, production, distribution, and maintenance of strategic defense products. By "defense policy" I refer to the Brazilian government's published "National Defense Policy," as well as any derivative document approved by the government that provides guidance, norms, or procedures to the Ministry of Defense, to other government ministries or agencies, to the military services, and to defense industry on national defense issues.

Defining "autonomy" is a trickier task. In a world which features increasing globalization of production, with components for complex systems manufactured just about anywhere in the world, calling any nation's production activities autonomous is becoming more difficult. Among globalization's consequences in many defense industry sectors are changes to production processes that move away from vertical domination of all stages of producing arms systems and emphasize outsourcing for production of components and subsystems. Much of the overseas suppliers either have a superior capacity to produce certain components and technology or their labor is much cheaper, reducing the logic of producing the components or technology domestically. In Brazil's case, the defense industry developed through alliances of state and local

capital with multinational capital. Most systems had their origin in technology from abroad or were dependent on foreign technology.

If Brazil is to achieve true technological autonomy, it seems clear that it defense industry's firms and allied R&D centers would need to be able to generate the technology needed for weapons production locally, using local resources not subject to control by foreign actors, and be able to replicate, use, and export that technology without interference from outside actors. Such a definition is a tall order to fill in an era of globalized production.

The second hypothesis refers to the "defense and political leadership" which could be interpreted in a number of ways. For the purposes of this study, I consider the defense leadership to be those military and civilian leaders in key positions to make decisions about policy and resource expenditures in the procurement and industrial support realms. Typically this group includes the Defense Minister, the Commanders of the Air Force, Army, and Navy, and key subordinates in the ministry or services with the authority to sign contracts or extend benefits to national industry. By the political leadership, I refer to the President, the Vice-President, the president's chief of staff, several ministers who may control an aspect of policy affecting industry (i.e. Minister of Science and Technology, Minister of Development, Industry, and Commerce, Minister of Finance, Minister of Planning, Budget, and Management), and the leaders in Congress who hold significant control over defense resources.

This thesis has several underlying assumptions. One assumption is that the Brazilian military seeks to exploit global advances aerospace technology, communications technology, and intelligence, surveillance, and reconnaissance (ISR) technology during the next few years for national defense and commercial purposes. A second assumption is that the Brazilian military has defined procedures and processes in place for procurement and development activities that can be identified and tied to policy goals. A third assumption is that given sufficient resources, both the military and defense industrial firms are willing to spend these resources to fulfill their roles in the research and development of weapons systems and associated procurement and

production activities. A fourth assumption is that the defense industry seeks to produce defense systems and materials primarily for the local market, given the additional costs associated with exports, distribution, and servicing overseas. Another assumption that falls more within the realm of the methods used in this thesis is that reviewing documentary materials and evidence is sufficient to identify the patterns and trends of the phenomena studied, as well as to accurately divine the intentions of the actors involved.

A Note on Scope

This thesis will not dwell on the historical foundations, motivations, and factors that created Brazilian defense industry, as this has been addressed in other studies. The study does not seek to explore broad theoretical questions, examine the ideology behind the genesis or Brazil's arms industry, or compare Brazil's experience to other countries as others already have done. Rather the scope will be limited to exploring the relationship between defense policy and defense industry in Brazil and the domestic technological consequences of this relationship, particularly as they pertain to weapons development for internal defense consumption or for export.

The temptation to stray beyond these boundaries is great. The complexity of building Brazil's military industrial sector and the politics, ingenuity, and intrigue involved in each of the Brazilian defense sector's major technological projects are enough for any scholar to spend years studying. For reasons of simplicity in research design and in order to be able to execute the study within the National Defense Intelligence College's academic year, the field of inquiry and the number of cases examined had to be contained. For those bold enough to pursue similar lines of research on Brazilian defense industry and defense policy issues, the suggestions for further research in Chapter 8 should provide a number of fruitful areas for complementary studies that this thesis could not feasibly address.

Plan of the Thesis

In the chapters that follow, this study addresses aspects of contemporary defense policy that has developed over the past three administrations, defense industrialization efforts through major military procurement projects during the same period, and the corresponding state mechanisms that attempt to increase technological autonomy in Brazil. Chapter 2 explores previous efforts to explain various dimensions of the policy, industry, and autonomy interrelationship. The literature reviewed, while not exhaustive, targeted studies that were judged helpful for understanding Brazil specifically or which featured promising analytic tools for examining policy, industry, or autonomy questions and can serve as an academic departure point for examining Brazil.

Chapter 3 presents the methodology and analytic framework used in Chapters 4 through 7 to examining the two technological cases examined in the collective case study. Many of the concepts and analytic tools mentioned in this chapter are introduced in Chapter 2. Chapter 3 also aims at explaining what measurement scheme was used, how the data was researched, why specific technological cases were chosen, and what limitations were encountered during the application of the analytic framework to the data.

Chapter 4 is most specifically preoccupied with Brazil's defense policy. While the chapter's primary purpose, in conjunction with Chapters 5 and 6, is to address three of the five key questions identified earlier, it seeks to explore some of the documents that the Brazilian defense ministry, military services, and defense industrial base use to orient their planning for both domestic and external procurement decisions and for research, development, and production of weapons systems. Many documents were issued or in force over the 12 years this study covers and are reviewed for content in Chapter 4.

The central concern of Chapter 5 is presenting the first technological case, which deals with the Amazon Surveillance System (SIVAM). Chapter 5 outlines the government's most technologically sophisticated and most expensive procurement and technology development effort during the 1990s, and aims to complement Chapter 4 in answering the first three key questions identified earlier in this chapter. Chapter 5 provides deeper explanations of the Brazilian government's use of several policies and mechanisms identified in Chapter 4, and aims to demonstrate the military's use of defense guidance while interacting with the industrial sphere.

Chapter 6 presents the second technological case, the Air Force's AL-X light attack aircraft development and acquisition program. Like Chapters 4 and 5, it seeks to address the first three key questions identified in this chapter. Like Chapter 5, the AL-X program presents a technological case that seeks to demonstrate how the Brazilian military employs defense guidance to set requirements and engage industry in developing technology for a major procurement program. While the AL-X program is related to the SIVAM project, the cases are different several ways, which provides greater depth in addressing the key questions.

The main task of Chapter 7 is to address the remaining two key questions. Besides employing two of the analytic frameworks introduced in Chapter 2 dealing with defense industrialization, the chapter revisits both technological projects and shows how national and international resources are a critical factor in the behavior of defense industry firms and the military and political actors they interact with. The chapter also examines the defense industry's bargaining capabilities and influence over defense policy, with a specific focus on whether the government is responsive to addressing industry complaints and providing them with support to become more autonomous from external capital.

Chapter 8 summarizes the findings from Chapters 4-7 and evaluates the two hypotheses at the beginning of Chapter 1 in light of these findings. Several conclusions are drawn about the hypotheses and about the research question that generated them. Chapter 8 also revisits some of the arguments presented in Chapter 2 and presents what the findings from Chapters 4-7 reveal

about the validity of these arguments and their implications for theory. The chapter also suggests implications of the findings for U.S. policy towards Brazil. Finally, recommendations for future research along these lines are made for the following classes of MSSI students at the National Defense Intelligence College.

CHAPTER 2

LITERATURE ON BRAZILIAN DEFENSE POLICY, DEFENSE INDUSTRY, AND TECHNOLOGICAL AUTONOMY

Overview

The following review of literature on Brazilian defense policy and defense industrialization is divided into three categories that pertain to my study. First, I will address Brazilian interpretations of the importance of having a National Defense Policy for guiding defense industrial activity in support of military acquisition and technological goals. I will also identify some important considerations for evaluating policy and strategy formulation. Second, I will move on to several articles and book-length examinations of Brazilian defense industrialization, identifying potentially useful analytical frameworks and approaches for examining Brazil's defense industry. Third, I will address literature dealing with technological autonomy and technology transfer as it pertains to Brazil, pointing out promising schemes to identify the modalities in the Brazilian context. Finally, I will explain my own intended contribution to this literature and what differences my approach to this topic will have.

The Impact of Defense Policy on Defense Industry

In 1996 Brazil issued its first National Defense Policy, three years before the establishment of the Defense Ministry in 1999. President Fernando Henrique Cardoso hailed the inter-ministerial document as overall guidance for integrating the strategies and plans of Brazil's

three separate military ministries in order to better optimize resources and efforts.[26] At that time, analysts argued that any defense policy drafted without a defense ministry coordinating the service-specific inputs would fail to harmonize procurement planning. They also argued that an uncoordinated policy would fail to provide an underpinning logic for each service's approach to S&T research, weapons R&D, and arms acquisition from domestic or external sources.[27]

Antonio Carlos Pereira argued in 1996, shortly after Brazil's initial National Defense Policy was published, that defense industry does not develop from the mere equipment needs of the Armed Forces, but is rather a more complex set of decisions that stem from security and defense policies that allow a specific military industrial policy to arise. Outside this progression, as happened in Brazil's case, industries were set up without an overarching state policy to guide and support their activities for the long term. Pereira mentioned that to sustain themselves the industries depended on the Brazilian military's autonomous activity during military rule, as well as the international market's ability to absorb medium-technology military goods. Once military budgets became scarce and external markets for arms tailed off, lacking a national policy, the defense firms in Brazil were unable to compete with foreign defense firms, which were better supported by their governments.[28]

Pereira blamed the Brazilian political class and broader Brazilian society for not taking an interest in defense issues stating, "the commander-in-chief does not outline the defense directives, the Congress does not discuss or examine the priorities or programmatic objectives

[26] Fernando Henrique Cardoso, "Discurso sobre Política de Defesa," *Parcerias Estratégicas* 1, no. 2 (1996): 18.

[27] Antônio Carlos Pereira, "Por um política de defesa," *Premissas* 14 (1996): 164; Domício Proença Júnior and Eugênio Diniz, "Considerações sobre uma Política de Defesa do Brasil," *Parcerias Estratégicas* 1, no. 2 (1996): 29-30; Thomaz Guedes da Costa, "Política de Defesa: uma discussão conceitual e o caso do Brasil," *Revista Brasileira de Política Internacional* 37, no. 1 (1994): 116-118.

[28] Pereira, "Por um política de defesa," 164-165.

built into the Budget, and the population thinks this is all normal – in this country, only with difficulty will there be a place for a defense industry, as wrong or inconvenient as this may be."[29]

Thomaz Guedes da Costa's discussion of defense policy in 1990 identified that Brazil lacked a codified joint military doctrine that would allow Brazil's military services to have a shared understanding of coordinated military operations. Each service (Army, Navy, and Air Force) at that time planned, organized, and managed budgets independent of each other, and zealously sought to maintain their autonomy.[30] Budgets grew tight in the late 1980s when the military began to disengage from politics, but the services' legacy technological projects, developed with national means during a period when resources were made available for the military and the defense industry, persisted.

Costa argued that the increased costs of modern warfare, which stressed integration of electronics into weapons and C³I systems, combined with no immediate justification for high expenditures on military hardware, forced Brazilian leaders to review the nation's industrial-technological model. The availability of budget resources, rather than hypothetical war contingencies, determined the pace of some large projects that relied on national resources – such as frigate construction, the nuclear submarine program, and fighter aircraft development.[31]

Costa's examination highlights shortcomings in Brazil's defense sector that Brazilian leaders sought to address with the formulation of a National Defense Policy. Costa's arguments a few years later highlighted that Brazilian political culture does not commonly embrace the concept of "defense policy." Perhaps anticipating forward movement on this front, he identified four areas that a debate about Brazilian defense policy should consider: discourse, employment,

[29] Pereira, "Por um política de defesa," 166.

[30] Thomaz Guedes da Costa, "Cooperação e Conflito nas Interações Estratégicas do Brasil: Os Desafios da Nova Década," *Política e Estratégia* VIII, no. 2-4 (1990): 144.

[31] Costa, "Cooperação e Conflito nas Interações Estratégicas do Brasil, 144-145.

preparation, and acquisition. Costa's four categories are useful for this analysis of contemporary Brazilian defense policy and consequently require identification here:

- Discourse – Includes internal messages of the decision process and of governmental action and the external messages of communication between political actors in the political game.
- Employment – Includes understanding the possibilities for potential use of the Armed Forces in hypothetical circumstances.
- Preparation – Includes development of doctrine, training, and establishment of C³I mechanisms among the armed forces' units.
- Acquisition – Includes the level of technological development, the types of materiel, resource transformation, internal and external purchasing processes, and the ownership of war materiel.[32]

With respect to the final category of acquisition, Costa maintained that Brazilian society would need to resolve the questions of the degree of "nationalization" (domestic private or state-owned firms) desired for weapons systems and the criteria for sustaining costs and subsidies extended to Brazil's defense industry as a part of a national defense policy.[33]

Like Costa, Clóvis Brigagão and Domício Proença Jr. argued in 2002 that the individual services' tendencies toward autonomy still determine their courses in defense activity, despite the 1996 National Defense Policy and creation of a Ministry of Defense in 1999. They see Army, Navy, and Air Force operating much as they have previously, while making adjustments for changes in the international context and agreeing to certain rhetoric and formal agreements about common objectives, which for them are essentially secondary.[34] They conclude that no integrated

[32] Costa, "Política de Defesa: uma discussão conceitual e o caso do Brasil," 110.

[33] Costa, "Política de Defesa: uma discussão conceitual e o caso do Brasil," 110.

[34] Clóvis Brigagão and Domício Proença Jr., *Concertação Múltipla: Inserção Internacional de Segurança do Brasil* (Rio de Janeiro: Livraria Francisco Alves Editora, S.A., 2002), 88.

perspective for defense management exists between the services, and that despite explicit directives from foreign and defense policies, the three services' hypotheses used to guide planning are isolated from each other and from these directives.[35]

Arguing in 1992, shortly after a dramatic contraction of Brazil's arms industry and seven years before the defense ministry's creation, former Navy Minister and Secretary of Strategic Affairs Admiral Mário César Flores asserted that Brazil cannot immediately strive to become a great military power, because the social and infrastructural debts that trouble the nation do not allow for substantial defense expenditures absent a compelling threat.[36] Flores argued that with no clearly defined threat hypotheses (scenarios used for contingency planning) Brazil's military must be ready to do what the state asks of it, even while low defense expenditures place military readiness in jeopardy.[37]

Flores' arguments about Brazilian strategic thought ten years later highlighted four technological parameters that he believed delimit the strategic concepts that Brazil can apply in 21st century warfare. They include: the use of precision weapons; the knowledge derived from sensor-based intelligence systems; the premature obsolescence of weapons systems after substantial research and development expenditures; and the reduction of space and blurring of traditional operation boundaries among the services.[38] Flores' discussion provides useful insight into key military considerations that shape formulation of Brazil's National Defense Policy, its military strategy, and these documents' logical implications for defense industrial development.

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[35] Brigagão and Proença Jr., *Concertação Múltipla*, 153.

[36] Mário César Flores, *Bases Para Uma Política Militar* (Campinas: Editora da UNICAMP, 1992), 117-118.

[37] Flores, *Bases Para Uma Política Militar*, 118, 121.

[38] Mário César Flores, *Reflexções Estratégicas: Repensando a Defesa Nacional* (São Paulo: É Realizações Ltda., 2002), 34-38.

These perspectives provide analysts with critiques of Brazil's defense planning landscape from some of Brazil's finest strategic thinkers who engage in academic debate. The picture they paint is a somewhat disjointed approach to planning for national defense, which ignores civilian input because few civilian are interested in military matters, and which must improve because modern warfare requires a more "joint" approach. What all of these works lack, however, is an up-to-date perspective that reflects the full spectrum of policy, planning, and doctrinal activity that has transpired in Brazil since 1995. Several defense guidance documents have been issued by the Defense Ministry since its inception in 1999, including a revised National Defense Policy (PDN) in 2005, a National Defense Industrial Policy (PNID) in 2005, a Military Doctrine of Defense (DMD) in 2001, and both a Military Strategy of Defense (EMiD) and a Military Policy of Defense (PMD) in 2002. The PMD was updated in 2005 after the Lula government issued the revised PDN. A revision of the EMiD was ongoing as of the end of 2006. This study examines those documents that are in the public domain, and they are discussed in chapter four with an emphasis on highlighting their implications for defense industrial activity and ascertaining whether the authors' arguments above are still valid.

Frameworks for Examining Brazilian Defense Industrial Efforts

The literature on Third World defense industrialization during the 1980s and 1990s is quite rich, owing to a number of studies that examined the entry of several newly industrialized countries into the global arms trade and their subsequent performance. Brazil was one of several countries repeatedly studied, and several journal articles, books and edited volumes provide insights into the history of Brazilian defense industrialization as well as some of the predominant factors that explain the industry's rise and fall.[39] While several book length studies provide good

[39] For edited volumes, see James Everett Katz, ed., *Arms Production in Developing Countries: An Analysis of Decision Making* (Lexington, MA: D.C. Heath and Company, 1984), Michael Brzoska and Thomas Ohlson, eds., *Arms Production in the Third World* (London: Taylor & Francis, 1986), and Efraim Inbar and Benzion Zilberfarb, eds., *The Politics and Economics of Defense Industries* (London and

detail on Brazilian defense industrial efforts and the factors that influenced them historically and during their period of greatest growth, few of them isolated the specific relationship between military policies and defense industry, probably because Brazil lacked a defense policy until 1996.

This study dwells on the 1996-2006 period, whereas most of the studies on defense industrialization in Brazil share no overlap with this era. The data used in most of the previous studies is useful for a historical explanation of how many existing Brazilian defense sector firms arrived to the point they are at, or how they lost traction and faltered, but they provide less insight into what their relationship is with contemporary defense policy. For instance, Franko-Jones' 1992 study of Brazil's defense industry uses data collected between 1983 and 1991, and she mentions that data collection was a significant problem because Brazilian defense firms and associated government entities were suspicious and protective of information during that time.[40] Maldifassi and Abetti, who used data ranging from 1961 to 1990 in their 1994 comparative study of industries in Argentina, Brazil, and Chile, also complained about the lack of precise data and reliable sources on Brazilian defense industries because of the confidential nature of their activity.[41] Both of these studies are rich in detail, with systematic, economically-oriented evaluations of the defense industries strengths and weaknesses in terms of its contributions to the

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Portland, OR: Frank Cass Publishers, 1998); for full length books examining Brazil, either alone or in comparative perspective, see Ken Conca, *Manufacturing Insecurity: The Rise and Fall of Brazil's Military-Industrial Complex* (Boulder and London: Lynne Rienner Publishers, 1997), Patrice Franko-Jones, *The Brazilian Defense Industry* (Boulder: Westview Press, 1992), Amit Gupta, *Building an Arsenal: The Evolution of Regional Power Force Structures* (Westport, CT: Praeger Publishers, 1997), José O. Maldifassi, and Pier A. Abetti, *Defense Industries in Latin American Countries: Argentina, Brazil, and Chile* (Westport, CT: Praeger Publishers, 1994), Ravi Ramamurti, *State-Owned Enterprises in High Technology Industries: Studies in India and Brazil* (New York, NY: Praeger Publishers, 1987), and David M. Schwam-Baird, *Ideas and Armaments: Military Ideologies in the Making of Brazil's Arms Industries* (Lanham, MD: University Press of America, Inc., 1997).

[40] Franko-Jones, 7-9.

[41] Madifassi and Abetti, 6.

Brazilian economy. However, they did not provide and adequate framework for examining the relationship of defense policy with Brazil's defense industry.

A range of descriptive articles published in both edited volumes and scholarly journals in the 1980s and 1990s examined the dynamics of the Brazilian defense industry. The common thread among these articles was to explain the growth, development, and contraction of Brazil's arms industry with particular emphasis of the national and international variables that propelled the industry's rapid development and successful export activities during the 1980s. While these studies mixed a variety of key political, economic, and cultural variables at both domestic and international levels of analysis to explain Brazil's defense industrial trajectory, some common themes emerged. Brigagão, Gouvea Neto, and Lock emphasized the importance of the alliance between state, private, and multinational capital as the base for Brazil's defense industry.[42] Barros, Brigagão, and Kapstein emphasized the importance of Brazil's arms industry and its exports for military involvement in Brazilian foreign policy and Brazil's increasing independence in global affairs.[43] Brigagão, Lock, Gouvea Neto, and Kapstein all highlighted the increasing need for more sophisticated technology in weapons systems as a key obstacle for export-oriented Brazilian defense firms.[44] All three of these themes are likely to apply to the contemporary period to a certain extent, so Brazilian defense policy will likely have directives and regulations that try address them.

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[42] Clóvis Brigagão, "The Brazilian Arms Industry," *Journal of International Affairs* 40, no. 1 (1986): 112; Raul de Gouvea Neto, "How Brazil Competes in the Global Arms Industry," *Latin American Research Review* 26, no. 3 (1991): 83-107; Raul de Gouvea Neto, "The Role of Transnational Companies in the Brazilian Defence Tripod," *Journal of Latin American Studies* 23 (1991): 573-597; Peter Lock, "Brazil: Arms for Export," in *Arms Production in the Third World*, Michael Brzoska and Thomas Ohlson, eds., (London: Taylor & Francis, 1986), 79-104.

[43] Alexandre de S. C. Barros, "Brazil," in *Arms Production in Developing Countries: An Analysis of Decision Making*, James Everett Katz, ed., (Lexington, MA: D.C. Heath and Company, 1984), 74; Brigagão, "The Brazilian Arms Industry," 101; Ethan B. Kapstein, "The Brazilian Defense Industry and the International System," *Political Science Quarterly* 105, no. 4 (1990-91): 586.

[44] Brigagão, 102; Gouvea Neto, "How Brazil Competes in the Global Arms Industry," 99; Gouvea Neto, "The Role of Transnational Companies in the Brazilian Defence Tripod," 579; Kapstein, 589; Lock, 99.

Two books among the literature provided particularly useful conceptual frameworks for examining the impact of Brazilian policy making and policy goals on defense industry autonomy and technological development efforts. Amit Gupta, while not seeking to offer a theoretical explanation of defense industrialization, provides a promising analytic framework to examine Brazilian defense industrialization efforts. Gupta sees three actors as key in the defense decision making process: 1) political leadership -- which I interpret broadly to include civilian decision-makers of ministerial rank and key members of congress); 2) the armed forces; and 3) the arms industries -- which I view as comprising a large portion of the defense industrial sector, including both private and publicly owned industries.[45] Gupta indicated these three sets of actors have very differing motives for getting involved in defense industrial decisions, as well as somewhat unequal bargaining capabilities. Motives and bargaining capabilities are shaped by two demand factors (threats and organizational ambitions) and two supply factors (availability of resources and existence of external suppliers).[46]

As I address my research question, Gupta's system of analyzing actors and the demand and supply factors conditioning their behavior may help draw distinctions between the national policy intentions aimed at developing domestic defense industry that are listed in Brazil's defense policy documents and the actual circumstances confronted by decision-makers in the contemporary cases I study.

Ken Conca also offers a useful framework to examine Brazilian defense industrialization. While his book's goal clearly is to provide a theoretical model to explain third world performance in defense industrialization efforts, he mixes two levels of analysis (domestic and international) and argues that, "Third World defense sectors sit at the intersection of domestic and international

[45] Gupta, 13-19.

[46] Gupta, 19-20.

structures."[47] Conca calls these structures "domestic politics" and "global markets" respectively, and he considers them critical because domestic political structures define who controls defense industrial policy, and international structures govern industry access to critical technology, investment capital or financing, and export markets.[48]

Conca's strategy for explaining defense industrial growth and decline in Brazil features an institutional focus centering on: 1) identifying the institutional core of roles, rules, and procedures present in the defense sector; 2) examining the defense sector's relationship with international and domestic structures and how they shape performance; and 3) observing whether the key institutions in the defense sector can adapt to structural change.[49]

While Conca has advanced several hypotheses about Brazil's experience in defense industrialization, I found his study's concepts and factors to be more relevant to my analysis of defense policy and defense industrialization. In particular, his discussion of how international structures govern access to technology, financing, and export markets are a useful tool to help gauge how autonomous Brazilian defense firms have become in the contemporary period. A scheme to help measure defense industry autonomy could be organized along these lines:

- The extent to which the Brazilian defense sector institutions can gain access to technology (both know-how and technological component hardware) from external source for production needs.
- The extent to which Brazil's industries can independently produce weapons systems or other military technology without inputs from outside sources.

[47] Ken Conca, *Manufacturing Insecurity: The Rise and Fall of Brazil's Military-Industrial Complex* (Boulder and London: Lynne Rienner Publishers, 1997), 9.

[48] Conca, 10-11.

[49] Conca, 13.

- The extent to which Brazil's industries can export military hardware to external markets or create spin-offs for internal and external markets, without outside interference from other nations.

Neither Gupta's nor Conca's study provided up-to-date defense industry data for Brazil. Neither study dealt with the contemporary set of actors present in the Brazilian milieu either. Despite their 1997 publication dates, the research for both books predates the formulation of the first Brazilian National Defense Policy in 1996 and the creation of the Brazil's Ministry of Defense in 1999. I believe that both of these developments have some impact on contemporary defense industrialization, and this makes my study unique, because it examines the past 12 years, following up on Gupta's and Conca's studies. Gupta's and Conca's methods of studying defense industry in Brazil offer, however, a fruitful approach to looking at the contemporary defense industrial landscape and to examine factors involve in the cases examined in this study.

Pursuit of Technological Autonomy and Technology Transfer

Finding contemporary academic studies dealing with Brazil's attempts at achieving technological autonomy, as well as the country's attempts to secure transfer of technology, was more difficult than locating literature for the other portions of this review. While a number of articles and some books addressed Brazilian goals to make its defense industry more autonomous, few did so with depth, most are from the 1980s and early 1990s, and none deal with Brazil's current efforts to revive its defense industry.

Rexford Hudson examined Brazil's maneuverings and mechanisms during the 1970s and 1980s to explain how the state sought to gain increasing technological independence for its aircraft industry. One key mechanism he observed the government using was joint ventures with terms favoring Brazilian firms instead of their foreign partners. The government also limited the percentage of foreign investment in these joint ventures and obligated foreign firms to co-produce

with a Brazilian partner or be cut out of bids for military contracts. Complete technology transfer was required, including design, engineering, and production planning services.[50]

Hudson also noted that the government enlisted licensing agreements as an early stage of the joint ventures. Brazilian firms assembled licensed technology first using components from its foreign partner, and then learning to produce the part itself, following an import substitution plan. Government rules demanded the Brazilian military purchase certain materiel that was manufactured in Brazil. Another supporting rule for the joint ventures and licensing agreements dictated that products produced in Brazil would be approved for export to third countries with no end-user restrictions.[51] The objective of all these measures was to gain access to technology and know-how and to nationalize it over time. Hudson claimed, however, that despite a significant percentage increase in Brazilian content for its aircraft, the main aeronautics manufacturers remained dependent on multinational corporations for key technological components.[52]

Besides employing mechanisms that helped transfer technology from abroad, the Brazilian military maintained robust research and development (R&D) efforts for weapons systems and other technology of use to the military to try and bolster increased autonomy. Renato Dagnino maintains that the basis for this effort historically was more linked to military concerns with Brazil's long term development than as a function of military defense. He argued that the wide ranging, technologically-intensive industrial pursuits that the military participated in during the 20th century – including metallurgy, petroleum, energy, telecommunications, and

[50] Rexford A. Hudson, "The Brazilian Way to Technological Independence: Foreign Joint Ventures and the Aircraft Industry," *Inter-American Economic Affairs* 37, no. 2 (1983): 24-28.

[51] Hudson, 24-28.

[52] Hudson, 38.

information technology – allowed military cadres to gain expertise and continue their R&D efforts with national scientific and technological development in mind.[53]

Dagnino maintains the key achievement of Brazil's arms industry during the 1960s and 1970s was not the concrete technologies transferred to the defense sector, but rather a technological approach concerned with development of human resources, which avoided the purchase of "black boxes,"[54] and which consequently allowed Brazilian engineers to harness components with differing characteristics in unique configurations of Brazilian design. Dagnino calls this approach an "innovation policy" and credits the military regime for its creation and integration within Brazil's state-owned enterprises.[55] While this approach helped Brazil overcome technological dependence in some areas, Dagnino was critical of military R&D, indicating it is inefficient, that internally generated technology spurred by military R&D rarely benefited the civilian sector, and that granting the service lavish R&D funding has generally "militarized" Brazilian S&T sector.[56]

Like Dagnino, Gamaliel Perruci argued that the Brazilian military industrial activities had little benefit for the civilian sector, with few spin-off products resulting from R&D or production efforts. He emphasized that during the late 1980s, as external arms markets became soft, Brazilian defense firms adjusted their production to incorporate more advanced technology in order to compete. Sources of this technology were either the Brazilian state or foreign suppliers, but military research budgets became scarce, so foreign technology transfer was usually the only option left for defense firms. Perruci indicates that many firms in Brazil's arms industry became dependent on foreign capital in order to avoid technological obsolescence in their production

[53] Renato Dagnino, "Brazilian S&T: To the Barracks or into the Labs? Military Programmes and Brazilian S&T Policy," *Science and Public Policy* 20, no. 6 (1993): 390.

[54] "Black Boxes" are closed technological systems that cannot be modified with a software source code or some type of reverse engineering to reveal their secrets.

[55] Dagnino, 391.

[56] Dagnino, 391-393.

efforts.[57] In order to keep pace with technology, defense firms had to increase their dependence rather than their autonomy.

Emanuel Adler's 1987 study highlights Brazil's past quest for increased technological autonomy in nuclear and computer technology during its period of military rule. His study examined the implications of self-reliance in science and technology as well as the modes of technology transfer that can help developing countries like Brazil move towards greater technological autonomy.[58] A checklist that Adler formulates on the implications of technological self-reliance is a useful reference for the Brazilian case, assuming that contemporary Brazilian policy objectives are subject to the obstacles that are presented throughout this chapter.

Adler also lists seven modes of technology transfer, including: 1) "technical assistance"; 2) "knowledge-generating capital equipment purchases"; 3) "acquiring rights to a foreign patent" or obtaining a "licensing agreement"; 4) local product assembly of imported parts; 5) "mixed operations" of locally produced and imported parts; 6) "complete local manufacture of the product"; 7) "joint ventures" – agreements to install a new productive capacity.[59] The modes of technology transfer are a useful reference for identifying how contemporary Brazilian defense sector entities attempt to obtain foreign technology and capital investments in the collective case study in chapters four and five.

Christian Catrina's study of conventional arms transfers focused even more deeply than Adler's on the strategies nations employ to avoid dependence on foreign suppliers and markets for weapons systems. Several concepts Catrina outlined appear useful for examining Brazil's activities. Among these concepts are 'recipient dependence" and "supplier dependence," which

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[57] Gamaliel Perruci, Jr., "The North-South Security Dialogue in Brazil's Technology Policy," *Armed Forces & Society* 21, no. 3 (1995): 375-378.

[58] Emanuel Adler, *The Power of Ideology: The Quest for Technological Autonomy in Argentina and Brazil* (Berkeley and Los Angeles: University of California Press, 1987), 50, 54-56.

[59] Adler, *The Power of Ideology*, 54-56.

apply to Brazil because the nation imports components for its own defense industry's products and also exports finished weapons systems to global markets.[60] Catrina specifies a number of strategies nations use to minimize recipient and supplier arms transfer dependence.[61] Assuming that Brazil's principal problem is with recipient dependence, and that defense sector decision-makers seek to reduce that dependence, examining Brazil's actions using Catrina's menu of recipient dependence strategies should provide insight into whether Brazil's current set of policies is enabling its defense industry to become more technologically autonomous. A slightly more detailed discussion of recipient dependence will be discussed in Chapter 4. Several of Catrina's specified strategies are likely employed among the rules and procedures that flow out of the Brazilian National Defense Policy's strategic directives. This will be analyzed in chapter four.

Each of the critiques from Hudson, Dagnino, and Perucci are important to consider when examining the contemporary defense policy, Brazilian defense industry pursuits, and the technological goals of each. Is industry still dependent on foreign technology? Have policies incorporated mechanisms to build increasing autonomy among Brazil's defense firms? These questions are as relevant today as when these authors examined them. Adler and Catrina provide tools to examine these questions.

Summary

This study of Brazil's national defense policy considerations, as they pertain to defense industrial activity and technological development in contemporary Brazil, aims to identify native capabilities and technologies being developed in the defense sector that could ultimately present threats or opportunities to the U.S. Government. This study is different from past studies of Brazil's defense industry because it examines defense policy as a variable and the Brazilian

[60] Christian Catrina, *Arms Transfers and Dependence* (New York, NY: Taylor & Francis, 1988), 167, 235.

[61] Catrina, *Arms Transfers and Dependence*, 307-321.

defense ministry as an actor in the process of Brazilian defense industrial development and autonomy. This is, perhaps, the first study in English to address this issue. The examined cases of technological development in Brazil's defense industry are also more recent than data available in the existing literature on this topic.

The first group of literature reviewed above identified Brazilian considerations in the technological realm that affect national defense strategy and the military's need for, and use of, technology for military preparedness. The second group of literature examined key works on Brazilian defense industry from the 1980s and 1990s, but identified a less than perfect fit with my study in terms the data examined and the variables focused upon. Two studies provided promising frameworks, however, for examining how the institutional actors operating at the national and international levels affect the way that defense industry develops in Brazil. The final group of literature identified promising categories and tools for analyzing Brazil's pursuit of more autonomous technological development, as well as its efforts to reduce dependence on conventional arms transfers to acquire military technology. The concepts and trends identified in this chapter play an important role in the analysis of two Brazilian defense industrial cases that were selected as the focus of research in following chapter, which took place over the 1995-2006 timeframe.

CHAPTER 3

METHODOLOGY

This chapter addresses the analytic framework used to examine the two military projects that compose the collective case study, what measurement scheme was used, how the data was researched, why specific technological cases were chosen, and what limitations were encountered during the application of the analytic framework to the data.

Analytic Framework

This thesis is a qualitative study that analyzed the data by looking for the presence or absence of specific features in the data for each technological case reviewed. The study compared each case's actual developments by attempting to correlate the behavior of decision-makers (political, military, industry) to what defense policy directives dictate. The study employed elements of analytic approaches identified in the literature review, based on the studies by Amit Gupta and Ken Conca on defense industrialization, by Emanuel Adler on strategies for technological autonomy, and by Christian Catrina on avoiding conventional arms transfer dependence.

Their studies provided insight into how to organize details of the collective case study and categorize the data to identify patterns. The cases were analyzed looking for the application of specified strategies by defense industry to achieve autonomy, whether defense policy shaped their behavior, and whether they were supported by state actors. The cases were scrutinized for military service decisions on acquisition planning, whether such planning tracked with policy

directives, and whether actions the services took helped defense industry achieve defense policy goals. Much of the data is displayed in matrices and tables for comparisons across the collective case study.

This study used the factors identified in the literature review to ascertain whether defense policy made a difference in industrial activities – an if not why not. The factors identified in the literature review were:

- Technological and planning parameters delimiting Brazilian defense strategy considerations;
- Demand and supply factor impact on political, military, and industry actor motives and bargaining capabilities;
- Institutional roles, rules, and procedures present in the defense sector; access to technology, financing, and export markets;
- Seven modes of technology transfer;
- Recipient dependence strategies.

Data Collection and Exploitation

The data collected for this study consisted principally of public documents and press releases made available through World Wide Web sites maintained by the Brazilian government, including the Brazilian Congress, several government ministries, the military services, and other subordinated agencies that have responsibility for auditing, official record keeping, and interface with the Brazilian private sector. The Brazilian public documents were supplemented with a variety of other documents, mostly available through the Internet. These included Brazilian media reports, articles from Brazilian periodicals, academic or trade journals, minutes and briefings from specialized conferences, reports from international organizations and non-

governmental organizations, selected U.S. government records and filings, and public announcements by private sector firms involved in defense industrial activities.

The explosion of data available through the Internet since the mid 1990s has greatly increased the reach and access of U.S. researchers into Brazilian public records. An underlying assumption of this study is that the data analyzed and cited from Brazilian official sources faithfully represents the best efforts on the part of the Brazilian institutions that produced them to capture reality in the official record. In order to hedge against possible distortions in the official record, multi-source corroboration from a variety of sources was employed to buttress the veracity of certain public information.

The data collection efforts were deliberately bounded between 1995 and 2006, coinciding with Brazil's past three administrations. This was done partially because the data set available for analysis was fairly rich and relatively easy to uncover with proper employment of key word searches in Portuguese and a basic understanding of Brazilian government institutions and their functions. In order to fully explain processes and policies already in place during this bounded period, treating the time frame before 1995 was necessary in some cases, but the period of examination overwhelmingly falls within the 1995-2006 period.

The data exploited were mainly written in Portuguese. Any translated text of Portuguese language documents included in this study was performed by the author, unless otherwise noted. Interpretation of cited Portuguese language documents was based on the author's knowledge of this language, as well as his interpretation of their stated purpose and the contexts they were generated within.

Measurement Scheme

The first hypothesis examined asserted that Brazil's defense policy compels the military to seek national solutions to its procurement needs in order to stimulate autonomous technological development in support of the private sector before it can seek external solutions

for equipment and weapons systems needs. Measurement of the degree of compliance by the military to stated guidance requires an explanation of the policies in place over the studied period (1995-2006) and how the military incorporated these policies' directives into military R&D and procurement activities. In addition, an examination of the supply options that are considered by military and defense ministry decision makers in their planning processes for both weapons technology development and operational fielding of the technology is needed. This measures the constraints that decision makers face, especially when domestic procurement options are limited.

Evidence of the degree of service compliance can be measured by examination of the content of public statements from those involved in the decision process, by inspection of the content of technical reports that audit institutional compliance with rules and law, and by analysis of congressional oversight of budget allocations devoted to military programs. The level of actual Brazilian technological content in the cases was examined with a goal of determining whether the military truly maximized industry participation. Evidence of constraints on decision makers can be derived from these same sources, as well as press accounts, presentations in public and private forums such as symposiums and conferences, and academic studies that have examined similar phenomena.

Stimulation of autonomous development may be measured by:

- The extent to which the Brazilian defense sector institutions can gain access to and exploit technology (both know-how and technological component hardware) from external sources for production needs.
- The extent to which Brazil's industries can independently produce weapons systems or other military technology without inputs from outside sources.
- The extent to which Brazil's industries can export military hardware to external markets or create spin-offs for internal and external markets, without outside interference from other nations.

The second hypothesis in Chapter 1 contends that the defense industrial sector influences the shape and content of the nation's defense policy through its interaction with the defense and political leadership. The extent of interaction and influence may be measured by examining the presence and participation of defense industry actors at events sponsored by the defense ministry to revise its defense policies, particularly those that have implications for the defense industrial sector, and at congressional hearings where defense industrial activities are reviewed. A comparison of private sector presentations and their problem definitions at these events with subsequently issued defense guidance provides insight into the level of influence that private sector defense firms and their industrial lobbying allies had on the defense ministry. Interaction and influence may also be measured by documented meetings between political leadership and defense industry leaders and the results of those meetings.

Diagnostic Quality and Technological Case Selection

In order to examine of the relationship between defense policy and defense industry pursuits in Brazil, several guiding parameters were fashioned to guide the case selection. The long-term nature of many military R&D programs, production plans, and procurement processes guaranteed that many cases of industrial activity fell outside of the timeframe examined. Selecting a representative sample with appropriate diagnostic quality, when so many individual defense-related technological development projects existed, was difficult. Since the PDN only emerged in 1996, cases were selected adhering to the following criteria:

- The technology that the defense industry is developing, or that military was acquiring, was ostensibly linked to a military mission, objective, or directive, as listed in the 1996 or 2005 National Defense Policies.
- The industrial case studied featured developments mainly during 1995-2006 to establish a connection to the past three governments.

- Projects featuring technology of concern to the U.S. Intelligence Community were emphasized. Technology sought or developed by Brazilian industry in each case was listed on the Military Critical Technologies List and strengthened a military capability that could be used against the United States in a conflict or exported to other nations that are hostile to the United States.

Military technology projects featuring command, control, and communications, computers, intelligence, surveillance, and reconnaissance (C^4ISR) systems and light attack aircraft were chosen. The first project, the Amazon Surveillance System (SIVAM), featured contracts dating back to 1995, with installation of the system occurring over the 1997-2006 timeframe. SIVAM was a large-scale project featuring C^4ISR systems and environmental systems, with Brazilian defense industrial efforts concentrating principally on systems integration and software development activity. The second project was the Air Force's AL-X light attack aircraft program. The initial contract for development of this aircraft was signed in 1995 and as of the date of this thesis, production continues.

Both of these cases feature the Brazilian Air Force in the principle role as the military actor of focus, and consequently the study has a heavily bias towards Air Force procedures, norms, and technological considerations. Ideally a study of this nature would feature technological cases from all three services in order to achieve better balance. However, Air Forces of any nation tend to be the military service employing weapons systems of the highest technological sophistication, and in Brazil's case the aerospace industry is the leading sector for concentration of technology among Brazil's defense industrial base. The cases were selected, in part, because no prior study of the industrial aspects of these cases is available in English. The time frame for these cases is more up-to-date and currently relevant than other cases that have

been focus of the scholarly literature on defense industrialization in Brazil, since most major studies were written before the defense ministry was created in Brazil.

Limitations on Available Data

This study is based entirely on written documentation. While a great deal of data existed, the author was unable to augment this data with personal interviews. Ideally, interviews with Brazilian government actors, private and public sector defense firm actors, and military decision-makers would augment the data examined and provide a means of clarifying ambiguous data, filling in gaps in the data, and providing a high quality means of triangulation of the data. Performing such interviews was determined by the author to be unfeasible within the timeframe allocated for completion of the thesis.

The written record on the two technological cases examined was necessarily assembled in a piecemeal manner. Governments rarely make the full story of their defense sector activities completely transparent, and the Brazilian government was no different in this instance. Taking a piecemeal approach to data collection and exploitation has distinct limitations. The documents reviewed in this study did not include certain proprietary data such as contracts, internal records, and other data considered confidential by public and private sector actors involved in weapons and technology transactions. Consequently, the data sets examined were not perfect and absolute certainty about certain conclusions is impossible.

In applying the data to the analytic framework and measurement schemes, an attempt at thoroughness, evenness, and consistency was the ultimate goal. In the case of the SIVAM project, the data was more plentiful because of the intense public scrutiny of the project, particularly by the Congress and the National Accounting Tribunal (TCU). A portion of the written documentation on the SIVAM project from both government and industry sources is not currently available on the Internet, but the author maintained copies of the data, which was gathered during field research in Brazil in 1995 during a previous graduate program. The AL-X

program did not have as rich a documentary base available to the public given the project's less controversial nature and fewer numbers of actors involved in the program's development. Less controversy meant less attention from the Congress and the TCU. These factors help explain discernable gaps and variation in the documentary base of the data sets.

CHAPTER 4

DEFENSE POLICY, MILITARY PLANNING, AND DEFENSE PROCUREMENT

This chapter's purpose, in conjunction with Chapters 5 and 6, is to address three of the five key questions identified at the beginning of this study. The questions include: How closely have the military decision makers followed defense policy directives and other guidance to define technology needs to accomplish their missions? What range of supply options did military decision makers and the defense leadership consider when planning to acquire needed systems and technology? What explicit rules and mechanisms derived from the defense policy helped or hindered the national defense industry's ability to secure military orders and pursue R&D opportunities for this project? The remaining key questions will be addressed in Chapter 7.

This chapter seeks to explore some of the documents that the Brazilian defense ministry, military services, and defense industrial base use to orient their planning for both domestic and external procurement decisions and for research, development, and production of weapons systems. Many documents were issued or in force over the 12 years this study covers. Only by examining the content of several of these documents can one determine whether defense guidance has addressed some of the theoretical concerns of analysts in Chapter 2.

Therefore, this chapter presents the findings of a document content review with these concerns in mind. A temporal examination juxtaposes the timing of policy guidance with key milestones of the technological projects examined. A summary of how the two technological cases match up in supporting stated defense directives is also presented to provide baseline for more detailed examination in following chapters. Key policies and norms are also discussed in

conjunction with the defense ministry's military planning cycle and matched up against elements of the analytic framework identified in Chapters 2 and 3 to identify whether certain author's arguments still hold together today.

Developments in Defense Policy, Strategy, and Doctrine

Chapter 2 noted that several analysts have argued that Brazilian defense policy was poorly developed and lacked many clarifying guidelines to direct military procurement activities, military technological research and development, and corresponding defense industrial activities. The analysts also asserted that Brazil's lack of codified joint doctrine fostered service independence and worked against harmonization of service R&D and procurement activities, as well as coordinated operational activities using common technological solutions. This section aims to examine whether these arguments are still valid.

Table 4-1 provides a chronological list of pertinent policies issued by the Presidency, the military services, the Armed Forces General Staff, or the Defense Ministry that were in force during the 1995-2006 timeframe, which pertain to these arguments. Table 4-1 also offers significant milestones in each of the technological cases examined in order to provide a temporal reference between the cases and the policies that were in effect at the time. Table 4-1 demonstrates that both the SIVAM project and the AL-X program have origins that far precede the publication of Brazil's first National Defense Policy.

Date	Law/Policy/Regulation/ Norm	Approving Institution	Political Milestones	Technological Case Program Milestones
21-Sep-1990				Exposition of Motives for SIVAM/SIPAM projects presented to President Fernando Collor de Melo
18-Dec-1991	Portaria No. 853/GM-2 - Air Force Offset Policy	Aeronautics Ministry		
25-May-1992	Portaria No. 1808/SC-6 - Armed Forces S&T Policy (FA-E-01/92)	Armed Forces General Staff		
21-Sep-1992	Portaria No. 747/GM-2/Air Force Offset Directive	Aeronautics Ministry		
1-Mar-1993	Portaria No. 431/SC-1 - Brazilian Military Policy (FA-E-01/89)	Armed Forces General Staff		
21-Jun-1993	Law Nº 8.666 - Regulates Art. 37, paragraph XXI, of the Federal Constitution, institutes norms for public bids and contracts for Public Administration and gives other provisions	Presidency of the Republic		
11-Aug-1993				National Defense Council waived public bidding process for SIVAM project and ordered immediate commencement of the project
12-Aug-1993	Decree No. 892 - Defines the orientation for the process of installing the Amazon Surveillance System	Presidency of the Republic		
18-Jul-1994				Raytheon Co. led consortium selected as winning bidder for SIVAM project
1-Jan-1995			President Fernando Henrique Cardoso Inaugurated	
27-May-1995				Raytheon Co. signed SIVAM Contract with Brazilian Government
18-Aug-1995				Embraer awarded AL-X R&D Contract

29-Mar-1996	Portaria No. 972/CISMC2 - Policy of Electronic Warfare for the Armed Forces (FA-E-01/96)	Armed Forces General Staff		
31-May-1996	Portaria No. 1925/CISCOMIS - Directive for the Installation of the Basic Structure for the System of Military Communications by Satellite	Armed Forces General Staff		
7-Nov-1996	National Defense Policy	Presidency of the Republic		
1-Jan-1999			President Fernando Henrique Cardoso Inaugurated for 2nd Term; Elcio Alvares appointed as Extraordinary Minister for Defense	
10-Jun-1999			Defense Ministry Created	
24-Jan-2000			Geraldo da Cruz Quintao appointed as Defense Minister	
15-Mar-2001	Portaria No. 188/MD - Defense Policy for the Area of Science & Technology	Ministry of Defense		
27-Mar-2001	Portaria Normativa No. 214/MD - Basic Doctrine for Operation of Command & Control Centers of the Military Command & Control System (MD31-M-02)	Ministry of Defense		
27-Mar-2001	Portaria Normativa No. 215/MD - Policy for the Military Command & Control System (MD31-P-01)	Ministry of Defense		
2-Apr-2001	Portaria Normativa No. 227/MD - Project for Development and Installation of the Military Command & Control System (PRODISMC)	Ministry of Defense		
31-Jul-2001	Portaria Normativa No. 414/MD - Military Doctrine of Defense (MD33-M-04)	Ministry of Defense		
8-Aug-2001				Brazilian Air Force contracted with Embraer for production of 76 AL-X aircraft with an option for 23 more
19-Sep-2001	Portaria Normativa No. 593/MD - Plan for Development and Installation of the System of Military Communications by	Ministry of Defense		

	Satellite			
26-Nov-2001	Portaria Normativa No. 740/GABINETE - Science & Technology Policy of the Armed Forces	Ministry of Defense		
7-Jan-2002				Elbit Systems of Israel contracted by the Brazilian Air Force to supply avionics for the AL-X aircraft
7-May-2002				Rohde & Schwarz of Germany contracted by the Brazilian Air Force to supply 152 datalink systems/software radios for the AL-X program, with another 46 units to follow
19-Jun-2002	Portaria No. 349/MD - Creation of the Commission for the Installation of the Secure Communications System (CISECOS)	Ministry of Defense		
25-Jul-2002				SIVAM initial operational capability celebrated by President Fernando Henrique Cardoso in Manaus
24-Oct-2002	Portaria Normativa No. 614/MD - Doctrine of Military Logistics	Ministry of Defense		
26-Nov-2002	Science, Technology and Innovation: Proposal of Strategic Directives for National Defense	Ministry of Defense and Ministry of Science and Technology		
20-Dec-2002	Portaria No. 754/GABINETE - Military Strategy of Defense (MD50-D-01)	Ministry of Defense		
20-Dec-2002	Portaria No.755/GABINETE - Military Policy of Defense (MD50-P-01)	Ministry of Defense		
23-Dec-2002	Portaria No. 763/MD - Strategic Orientations of the Ministry of Defense	Ministry of Defense		
27-Dec-2002	Portaria Normativa No. 764/MD - Policy and Directives for Commercial, Industrial, and Technological Compensation of the Ministry of Defense	Ministry of Defense		
1-Jan-2003			President Luiz Inacio Lula da Silva Inaugurated; Jose Viegas Filho appointeed as Defense Minister	

9-Apr-2003	Portaria Normativa No. 299/MD - Sectoral Directive for Military Mobilization (M51-D-01)	Ministry of Defense		
18-Dec-2003				Embraer delivered the first of 76 units of the completed AL-X aircraft to the Air Force for testing
26-Mar-2004	Portaria Normativa No. 333/MD - Policy of Electronic Warfare for Defense (MD32-P-01)	Ministry of Defense		
26-Apr-2004	Portaria Normativa No. 447/MD - Policy of Remote Sensing for Defense	Ministry of Defense		
6-Aug-2004				Air Force received its first 3 operational A-29 AL-X Super Tucano aircraft after quality certification by CTA
4-Nov-2004	Portaria Normativa No. 1317/MD - Policy of Science, Technology, and Innovation for National Defense	Ministry of Defense		
8-Nov-2004			Vice President Jose Alencar appointed as Defense Minister	
30-Jun-2005	Decree No. 5.484 - National Defense Policy	Presidency of the Republic		
19-Jul-2005	Portaria Normativa No. 899/MD - National Policy for Defense Industry - PNID	Ministry of Defense		
22-Jul-2005				Final SIVAM equipment components installed marking completion of the system
24-Aug-2005	Portaria No. 998/SPEAI/MD - Systematization of Military Strategic Planning (MD51-M-01)	Ministry of Defense		
30-Nov-2005	Portaria No. 1320/MD - Creation of the Commission for the Installation of the Program of Development and Implementation of Military Command & Control System (PDI-SISMC2)	Ministry of Defense		
13-Dec-2005	Portaria No. 1.395/GC4 - Policy and Strategy of Commercial, Industrial, and Technological Compensation for Aeronautics (DCA 360-1)	Aeronautics Command		

13-Dec-2005	Portaria No. 1.397/GC4 - Precepts for the Negotiation of Commercial, Industrial, and Technological Compensation Accords for Aeronautics (ICA-360-1)	Aeronautics Command		
6-Mar-2006	Portaria No. 281/EMD/MD - Internal Rules of the Commission for the Installation of the Program of Development and Implementation of Military Command & Control System (CISMC2)	Defense General Staff		
31-Mar-2006			Waldir Pires appointed as Defense Minister	
3-Apr-2006				Amazon Protection System General Coordination Center opened in Brasilia
24-Apr-2006	Portaria Normativa No. 586/MD - Strategic Actions for the National Policy for Defense Industry	Ministry of Defense		
24-Apr-2006	Portaria Normativa No. 571/MD - Policy of Remote Sensing for Defense (MD32-P-02)	Ministry of Defense		
7-Dec-2006	Portaria Normativa No. 1.780/MD - Creation of the Commission for the Installation of the Tactical Datalink System	Ministry of Defense		
27-Dec-2006	Portaria No. 578/GABINETE/MD - Military Strategy of Defense (MD51-M-03)	Ministry of Defense		
11-Jan-2007	Portaria Normativa No. 1.890/MD - Policy for Defense Logistics (PLD)	Ministry of Defense		

Table 4-1: Chronology of Significant Defense Guidance and Project Milestones.

Sources: Ministério da Defesa and Author's Analysis.

Table 4-2 provides a listing of the 1996 and 2005 PDN directives and their linkages to the activities associated with the two technological cases in the R&D, technology transfer, military operations, or foreign policy realms. Given the two cases' origins before the publication of the PDN in 1996, the inter-ministerial working group that drafted the original document may have been attempting to ratify or justify existing defense plans and programs, capturing each service's

parochial priorities at the time the document was drafted.[62] Regardless, drafting a PDN from scratch and ignoring the existing defense technology projects would be unrealistic, especially since each project examined had serious strategic thought underlying it.

1996 PDN Directives	Case: AL-X	Case: SIVAM	**2005 PDN Directives**	Case: AL-X	Case: SIVAM
a. Contribute actively to the construction of an international order based on the rule of law, which provides regional and worldwide peace, as well as the sustainable development of humanity.	√	√	1. Maintain strategic forces in immediate-use conditions, for solving conflicts.		
b. Participate increasingly in the significant international decision-making processes.			2. Have military means capable of safeguarding Brazilian persons, goods, and resources abroad.		
c. Improve and increase Brazil's negotiating capabilities in the international scene.			3. Improve the command and control capability and that of the intelligence system of the organizations involved in National Defense.		√
d. Promote the Brazilian position in favor of global disarmament, contingent upon the dismantling of stockpiles of nuclear weapons, and other weapons of mass destruction, through a process agreed to multilaterally.			4. Increase interoperability between the Armed Forces, expanding joint use.	√	√
e. Participate in international peacekeeping operations, in accordance with national interests.			5. Improve the surveillance, control, and defense of the borders, the jurisdictional waters, and the airspace of Brazil.	√	√
f. Contribute actively to the strengthening, expansion, and consolidation of regional integration.	√	√	6. Increase the military presence in the strategic areas of the South Atlantic and the Brazilian Amazon Region.	√	√
g. Take actions to maintain a climate of peace and cooperation along all of Brazil's borders and to foster solidarity within Latin America and in the South Atlantic region.	√	√	7. Ensure sufficient and continuous funds that provide effective conditions for preparation and use of the Armed Forces and other organizations involved in National Defense, in harmony with the nation's political-strategic stature.		
h. Expand exchange programs with the Armed Forces of friendly nations.			8. Perfect processes for the management of crises of a political-strategic nature.		√
i. Maintain the participation of the Armed Forces in support activities with the aim of national integration, civil defense, and the social and economic development of Brazil, in harmony with their constitutional mission.		√	9. Set up the National Mobilization System and improve military logistics.		
j. Protect the Brazilian Amazon, with the support of all of Brazilian society, and with a high value given to the military presence.	√	√	10. Protect the maritime communication lines of vital importance to the nation.		
l. Give priority to actions for the development and reinvigoration of the strip of land along Brazil's borders, especially in the northern and central western regions.		√	11. Have a structure capable of contributing to the prevention of terrorist attacks and conducting counterterrorism operations.		
m. Improve the organization, matériel, training, and coordination of the Armed Forces, ensuring that they have the wherewithal, the organizational means and the professionally-qualified personnel to fulfill their constitutional mission.			12. Perfect the security arrangements and procedures that reduce the vulnerability to cybernetic attacks of the systems related to National Defense and, if need be, enable their fast recovery.		
n. Enhance the command, control and intelligence capabilities of all entities involved in national		√	13. Strengthen the infrastructure of strategic value to National Defense, especially that of		√

[62] The inter-ministerial working group was made up of the Secretary for Strategic Affairs, the Minister of Justice, and the Minister of Foreign Relations on the civilian side and the Chief of the Presidential Military Household, the Minister of the Armed Forces General Staff, and the Ministers of the Air Force, Army, and Navy on the military side. See Senado Federal/Subsecretaria de Informações, *Decreto No. 1.895, de 6 de Maio de 1996 – Cria a Câmara de Relações Exteriores e Defesa Nacional, do Conselho do Governo*, 6 May 1996, URL: <http://www6.senado.gov.br/legislacao/ListaPublicacoes.action?id=143331>, Accessed on 4 June 2007.

defense, providing to them means to facilitate the decision-making process, both during peacetime and in situations of conflict.			transportation, energy and communications.		
o. Enhance the system for surveillance, control and defense of Brazil's borders, airspace, continental shelf, and the waters under its jurisdiction, as well as maritime and air traffic.	√	√	14. Promote the interaction of other governmental policies with the National Defense Policy.	√	√
p. Guarantee resources that are sufficient and continuous to provide the means for effective preparedness of the Armed Forces and all other entities involved in national defense.			15. Implement actions for developing and integrating the Amazon Region, with support of the public, aiming especially at developing and bringing the border strip to life.		√
q. Strengthen the national transportation, energy and telecommunications systems.		√	16. Promote public awareness-raising on National Defense matters.		
r. Seek a level of scientific research, technological development and production capacity that will minimize this country's dependence on foreign sources for strategic resources that are needed for its defense.	√	√	17. Stimulate scientific research, technological development, and the capability to produce materials and services of interest to defense.	√	√
s. Promote scientific knowledge of the Antarctic region and an active Brazilian participation in the decision-making process about its future.			18. Increase the interchange of the Armed Forces among themselves and with universities, research institutions, and industries in the areas of interest to defense.	√	√
t. Enhance the Mobilization System in order to meet this country's needs, when forced to become involved in an armed conflict.		√	19. Act to maintain the climate of peace and cooperation in the border areas.	√	√
u. Stimulate and inform public opinion, with the aim of creating and maintaining a National Defense consciousness, by means of encouraging patriotism and dedication to the motherland.			20. Increase the interchange of the Armed Forces with friendly nations, particularly those of South America and those of Africa bordering the South Atlantic.	√	√
			21. Contribute actively to the strengthening, expansion, and consolidation of regional integration with emphasis on the development of a defense industrial base.	√	√
			22. Participate actively in the decision processes on the fate of the Antarctica region.		
			23. Have the capability to project power, aiming at possible participation in operations established or authorized by the UN Security Council.		
			24. Create new partnerships with countries that can contribute to the development of technologies of interest to defense.	√	√
			25. Participate in peacekeeping missions and humanitarian actions, according to the national interests.		
			26. Participate increasingly in the important international decision-making processes, improving and increasing Brazil's negotiation capability.		

Table 4-2: Defense Policy Directive Linkages to Technological Development Projects.

Sources: Brazilian Embassy in Washington, DC, (b) (3) , and Author's Analysis.

Slight differences exist between the two cases examined in Table 4-2. The two PDNs were published nine years apart, which has an impact on some directive linkages to each case. Evolution in the military's approach to dealing with the Amazon region developed along with the movement of Army units to Boa Vista and Tefé in the mid 1990s, the new legal requirement

stemming from a Shoot-Down Law passed in 1998, and a refined perception of threat, as introduced in Chapter 1, buttressed by new doctrine and strategy.

A better defined process for matching each service's strategic needs to anticipated threats may be another reason for the differences. On 31 July 2001, the Defense Ministry issued the "Military Doctrine of Defense" (DMD), the first basic joint doctrine for organization, training, and employment of Brazil's three services. Besides providing a common language and conceptual base for defense planning, the document laid out the different strategies that could be used for joint operations in defense of the country and explained how contingencies should ideally be matched up with strategic actions.[63] These contingencies, known as "Employment Hypotheses" (Hipótese de Emprego), and the "Political-Strategic Scenarios" they respond to were defined in the classified "Military Strategy of Defense" (EMiD) and "Military Policy of Defense" (PMD), both issued in December 2002.[64]

In August 2005 the Defense Ministry codified its planning cycle in the "Systematization of Military Strategic Planning," which starts at the national level with guiding documents like the Constitution, complementary laws, and other pertinent legislation. The output at this level is the PDN, which guides ministerial ("sector") level planning that ultimately produces documents like the DMD, PMD, EMiD, and strategic plans for military employment. At the ministerial level the DMD, PMD, and EMiD provide the basic guidance, but they are complemented by an assessment of the national and international situations, performed by the ministry and its intelligence service, examining the potential affect of these situations on Brazilian interests or in generating crises

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[63] Ministério da Defesa, *PORTARIA NORMATIVA Nº 414/MD – Dispõe sobre a Doutrina Militar de Defesa*, (Brasilia, DF: Gabinete do Ministro, 31 July 2001), URL: <https://www.defesa.gov.br/bdlegis/dados_norma.php?numero=2&ano=2001&serie=A>, Accessed on 15 December 2006.

[64] Ministério da Defesa, *PORTARIA Nº 755/GABINETE – Dispõe sobre a Política Militar de Defesa*, (Brasilia, DF: Gabinete do Ministro, 20 December 2002), URL: <https://www.defesa.gov.br/bdlegis/dados_norma.php?numero=755&ano=2002&serie=A>, Accessed on 15 December 2006; Ministério da Defesa, *PORTARIA Nº 754/GABINETE – Dispõe sobre a Estratégia Militar de Defesa*, (Brasilia, DF: Gabinete do Ministro, 20 December 2002), URL: <https://www.defesa.gov.br/bdlegis/dados_norma.php?numero=754&ano=2002&serie=A>, Accessed on 15 December 2006.

requiring military action. The output of this process is a series of "Prospective Scenarios" which are estimative in nature and are used by the Armed Forces at the service ("sub-sector") level to evaluate and help define their force configuration, their science and technology plans, their procurement plans, their logistic support plans, their training and educational plans, and their budget needs.[65]

Table 4-1 lists some of the steady stream of defense guidance that has flowed from the Defense Ministry since its creation. Common policies and doctrine guiding science and technology, command and control, defense logistics, electronic warfare, strategic military planning, military mobilization, national defense industry, secure communications by satellite, and many other areas pertaining to operations have been established.[66] These developments would seemingly challenge past criticisms of the defense sector's non-existent joint planning activities.

In fact, the policies and norms listed in Table 4-1 can be broken into the four categories outlined by Thomaz Guedes da Costa, which were introduced in Chapter 2. In the "discourse" category Costa was concerned with Brazil's lacking declaratory official documents about national defense and the inclusion of societal debate in their shaping. Both the 1996 and 2005 PDN documents fall into this category, and while the first of these two documents did not include significant civil society input, the 2005 version went through two iterations of domestic expert panels and debate cycles featuring civil society actors during 2000-2004, before publication.[67]

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[65] Ministério da Defesa, *PORTARIA Nº 998/SPEAI/MD – Sistemática de Planejamento Estratégico Militar - MD51-M-01*, (Brasilia, DF: Gabinete do Ministro, 24 August 2005), URL: <https://www.defesa.gov.br>, Accessed on 15 September 2005; Ministério da Defesa, "PORTARIA No. 1.796/SPEAI, DE 13 DE DEZEMBRO DE 2006 - Aprova a Diretriz ao Núcleo de Controle para Monitoramento de Cenários Prospectivos do Ministério da Defesa e dá outras providências," *Diáro Oficial da União* Nº 241, 18 December 2006.

[66] The Brazilian Defense Ministry World Wide Web site has a searchable database of legislation, internal norms, doctrine, and regulations that apply to the three military services, the defense industrial sector, and the ministry itself, available at <https://www.defesa.gov.br/bdlegis/>.

[67] Ministério da Defesa, *Reflexões Sobre Defesa e Segurança : Uma Estratégia Para o Brasil*, eds., J.R. de Almeida Pinto, A.J. Ramalho da Rocha, R. Doring Pinho da Silva (Brasília : Ministério da

Some of the directives from the PDN documents may seem vague, but they are strategic level documents and the details from many derivative policies, rules, norms, and doctrine spell out Brazil's defense plans in greater detail, as can be expected.

At the next level down, the PMD and the EMiD define the hypotheses of employment at the strategic level. It is hard to evaluate whether these documents satisfy Costa's conceptual category of "employment" since the documents are classified and not publicly available. While discussing this category, Costa identified four angles to examine employment questions: security dilemmas, collective security, technology transfer, and territorial integrity.[68] The Systematization of Military Strategic Planning and the Doctrine of Military Defense make it clear that hypothetical threat scenarios exist and the Armed Forces use them in their planning cycle. Yearly exercises conducted by the military clearly show their planning for a variety of defenses of the nation's territorial integrity.[69] Less clear is whether the defense ministry's employment hypotheses account for security dilemmas that Brazil could provoke by its weapons development and acquisition activities, Brazil's treaty-based collective security obligations, or anxieties over Brazil's technology transfer ambitions and practices.

Costa's category of "preparation," which stresses common military doctrine, training, and C³I systems, has certainly received attention from the Defense Ministry. While during most of Brazil's history the Armed Forces have operated independently, the pace of technological change

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Defesa, Secretaria de Estudos e de Cooperação, 2004); Ministério da Defesa, *O Brasil No Cenário Internacional de Defesa e Segurança,* eds., J.R. de Almeida Pinto, A.J. Ramalho da Rocha, R. Doring Pinho da Silva (Brasília : Ministério da Defesa, Secretaria de Estudos e de Cooperação, 2004); Ministério da Defesa, *As Forças Armadas e o Desenvolvimento Científico e Tecnológico do País,* eds., J.R. de Almeida Pinto, A.J. Ramalho da Rocha, R. Doring Pinho da Silva (Brasília : Ministério da Defesa, Secretaria de Estudos e de Cooperação, 2004); Câmara dos Deputados, *Comissão de Relações Exteriores E Defesa Nacional/ Amazônia e de Desenvolvimento Regional - Audiência Pública Nº: 0860/00 - Esclarecimentos Sobre Prioridades, Diretrizes e Planos de Trabalho do Ministério da Defesa*, (Brasilia, DF: Departamento de Taquigrafia, Revisão e Redação, 10 August 2000): 9.

[68] Costa, "Política de Defesa: uma discussão conceitual e o caso do Brasil," 114-116.

[69] A summary of independent and joint exercises performed each year by the military services is typically reported in the yearly publication *Balanço Geral da União*, issued by the Presidency's Controller-General of the Union office.

(as Flores has argued, see Chapter 2), has compelled the ministry to issue concrete guidance for joint operations and integrated command, control, communications, and intelligence systems as the battle space has contracted. As early as August 2000, Defense Minister Geraldo Quintão indicated that his ministry was undertaking studies to integrate the three military services' technology.[70] Much of the subsequent guidance stressing integration is apparent in Table 4-1, such as the orders, policies, and doctrine dealing with the Military Command and Control System (SMC2), the Military Communications by Satellite System (SISCOMIS), the Secure Communications System (SECOS), the Tactical Data-link System (SISTED), and the common policies for electronic warfare, remote sensing, science and technology, logistics, and mobilization. Investments in improving and linking the services separate systems are ongoing. The Armed Forces are increasingly conducting joint exercises using these new guidelines and doctrinal modifications. In the discussion that follows on SIVAM, these changes will be elaborated on.

Costa's final category, "acquisition," gets to the crux of this study's main concern – defense industrialization. Costa argued that societal debate about the degree of support for domestic defense industry and nationalization of weapons system production would be a critical component of a defense policy and strategy.[71] Brazil's defense ministry has sponsored at least two iterations of this debate since 2002, with a National Meeting for Military Logistics in March 2002 and two "Cycles of Debates" on defense industry and scientific and technological development in March and April 2004.[72] During these sessions, both private sector defense firms

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[70] "Entrevista: 'A capacitacão militar é relevante' – O Ministro da defesa fala à Tecnologia & Defesa," *Tecnologia & Defesa*, *NOTIMP No. 147*, 3 August 2000, URL: <http://www.fab.mil.br/imprensa/enotimp/>, Accessed on 3 August 2000.

[71] Costa, "Política de Defesa: uma discussão conceitual e o caso do Brasil," 117-118.

[72] Ministério da Defesa, *As Forças Armadas e o Desenvolvimento Científico e Tecnológico do País*; Ministério da Defesa, "A Logísitica Militar Brasileira: Visão Prospectiva," Briefing given by General Joélcio de Campos Silveira at the 1st National Meeting for Military Logistics, 6 March 2002, URL: <http://www.defesa.gov.br/Site_DPE/palestra_GenJoelcio.html>, Accessed on 9 May 2002; Defesanet,

and members of the academic sector were involved. Table 4-1 indicates that shortly after these events, the Brazilian Defense Ministry published significant guidance in for the military's logistic support and S&T activities. After the cycle of debates held during Defense Minister José Viegas' tenure, the defense ministry refined and issued its first-ever National Policy for Defense Industry in mid 2005, which built upon the previous defense minister's groundwork in this area.[73]

Given the abundance of defense guidance published since the Brazilian Defense Ministry was created, it appears on the surface that some of the concerns about undeveloped Brazilian defense policy have been addressed by the government. Publication of norms, policies, strategies, directives, orders, and instructions are an obvious consequence of the creation of a new bureaucracy. In order to see whether they have effectively taken root, and whether the military services are following their mandates, a deeper examination of the military's application or dismissal of these documents in their weapons development and acquisition practices is necessary. The longer term progress of the SIVAM project and the AL-X program provide some insight to this question.

Defense Policy, Dependence, and Technology Transfer

In Chapter 2, several categories of strategies and mechanisms used by developing nations to gain access to technology and reduce dependence on external suppliers were introduced, based on the studies of Christian Catrina and Emanuel Adler. Before looking at specific Brazilian cases, laying out these strategies and mechanisms in more systematic manner is useful for their comparison to Brazilian defense policy. Catrina identified seven factors which determine the degree of "recipient dependence" in arms transfers:

"Encontro Nacional de Logísitica Militar, 06 e 07 Março 2002 – São Paulo," *Defesa@Net*, 19 March 2002, URL: <http://www.defesanet.com.br/rv/logistica/index.html>, Accessed on 14 May 2007.

[73] Câmara dos Deputados, *Comissão das Relações Exteriores e Defesa Nacional - Audiência Pública No. 001162/01 – Debate sobre Política Indústrial na Área de Defesa Nacional* (Brasília: Departamento de Taquigrafia, Revisão e Redação, 18 October 2001), URL: <http://www2.camara.gov.br>, Accessed on 13 February 2003.

1. The extent to which a recipient government perceives a threat that could make necessary the use of military means, requiring either new arms imports or a high readiness of arms already deployed.
2. The extent to which a recipient state can cover its needs for arms from indigenous production (self-sufficiency).
3. The extent to which a recipient state can rapidly start or expand domestic arms production, i.e. increase its present level of self-sufficiency.
4. The extent to which a recipient state has diversified its arms supply among a number of suppliers.
5. The availability to a recipient state of alternative suppliers. This depends on:
   - the number of alternative producers of a given type of arms
   - the recipient country's financial resources
   - the recipient country's ideological flexibility
   - the recipient country's degree of diplomatic isolation
   - the ability of the recipient country's forces to convert to new weapons systems.
6. The extent to which spare parts are domestically available, either through manufacture or through stockpiling.
7. The extent to which a recipient state is self-sufficient in training and maintenance, overhaul, and repair.[74]

Table 4-3 provides a comparison of the four most cogent recipient dependent strategies identified by Catrina that would apply to the Brazilian arms procurement landscape. The content of each Brazilian policy or normative document was compared against the strategies specified by Catrina's study, using his definitions for each category, to evaluate whether the countermeasures against dependence were captured in the documents' verbiage. The first category of strategy, "confidence building and arms control," is based on the notion of implementing confidence and security building measures in order to reduce tensions and threat and consequently eliminate the need to import sophisticated weapons from eternal suppliers.[75] The second category, "increasing self-sufficiency and surge capability," while somewhat self-explanatory, emphasizes adapting civilian industry production capacity to substitute for external produced component on short notice.[76] A third category, "diversification/maintaining multiple sources of supply," mean a country could switch rapidly to another supplier for the same defense need in the event of an

[74] Catrina, *Arms Transfers and Dependence*, 172-173.

[75] Catrina, *Arms Transfers and Dependence*, 308.

[76] Catrina, *Arms Transfers and Dependence*, 309.

emergency.[77] The fourth category examined, "increasing control over spare parts and technical support," considers the training of personnel, maintaining large parts inventories, and the establishment of facilities for domestic production of parts or and associated maintenance of weapons systems as key elements.[78]

[77] Catrina, *Arms Transfers and Dependence*, 311.

[78] Catrina, *Arms Transfers and Dependence*, 313.

	Recipient Dependent Strategy			
	Confidence Building and Arms Control	Increasing Self-Sufficiency and Surge Capability	Diversification, Maintaining Multiple Sources of Supply	Increasing Control over Spare Parts and Technical Support
Defense Policy				
Portaria No. 853/GM-2 Air Force Offset Policy 1991		X		X
Portaria No.747/GM-2 Air Force Offset Directive 1992		X		X
PDN 1996	X	X		
Portaria Normativa No. 764/MD MOD Offset Policy 2002		X		X
PDN 2005	X	X	X	X
Portaria Normativa No. 899/MD MOD PNID 2005		X		
Portaria No. 1395/GC-4 Air Force Offset Policy 2005				X
Portaria 1397/GC-4 Air Force Offset Negotiation Instructions 2005				X
Portaria Normativa No. 586/MD MOD Strategic Actions for PNID 2006		X		X
Portaria Normativa No. 1.890/MD - Policy for Defense Logistics (PLD)		X		X

TABLE 4-3: Recipient Dependence Strategies and Brazilian Defense Policy.

Sources: Catrina, *Arms Transfers and Dependence*, Ministério da Defesa, Força Aérea Brasileira.

Several details based on this comparison should be noted. First, the PDN from 1996 essentially left the third and fourth categories untreated in its text, while the 2005 PDN mentioned elements of all four strategies in its text. This may be explained by an increasing Brazilian concern with defense industrialization as well as the Defense Ministry's particular imprint on the 2005 PDN. Another explanation may be a differing view on military requirements from two

different administrations. Second, the Air Force's documents dealing with offsets from 1991 and 1992 paid homage to the second strategy, while both 2005 Air Force offsets documents dwelled on the fourth category in a more broad fashion, but did not treat the second strategy in an explicit and easily identifiable manner. Perhaps with the Defense Ministry offsets policy being published 3 years earlier, the Air Force felt less need to treat the second strategy in its offsets guidance. Third, only the 2005 PDN explicitly treated diversification of arms supply, while none of the other guidance does. The provision is tied to the new PDN's interest in regionalization of the defense industry to support mutual development and expand markets, a topic which José Viegas pushed during his 2003-2004 tenure as Defense Minister.[79] Finally, from this sample of documents it appears that Brazil's preferred strategies fall into the second and fourth categories.

Table 4-4 matches up the content of the same Brazilian defense policies or normative documents as Table 4-3, but with the intent of identifying specific technology transfers modes or mechanisms in their texts which Adler specified in his study of the computer and nuclear industries during the 1970s and 1980s. The mechanisms that Adler identified are not all-inclusive – in fact, he admitted as much in his study.[80] Brazil uses more methods in its compensation/offset policies than are identified in Adler's schema. The application of Brazil's preferred modes of technology transfer will be examined in-depth in the technological cases in Chapters 5 and 6.

[79] Janaína Figueiredo and Evandro Éboli, "O Aliado Portenho," *O Globo*, 11 November 2003, URL: <http://www.mre.gov.br/portugues/noticiario/nacional/selecao_detalhe.asp?ID_RESENHA=22954>, Accessed on 17 May 2007; Marcelo Rafael Rech, "Ministro da Defesa José Viegas Filho Fala a Defesanet: Parte II – Viegas defende integração das indústrias de defesa da América do Sul," *Defesa@Net*, URL: <http://defesanet.web.terra.com.br/bsb/mdviegas1/>, Accessed on 17 May 2007.

[80] Adler, *The Power of Ideology*, 341n.

Technology Transfer Modality							
Defense Policy Document	Technical Assistance	Knowledge-Generating Capital Equipment Purchases	Acquiring Rights to a Foreign Patent or Obtaining a Licensing Agreement	Local Product Assembly of Imported Parts	Mixed Operations of Locally Produced and Imported Parts	Complete Local Manufacture of the Product	Joint Ventures – Agreements to Install a New Productive Capacity
Portaria No. 853/GM-2 Air Force Offset Policy 1991							
Portaria No.747/GM-2 Air Force Offset Directive 1992	X		X		X	X	X
PDN 1996							
Portaria Normativa No. 764/MD MOD Offset Policy 2002	X	X			X	X	
PDN 2005							
Portaria Normativa No. 899/MD MOD PNID 2005							
Portaria No. 1395/GC-4 Air Force Offset Policy 2005	X		X		X	X	X
Portaria 1397/GC-4 Air Force Offset Negotiation Instructions	X		X		X	X	X
Portaria Normativa No. 586/MD MOD Strategic Actions for PNID 2006							X
Portaria Normativa No. 1.890/MD - Policy for Defense Logistics (PLD)		X				X	X

TABLE 4-4: Technology Transfer Modalities and Brazilian Defense Policy.

Sources: Adler, *The Power of Ideology*, Ministério da Defesa, Força Aérea Brasileira.

A review of Table 4-4 reveals some glaring absences. Several of the policy documents, including the Air Force's 1991 offset policy, the 1996 PDN, the 2005 PDN, and the 2005 PNID

do not contain reference to modes or mechanisms of technology transfer. The 2006 document "Strategic Actions for the PNID" only briefly addresses cooperative ventures with external actors, and really is more concerned with providing the details for how to execute the 2005 PNID.[81] A simple explanation for the absence of provisions dealing with modes of technology transfer may be these documents' strategic nature and consequently no need to spell out the details of this activity. Another explanation may be that Adler's discussion of technology transfer mechanisms was concerned with transfer of knowledge, capital, or a mixture of both from abroad, while three of the policy documents cited above are more concerned with generating defense technology from within and promoting domestically produced military hardware.

In reviewing the SIVAM and AL-X programs, greater flexibility in categorization of strategies employed to avoid dependence and to secure technology may be warranted. Both of the programs examined were managed by the Air Force and conceived of in the early 1990s at the time that the Air Force issued its original offset policy and its set of instructions. As indicated in Chapter 2, Rexford Hudson noted that the Air Force had used joint ventures, licensing agreements, foreign investments, and technical assistance as mechanisms for several years to ensure the state-controlled aeronautics company Embraer had access to capital and know-how so it could become increasingly independent an its aircraft manufacturing pursuits. By 1991 the Air Force, under the leadership of Aeronautics Minister Sócrates da Costa Monteiro, had formalized a policy to demand "offsets" for any contracts featuring weapons imported from abroad of a value greater that US $1 million. The Air Force Policy of Commercial, Industrial, and Technological Compensation, better known as the Air Force offsets policy, justifies its demand for reciprocal compensation on the effects of globalization and its impact on developing nations like Brazil:

> The world-wide evolution of industries using advanced technology shows a clear tendency for substituting the concept of verticalization with specialized production, which forces developing nations to seek to strengthen themselves technologically and create commercial alternatives in

[81] Ministério da Defesa, *Portaria Normativa No. 586/MD de 24 de Abril de 2006 - Aprova as Ações Estratégicas para a Política Nacional da Indústria de Defesa, Defesa@Net*, 26 April 2006, URL: <http://www.defesanet.com.br/md/pnid_1.htm>, Accessed on 3 May 2006.

> order to participate in an international common market. Among these commercial alternatives, negotiation by the supplier of some form of compensation has been broadly practiced as a condition for importing goods and services.
>
> This compensatory practice, commonly referred to as "OFFSET", has shown itself to be an effective instrument in industrial development and foreign commercial policies, in terms of creating benefits of a technological, industrial, and commercial nature for the purchasing country.[82]

The Air Force directive that fleshed out this policy specified seven different mechanisms that could be used in "compensation accords" that are inserted as clauses into the contracts negotiated by the Air Force's Department of Research and Development (DEPED).[83] The seven mechanisms included "co-production," (a.k.a. joint venture), "production under license," "subcontracted production," "financial investment in industrial and technological capabilities," "technology transfer," "training of human resources," and "commercial counter-trade."[84] Both the 1991 offset policy and its 1992 implementing directive are short documents without much detail, but they guided Air Force acquisition efforts as the SIVAM project and the AL-X program developed.

The updates to the Air Force offsets policy and implementing directive, published in 2005, are consistent with the Defense Ministry's 2002 overarching offset policy, but they are much more detailed from a conceptual and language stand point. The categories of offset modes defined by the Air Force have advanced in their specificity, and the goals of the offsets policy are clearly directed toward extracting maximum economic benefit from any foreign entity that signs a

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[82] Ministério da Aeronáutica, *Portaria No. 853/GM-2 de 18 de Dezembro de 1991 - Aprova a Política de Compensação Comercial, Industrial e Tecnológica do Ministério da Aeronáutica* (Brasilia, DF: Ministério da Aeronáutica, 18 December 1991), URL: <http://www.ita.mil.br>, Accessed on 23 March 2006.

[83] During a reorganization in 2006, the Air Force's Department of Research and Development (DEPED) was subsumed by the newly created General-Command of Aerospace Technology.

[84] Ministério da Aeronáutica, *Portaria No. 747/GM-2 de 21 de Setembro de 1992 – Ação da Política de Compensação Comercial, Industrial e Tecnológica do Ministério da Aeronáutica* (Brasilia, DF: Ministério da Aeronáutica, 21 September 1992), URL: <http://www.ita.mil.br>, Accessed on 23 March 2006.

contract of more than US $5 million with the Air Force. Table 4-5 outlines the key features of the 2005 offset policy, which are in force today.

Air Force 2005 Offset Policy Summary
Objectives:
1. Use of the power of purchasing and the power to grant Air Force concessions in favor of development of the Brazilian Aerospace Industrial Park.
2. Creation of new market opportunities to export goods and services, which promote increased work loads for the industries of the sector, preferably in areas of technological significance.
3. Enlargement of the job market.
4. Acquisition of external resources for industrial and technological preparedness in the aerospace sector.
5. Supply and strengthening of sectors of interest to the Air Force, creating conditions for the improvement of aerospace sector industries and their technological base.
6. Incremental nationalization and resulting independence from the external market, with respect to aerospace sector products.
7. Preparation and development of existing human resources in the Brazilian Aerospace Industrial Park.
Types:
1. Direct Compensation - Compensation Accords involve goods and services directly related with the object of the contracted imports.
2. Indirect Compensation - Compensation Accords involve goods and services not directly related with the object of the contracted imports.
Modalities of Compensation Transactions:
1. Production Under License
2. Co-Production (Joint Venture)
3. Production Under Subcontract
4. Investments
5. Transfer of Technology: • Technical assistance • Research & Development • Training • Other activities that represent a qualitative increase in the country's technological level
6. Counter-Trade: • Counter-purchase – foreign supplier purchases national products of a value defined as a percentage of the value of the acquisition. • Buy-back – foreign supplier accepts products derived from the product originally imported as total or partial payment. • Barter – a unique transaction that specifies the trade of products or selected services for others of an equivalent value.

Table 4-5: Key Features of 2005 Air Force Offset Policy.

Source: Brazilian Air Force, Portaria No. 1395/GC-4, 13 December 2005.

Summary of Key Findings

Having examined the content of several Brazilian defense policies, directives, norms and instructions, this chapter provided the reader with a basic understanding of key guidance the Brazilian defense planning and procurement process uses to orient its acquisition of technology and weapons systems. The chapter addressed several critiques of the paucity of defense policy guidance referred to by several analysts as presented in the review of literature in chapter two. It seems clear that several of these critiques, while quite valid when written, are now outdated and Brazil's development of a defense ministry has helped address a number of their concerns.

This chapter also established a temporal foundation for understanding when certain policies went into effect so correlations can be drawn to procurement activities and technological development decisions in the two technological cases that follow. The chapter also summarized the links between the directives of Brazil's National Defense Policies of 1996 and 2005 and the two technological cases, providing a baseline for deeper examination of the SIVAM project and the AL-X program in Chapters 5 and 6. It appears that the technological cases, while having origins preceding the PDNs, are consistent with overarching defense policy and strategy and are not as parochial as other analysts might argue.

This chapter also examined the content of several key Brazilian defense guidance documents using the tools that other scholars examining technology transfer and strategies to avoid technological dependence have used. The chapter demonstrated that while these tools can be applied to examining Brazil's defense policies and identifying mechanisms used by the state to lessen its dependence, analyzing the technological cases with the provisions and mechanisms defined in the government's own policies may be a better approach.

What the content review showed is that selected defense policies and norms used by the military as guidance for procurement and R&D activities reveal a clear concern with avoiding

dependence through the application of strategies to increase self-sufficiency and increase national control over spare parts and technical support activity. The content review also revealed that selected defense policies and norms used by the military in their procurement and R&D activities show a preference for seeking technology transfer through technical assistance, local component manufacture, and agreements to install new productive capacities in the country. These preferred strategies and technology transfer modalities are clearly defined in the Brazilian Air Force's offsets policy and directive.

In order to answer the three key questions outlined at the beginning of this chapter, deeper examination is Chapters 5 and 6 must supplement the findings from this chapter.

CHAPTER 5

NATIONAL TECHNOLOGY PROCUREMENT AND SIVAM

The first technological project examined for this study was the Amazon Surveillance System (SIVAM) – a project of national scope, used by both civilian and military organizations, that was managed by the Presidency and Air Force and principally utilizes ISR and C³I related technologies. This project was defined early on as a project critical to national security and key for delivering on Brazil's global commitment to environmental preservation in the Amazon basin.

By examining SIVAM and how Brazil's defense sector dealt with the defense industrial and procurement issues incumbent in the project, I sought to address the following questions: How closely do the military decision makers follow defense policy directives and other guidance to define technology needs for mission accomplishment? What range of supply options did military decision makers and the defense leadership consider when planning to acquire the systems and technology for stated or perceived needs? What explicit rules and mechanisms derived from the defense policy helped or hindered the national defense industry's ability to secure military orders and pursue R&D opportunities for this project?

The Brazilian government's most technologically sophisticated most expensive procurement and technology development effort during the 1990s was SIVAM, which the Air Force and the Presidency's Secretariat for Strategic Affairs managed jointly from 1990-1999. The primary contractor for this system was the U.S. defense firm Raytheon Company, which provided most of the hardware and helped design some of the software in cooperation with Brazilian partner firms. While this system's genesis predates the issuing of the first PDN, its installation only began in 1997 due to a number of political and technical delays.

SIVAM Genesis and System Description

During the late 1980s a concentration of ills in the Amazon region knocked Brazilian leaders off balance and left them on the defensive. First, in September 1989 *TIME Magazine* published a cover story article entitled, "Torching the Amazon: Can the Rain Forest Be Saved?" To Brazilian leaders the slight was clear – they were accused of mismanaging their national patrimony, the Amazon region. From the mid 1980s a growing consensus in the developed world's scientific community heavily criticized Brazil's stewardship of its Amazonian ecosystem. Prominent politicians in France, the United States, and Great Britain echoed the scientific community, claiming that Brazil ought to accept that neglect of the Amazon basin would have consequences if it persisted, including international management of the region.[85] Second, in the late 1980s, the Brazilian Foreign Ministry faced efforts in the United Nations (UN), supported by non-governmental organizations (NGOs) based in Europe and the U.S., to define new rights for indigenous tribes that would challenge Brazilian sovereignty in Amazônia.[86] Third, in September 1989 the Brazilian national airlines VARIG lost flight RG254 in the state of Mato Grosso. For lack of adequate air traffic control infrastructure and search and rescue capability, Air Force authorities did not locate the flight's crash site until 44 hours after it went down.[87] Fourth,

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[85] Senado Federal, *CPI Hiléia Amazônia - Relatório Final* (Brasilia, DF: Senado Federal/Secretaria de Comissões, 1989): 10-26, 69, URL: <http://www.senado.gov.br/web/comissoes/CPI/arquivo/CPIAmazonia.pdf>, Accessed on 10 April 2007; Senado Federal, *Nota Taquigráfica da Quarta Reunião Ordinária da Terceira Sessão Legislativa Ordinária da Quinquagésima Segunda Legislatura da Comissão De Relações Exteriores e Defesa Nacional, Realizada no Dia Trinta e Um de Março do Ano de Dois Mil e Cinco,* SC-14.

[86] Senado Federal, *Comissão Parlamentar de Inquérito destinada a apurar as denúncias veiculadas a respeito da atuação irregular de Organizações Não-Governamentais – Relatório Final* (Brasilia, DF: Senado Federal/Secretaria de Comissões, 2002): 174-176, URL: <http://www.senado.gov.br>, Accessed on 10 April 2007.

[87] Ministério da Aeronáutica, *Relatório Final CENIPA 04* (Brasilia, DF: Estado-Maior Da Aeronáutica/ Sistema de Investigação e Prevenção de Acidentes Aeronáuticos), 23 April 1991, URL: <http://web.house.com.ar/users/hf_crm/xingutexto.htm>, Accessed on 6 April 2007.

prospectors in the state of Roraima during 1989 and 1990 were regularly invading indigenous lands to mine for gold, frequently killing Indians and drawing the attention of human rights NGOs, which were quick to blame the Brazilian government for its failure to protect its vulnerable tribes.[88]

The Brazilian military's interest in defending the Amazon region intensified in conjunction with the Brazilian government's growing concerns about international designs on its territory. The government, with the Air Force in the lead, initiated the planning, bidding, and contracting for the Amazon Surveillance and Protection Systems (SIVAM and SIPAM) during 1990-1995 as a response to state problems of controlling air traffic, preventing environmental problems, and containing illicit phenomena in the Amazon region.

The development and installation of SIVAM from 1997-2005 provided the technical infrastructure that makes SIPAM, an interagency organization managed by the Brazilian presidency, work.[89] SIVAM's capabilities are based on a sophisticated, integrated network of ground, airborne, and space-based sensors that are connected to three regional technical operations centers (CTOs) in Manaus (Amazonas State), Belém (Pará State), and Porto Velho (Rondônia State) through the Brazilian telecommunications system. The sensors collect data within the 5.2 million square kilometer Brazilian Amazon region for the purposes of airspace management and defense, environmental monitoring, and detection of illicit activities, and the

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[88] Câmara dos Deputados, *Comissão de Defesa Nacional Audiência Pública No. 54/95 – Considerações sobre o Projeto SIVAM-SIPAM* (Brasilia, DF: Departamento de Taquigrafia, Revisão e Redação, 15 March 1995): 15-16.

[89] The reader should consider SIVAM to be a technological tool used by many government clients. SIPAM, on the other hand, is an inter-agency organization subordinated to the Civilian Household of the Presidency, whose management and operation center (CENSIPAM) runs the Technical Operations Centers in Manaus, Porto Velho, and Belém. CENSIPAM also runs the General Coordination Center in Brasilia.

CTOs forward the information to regionally-based federal and state government organizations for their operations.[90] Figure 5-1 gives a graphic representation of the system.

Figure 5-1: Amazon Surveillance System Key Components.

Source: ATECH Foundation, 2001.

SIVAM's infrastructure consists of a data acquisition subsystem, a subsystem for treatment and visualization of data, a telecommunications subsystem, a back-up air navigation subsystem, and a transmission support subsystem. Among the data that SIVAM collects and processes are: airborne electro-optical, multi-spectral, hyper-spectral, and radar imagery;

[90] "'Technology and Humanity': The SIVAM Project," *Military Technology* 12 (2005): 28-33; David A. Fulghum, "Flying Proctors," *Aviation Week and Space Technology* (12 July 2004): 48-50; David Jensen, "SIVAM: Communication, Navigation and Surveillance for the Amazon," *Avionics Magazine*, online ed., (June 2002), URL; <http://www.aviationtoday.com/reports/avionics/previous/0602/0602sivam.htm>, Accessed on 26 September 2003.

COMINT and ELINT signals in the HF/VHF/UHF spectrums; air surveillance data from both 5 airborne and 25 ground-based surveillance radars; and environmental and meteorological data that come from both ground-based sensors and satellites, such as the CBERS, GOES, LANDSAT, SPOT, RADARSAT, and ERS satellites managed by different nations.[91] The airborne imagery, SIGINT, and air surveillance data is collected by five R-99A airborne surveillance aircraft, three R-99B remote sensing aircraft, and one R-95 Bandeirante aircraft operated by the Brazilian Air Force.[92] The information is processed and consolidated at the three regional CTOs and then forwarded to a General Coordination Center (CCG) in Brasilia, where SIPAM is headquartered.[93] Space based images are downloaded, processed, and exploited by the National Space Research Institute (INPE) facilities in Cuiabá (Mato Grosso State) and Cachoeira Paulista (São Paulo State), which have a direct link to SIPAM.

SIVAM Public Bidding and Government Options

Once the decision to acquire SIVAM was made, the government had to decide whether to build a system meeting Brazilian needs using national technology or to import the technology from foreign suppliers. Brazilian decision makers decided during an August 1993 meeting of the

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[91] Jensen; CCSIVAM, "Informações: SIVAM Entrega o Primeiro Produto: INPE Upgrade," n.d., URL: <http://www.sivam.gov.br/info/press31.htm>, Accessed on 19 July 1999.

[92] Fulghum, 48-50; "Capability of Brazilian Air Force's R-99A, R-99B Surveillance Aircraft Described" (text), Brasilia *Força Aérea Brasileira Revista Aéreo*, 13 October 2004, (b) (3) [redacted]; CCSIVAM, "Informações: Curso de Aplicação de dados do HSS do SIVAM é Realizado no IBAMA," n.d., URL: <http://www.sivam.gov.br/INFO/evento%2024_2003.htm>, Accessed on 03 August 2003; Força Aérea Brasileira, "Militares do Exército visitam Esquadrão Guardião," Sala de Imprensa, 22 September 2005, URL: <http://www.fab.mil.br/portal/imprensa/Noticias/2005/set/2209_guardiao.htm>, Accessed on 23 September 2005.

[93] Tribunal das Contas da União, *TC 015.444/2003-8 - Relatório de Auditoria. DECEA e CCSIVAM. Impropriedade na celebração de termo aditivo que reduziu o valor de garantia contratualmente prevista, em desacordo com o disposto no § 4° do art. 56 da Lei 8.666/93*, 13 October 2004, URL: <http://www.tcu.gov.br/Consultas/Juris/Docs/judoc/Acord/20041013/TC%20015.444.doc>, Accessed on 03 November 2006; Alvaro Luiz Pinheiro da Costa, "Nós estávamos preparados?" *Aeroespaço* 3, no. 15 (Rio de Janeiro, RJ: Força Aérea Brasileira/Departamento de Controle do Espaço Aéreo, March 2006): 14-17.

National Defense Council (CDN) that seeking international bids and waiving normal bidding procedures provided the most advantageous framework for building SIVAM for a number of reasons.

The first reason was urgency. The government was truly concerned with developments in the Amazon basin, and while Brazilian industry was capable of supplying a portion of the components to be used in SIVAM, developing all aspects of the system fell beyond immediate Brazilian engineering capabilities. As President of the Coordinating Committee for SIVAM (CCSIVAM) Teomar Fonseca Quírico pointed out during a 2002 congressional hearing, "…when we see dozens and dozens of planes flying through the Amazon region without knowing what they want, where they are going, and what they are doing, the solution has to be today, the solution is urgent. I cannot wait 20 years for a company to develop a radar."[94]

A second reason was funding. As a part of an international tender for the SIVAM project, those bidding for the project were required to provide 100% of the financing for the system's hardware procurement, development, engineering, and logistic support during installation.[95] Aeronautics Minister Lélio Viana Lôbo pointed out during testimony to the Brazilian Senate that his ministry's experience with large, drawn-out projects, such as the installation of the three Integrated Centers for Air Defense and Air Traffic Control (CINDACTAs), had proven that the Air Force could not depend on resources from the national treasury being available to fully fund a project like SIVAM and keep it on schedule.[96]

A third reason for waiving formal bidding procedures was security. Law 8.666 of 1993 defines the rules the government usually applies to the public bidding process. The law dictates

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[94] Câmara dos Deputados, *CPI SIVAM Audiência Pública No. 0174/02* (Brasilia, DF: Departamento de Taquigrafia, Revisão e Redação, 2 April 2002): 33-34.

[95] Senado Federal, *Economic Affairs Commission Public Audience on 29 November 1994 (Translation)* (Brasilia, DF: Secretaria-Geral da Mesa/Subsecretaria de Taquigrafia, 29 November 1994): 17. Hereafter cited as Senado Federal, *Economic Affairs Commission Public Audience*.

[96] Senado Federal, *Economic Affairs Commission Public Audience*, 40.

that a "convening proclamation" be published in Brazil's Official Gazette (Diário Oficial da União) with the details of the project up for bid. The proclamation allows firms to develop competing proposals from which the government can pick the most advantageous bid.[97] The problem with having such an open process for a system as sophisticated as SIVAM, which is destined to protect Brazil's sovereignty and national security, is that it would expose the system's configuration and technical information to parties who seek to evade Brazilian law and counteract the system's purpose. Hence, the CDN decided for this reason that under paragraph 9, article 24 of Law 8.666, formal bidding rules would be waived because Brazil's national security as at stake.[98]

Brazilian leaders decided to pursue a semi-closed bidding process with abridged information about the system's concept, configuration, and technical information to potential foreign suppliers through 16 embassies in Brasilia in order to ensure some confidentiality of information. The rules stated that the one non-negotiable condition that all proposals had to abide by was to include a Brazilian national integrator company in their bid, which would be chosen by the Brazilian government. The national integrator company would exercise the primary role in systems integration and it would serve as the Brazilian entity entrusted to absorb all knowledge about the system's design, its software engineering, its technology, and other relevant details from the companies contracted for the project.[99]

The results of the bidding featured eleven proposals from seven individual companies and four large consortiums, which included 62 companies in all. Seven proposals were eliminated for

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[97] Carlos Wellington Leite de Almeida, "Licitação: acquisição de material militar no Brasil," *Red de Seguridad y Defensa de America Latina*, 27 October 2003, URL: <http://www.resdal.org.ar/Archivo /d0000233.htm>, Accessed on 21 May 2007.

[98] Almeida, "Licitação: acquisição de material militar no Brasil."; Senado Federal, *Economic Affairs Commission Public Audience*, 6-7, 14; Tribunal Regional Federal da 4ª Região, *Apelação Cível No. 97.04.44874-0/PR* (Porto Alegre: Poder Judiciário, 15 October 2003): 9, URL: <http://www.trf4.gov.br>, Accessed on 21 May 2007.

[99] Senado Federal, *Comissão De Relações Exteriores - Reunião 12 de Abril de 1995* (Brasilia, DF: Secretaria Legislativa/Subsecretaria de Taquigrafia, 12 April 1995): CC-9; Tribunal Regional Federal da 4ª Região, *Apelação Cível*, 10; Senado Federal, *Economic Affairs Commission Public Audience*, 15.

lack of a companion financing proposal, and four large consortiums led by European and American firms were left, with DASA/Alenia, Thomson-CSF/Alcatel, Raytheon Company, and UNISYS as the lead contractor candidates. The bids of these four consortiums all included participation by Brazilian companies and during early 1994 a commission of government specialists rated each proposal on the strength of its technical, commercial, and financial bids, with the assistance of a Brazilian national integrator firm that had been selected in December 1993. In May 1994 the two strongest proposals, from the Thomson-CSF/Alcatel and Raytheon-led consortiums were selected as finalists, and in June 1994 the Raytheon proposal was chosen as the winner due to its combination of the best technological solution, the lowest price, and the least risk for the project's execution.[100]

Procurement Activities and SIVAM

Developing, installing, and integrating SIVAM components was a multi-year endeavor featuring a consortium of companies with either general or specific tasks. Table 5-1 breaks down the responsibilities between the parties involved.[101] Many of the U.S.-based equipment suppliers changed in name during the period prior to installation and before equipment was exported to Brazil. The terms of the contract specified that 85 percent of the system's hardware and services would be purchased from U.S. suppliers because of the financing rules imposed by the U.S. Export-Import Bank (Eximbank), which financed most of the system.[102] Besides the Eximbank

[100] Tribunal das Contas da União, *DC 0086-50/96-P - Decisão 806-1996 Plenário – Inspeção. MAER. Legitimidade do processo de seleção e contratação da firma vencedora para o fornecimento de equipamentos para o projeto SIVAM*, 4 December 1996, URL: <http://www.tcu.gov.br>, Accessed on 6 May 2006; Senado Federal, *Economic Affairs Commission Public Audience*, 15-16; Senado Federal, *Relatório SIVAM* (Brasilia, DF: Comissão De Assuntos Econômicos/Comissão De Relações Exteriores e Defesa Nacional/Comissão De Fiscalização e Controle, 7 February 1996), 46-48.

[101] The contractor list was compiled from multiple sources, and may feature some subcontractors who were eliminated during a two-year lag period between signing of the contract with Raytheon and the initiation of activities specified in the contract. The author was unable to sort out definitively which subcontractors are redundant in Table 5-1.

[102] CCSIVAM, "Estrutura de Financiamento," n.d., URL: <http://www.sivam.gov.br/PROJETO

loan, which totaled approximately US$ 1.023 billion, the Swedish Export Bank (SEK/EKN) provided US $85 million in financing for acquisition of Ericsson airborne early warning and control radars.[103] Raytheon's Credit Facility provided US$ 239 million in financing and the SIVAM Vendor Trust, backed by consortium of SIVAM subcontractors, contributed an additional US$ 48 million, helping the government pay for the air surveillance and remote sensing aircraft built by Embraer among other equipment and services.[104] SIVAM investments were apportioned with a heavy emphasis on data collection systems and aircraft, which made up 61 percent of the investments. Data processing and visualization (9 percent), logistics (8 percent), civil works (8 percent), telecommunications equipment (7 percent), project management (4 percent), meteorological services and equipment (2 percent), and data-link development rounded out the rest of the investments.[105]

/finan1.htm>, Accessed on 12 January 2004; U.S. Congress, Senate, Committee on Banking, Housing and Urban Affairs, Subcommittee on International Finance, *Hearing on the Reauthorization of the Export-Import Bank of the United States*, Hearings, 105th Cong., 1st sess., 17 July 1997, URL: <http://banking.senate.gov/97_07hrg/071797/witness/harmon.htm>, Accessed on 21 May 2007; Senado Federal, *Resolução No. 96, de 1994* (Brasilia, DF: Subsecretaria de Informações, 27 December 1994), URL: <http://www6.senado.gov.br/legislacao/ListaPublicacoes.action?id=140521>, Accessed on 9 March 2007.

[103] Senado Federal, *Resolução No. 91, de 1994* (Brasilia, DF: Subsecretaria de Informações, 27 December 1994), URL: <http://www6.senado.gov.br/legislacao/ListaPublicacoes.action?id=140516>, Accessed on 9 March 2007; CCSIVAM, "SEK/EKN," n.d., URL: <http://www.sivam.gov.br/PROJETO/finan4.htm>, Accessed on 17 May 2007.

[104] Senado Federal, *Resolução No. 97, de 1994* (Brasilia, DF: Subsecretaria de Informações, 27 December 1994), URL: <http://www6.senado.gov.br/legislacao/ListaPublicacoes.action?id=140522>, Accessed on 9 March 2007; CCSIVAM, "Raytheon Credit Facility," n.d., URL: <http://www.sivam.gov.br/PROJETO/finan3.htm>, Accessed on 17 May 2007; Senado Federal, *Resolução No. 95, de 1994* (Brasilia, DF: Subsecretaria de Informações, 27 December 1994), URL: <http://www6.senado.gov.br/legislacao/ListaPublicacoes.action?id=140520>, Accessed on 9 March 2007.

[105] CCSIVAM, "Engenharia de Custos do Projeto SIVAM É Tema de Palestra no I Congresso Íbero-Americano de Engenharia de Custos," n.d., URL: <http://www.sivam.gov.br/info/evento%2025_2003.htm>, Accessed on 29 October 2003.

Country	Team Member	Responsibility	Equipment/Service Supplied
U.S.	Raytheon Co.	Primary Contractor	Primary and Secondary Air Traffic Control Radars, VHF Digital Radios, Flight Inspection Aircraft, Software
U.S.	Parker-Gull	Subcontractor	Calibration Equipment for Flight Inspection System
U.S.	Summit Aviation, Inc.	Subcontractor	Aircraft Electronics for Flight Inspection Aircraft
U.S.	Lockheed Martin	Subcontractor	Transportable Primary/Secondary Radar Systems
U.S.	Expersoft	Subcontractor	Infrastructure Reasoning Toolkit Products
U.S.	University of New Hampshire	Subcontractor	Environmental Scientific Support
U.S.	Enterprise Electronics Corporation	Subcontractor	Meteorological Radars
U.S.	Viz Meteorological Instruments	Subcontractor	Altitude Weather Stations
U.S.	Campbell Scientific	Subcontractor	Surface Weather Stations
U.S.	Seaspace Corporation	Subcontractor	Ground Stations for TIROS and GOES Satellites
U.S.	Sutron Corp.	Subcontractor	Environmental Data Collection Platforms
U.S.	Sunair Electronics	Subcontractor	Ground-to-Air HF Radio Systems for ATC and Surveillance
U.S.	TCI International, Inc.	Subcontractor	HF/DF Fixed Communications Exploitation Stations
Canada	MacDonald Dettwiler and Associates Ltd.	Subcontractor	Synthetic Aperture Radars, Environmental Monitoring Upgrades

U.S.	Geophysical & Environmental Research Corporation	Subcontractor	Multispectral Scanning System
U.S.	Daedalus/SensyTech/Argon ST	Subcontractor	Hyperspectral Imaging System
U.S.	Watkins-Johnson/BAE/L3 Communications	Subcontractor	Airborne Communications Exploitation System
U.S.	Condor/EDO/L3 Communications	Subcontractor	Airborne Non-Communications Exploitation System
U.S.	FLIR Systems, Inc.	Subcontractor	Optical Infrared Imaging Systems
U.S.	Scientific Atlanta	Subcontractor	GPS Manpack (Radio Determination Satellite Service)
U.S.	Litton Denro/Northrup Grumman	Subcontractor	Enhanced Terminal Voice Switch
U.S.	Sun Microsystems	Subcontractor	Computer Display and Peripherals
U.S.	Hewlett Packard	Subcontractor	Computer Workstations and Preipherals
U.S.	Data Systems Analysts, Inc.	Subcontractor	Messaging Servers
U.S.	RSA Security Inc.	Subcontractor	Encryption Software
U.S.	Comtech	Subcontractor	Satellite Communications Terminals
U.S.	Hughes Network Systems	Subcontractor	Very Small Aperture Terminal Stations
U.S.	Microwave Radio Communications	Subcontractor	Line-Of-Sight Radio
U.S.	Servo Corporation	Subcontractor	VHF Direction Finder

U.S.	Southern Avionics	Subcontractor	Non-Directional Beacon
U.S.	Airport Systems	Subcontractor	Instrument Landing Systems
Germany	Rohde & Schwarz	Contractor	UHF/VHF Datalink and Secure Communication Software
Sweden	Ericsson Microwave Systems	Contractor	Airborne Early Earning & Control System
Brazil	Embraer	Contractor	Air Surveillance and Remote Sensing Aircraft Airframes and Systems Integration
Brazil	ATECH Foundation	National Integrator	Overall System Integration, Software Design
Brazil	Infranav	Subcontractor	Installation of System Components
Brazil	Schahin Group	Contractor	Civil Works and Engineering for Ground Sites
Brazil	Tecnasa/Tectelcom	Subcontractor	VOR/DME, VHF Ground-to-Air Radio
Brazil	IBM do Brasil	Subcontractor	User Requirements, Data Processing and Display, Integration and Logistics Support, INPE Upgrade
Brazil	StarOne	Subcontractor	Digital Satellite Telecommunications Services
Germany	GAMIC	Subcontractor	Weather Information Processing Software

Table 5-1: Contractors and Subcontractors in the SIVAM Project.

Sources: Raytheon Co., ATECH, CCSIVAM, Business Newswire, Tribunal de Contas da União, Securities and Exchange Commission, Space NewsFeed, Data Systems Analyts, RSA Security, Defense Daily Network, Sunair Electronics, Lockheed Martin, Comtech, RF Globalnet, EDO Corp., MDA Ltd., Antennas for Communications, Argon ST, Computer Business Review Online, FLIR Syystems Inc., Embraer, AmazonTech.

In order to oversee the procurement process overseas with the primary contractor and dozens of subcontractors, CCSIVAM set up a Commission for Oversight and Receipt of Materiel and Services (COMFIREM). The commission operated in Sweden, Germany, Canada, and several cities in the United States and was responsible for receiving 95 percent of the equipment and software acquired under the SIVAM contract. COMFIREM integrated military personnel from the Air Force, Army, and Navy with technical experts from the Brazilian national integrator company's U.S. subsidiary, Amazon Technologies.[106] COMFIREM procurement activities were diverse in nature and spread out across the United States. They included:

- Tracking the refurbishment of five Air Force C-130 aircraft in Lake City, FL to support important SIVAM logistics activities, such as subsequent transport of Swedish PS-890 early warning radar systems.[107]
- Monitoring installation of Automated Flight Information Systems into Raytheon Hawker 800XP laboratory aircraft in Wichita, KS.[108]
- Testing the capabilities of multi-spectral scanners in Millbrook, NY.[109]
- Inspecting the integration of communications exploitation and ELINT systems in Embraer EMB-145 airframes in Greenville, TX.[110]

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[106] Costa, "Nós estávamos preparados?"; Câmara dos Deputados, *CPI SIVAM Audiência Pública No. 0174/02*, 33; AmazonTech, "Procurement," August 2003, URL: <http://www.amazontech.com /Procurement.htm>, Accessed on 21 May 2007.

[107] CCSIVAM, "A entrega do primeiro C-130," n.d., URL: <http://www.sivam.gov.br/INFO/ un_13.htm>, Accessed on 21 May 2007; CCSIVAM, "Primeira Sistema do Radar Erieye Chega à Embraer," n.d., URL: <http://www.sivam.gov.br/INFO/PRESSERIEYE.htm >, Accessed on 16 May 2007.

[108] CCSIVAM, "SIVAM Recebe o Segundo Sistema Automatizado de Inspeção do Vôo," n.d., URL: <http://www.sivam.gov.br/INFO/press37.htm>, Accessed on 21 May 2007; CCSIVAM, "SIVAM Recebe a Primeira Aeronave-Laboratório," n.d., URL: <http://www.sivam.gov.br/INFO/PRESS34.htm>, Accessed on 21 May 2007.

[109] CCSIVAM, "Primeiro Imageador Multi-Espectral do SIVAM," n.d., URL: <http://www.sivam .gov.br/INFO/PRESS38.htm>, Accessed on 21 May 2007.

[110] CCSIVAM, "Primeira aeronave de vigilância chega aos EUA," n.d., URL: <http://www.sivam .gov.br/INFO/un_07.htm>, Accessed on 16 May 2007.

- Conducting Factory Acceptance Tests of meteorological radars in Enterprise, AL.[111]
- Overseeing the engineering and design of strategic software for SIVAM's coordination sub-center in Boston, MA and Garland, TX.[112]

Since most equipment for SIVAM was acquired in the U.S., this model for procurement was a special periodic case that required unusual activities that normally would be coordinated by the Brazilian Air Force Commission in Washington (CABW). CABW handles routine procurement activity in the U.S. with a staff of over 50 employees, but it also has the function of supporting COMFIREM missions when they are stood up.[113]

A great deal of criticism accompanied the post-bidding process, the initial implementation, and the associated procurement of the SIVAM project because the perception existed that Brazil was buying a huge "turn-key" system that would do little to help the nation develop its own technology, particularly in the environmental area. Gilberto Câmara, who became the director of Brazil's National Space Research Institute (INPE) in late 2005 and who is among Brazil's most accomplished geographic information systems scholar-practitioners, has discounted the technological strategy and model that the environmental side of SIVAM was built on. Câmara expressed distrust of the commercial motivations behind the primary contractor's and national integrator's actions, as well the duplicate tasks that SIPAM is performing with less

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[111] CCSIVAM, "Concluído o teste de aceitação do segundo radar meteorológico do SIVAM," n.d., URL: <http://www.sivam.gov.br/INFO/un_32.htm>, Accessed on 15 November 2003.

[112] CCSIVAM, "Workshop de Vigilância Territorial," n.d., URL: <http://www.sivam.gov.br/INFO/evento%2002_2001.htm>, Accessed on 15 May 2007; Câmara dos Deputados, *CPI SIVAM Audiência Pública No. 0174/02*, 33; José Orlando Bellon, "O Sistema de Vigilância da Amazônia Contribuindo para o Conhecimento da Biodiversidade," *Revista CEJ*, 8 August 1999, URL: <http://www.cjf.gov.br/revista/numero8/sumario.htm>, Accessed on 22 May 2007; Costa, "Nós estávamos preparados?".

[113] Tribunal de Contas da União, *TC-014.418/2004-1- Relatório de Auditoria Operacional - Comissões Militares De Aquisição No Exterior*, 14 June 2006, URL: <http://www.tcu.gov.br>, Accessed on 23 February 2007.

qualified personnel.[114] While this latter issue could be interpreted more as turf consciousness than a legitimate criticism of the technological model employed, Câmara's criticisms have caught the attention of SIPAM's leadership, as they were parroted in a 2006 internal audit of SIPAM's structure.[115]

In late 1995 and early 1996, when political questions placed SIVAM's future in doubt, criticisms were leveled from both the Brazilian scientific community and from some nationalistic critics in the military who were concerned with the cost of the system, the level of national input into its infrastructure, and the fact that a major U.S. defense contractor was chosen as the primary contractor for the system. The Brazilian Society for Progress in Science (SBPC), with Dr. Rogério Cezar de Cerqueira Leite as its spokesman, actually presented an alternative proposal for a similar system to the Senate which would cost less and feature more Brazilian scientific community and industrial input.[116] Also critical, and perhaps more xenophobic, was Ivan Moacyr da Frota, a former 4-star Air Force general and CISCEA chief who alleged that granting a U.S. company the role as primary contractor was akin to turning over the electronic surveillance and privileged information about the entire Amazon basin's resources to the U.S. government.[117]

A less likely critic, the former director of the Air Force's Department of Research and Development (DEPED) and Aeronautics Technology Center (CTA) Sergio Xavier Ferolla, also

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[114] Gilberto Câmara, "O Projeto SIVAM e a Biodiversidade Amazônica: Há Espaço para a Ciência Nacional?" Presentation to the 48th Annual Reunion of the SBPC, São Paulo, 7-12 July 1996, INPE Website, URL: <http://www.dpi.inpe.br/gilberto/palestras.html>, Accessed on 22 May 2007; Gilberto Câmara, "O SIVAM e a Questão Ambiental: Uma Avaliação" Presentation to the 7th Special Reunion of the SBPC – Amazonia no Brasil e no Mundo, Manaus, 25-27 Abril 2001, INPE Website, URL: <http://www .dpi.inpe.br/gilberto/palestras.html>, Accessed on 22 May 2007.

[115] SIPAM, *Nota Técnica No. 04/2006*, Presidência da República/Casa Civil/CENSIPAM, 14 September 2006, URL: http://www.sipam.gov.br/portal/index.php?option=com_docman&task=doc _view&gid=9>, Accessed on 23 March 2007.

[116] Senado Federal, *Relatório SIVAM*, 59-62, 66-68; Rogério Cezar de Cerqueira Leite, "O Sivam, a fênix e o sultão," *Folha de São Paulo*, 2 April 2001.

[117] Clóvis Brigagão, *Inteligência e Marketing: O Caso SIVAM* (Rio de Janeiro: Editora Record, 1996), 72-73; Senado Federal, *Relatório SIVAM*, 62-63.

complained about SIVAM procurement activities. He maintained in a 2001 letter to Defense Minister Quintão that CCSIVAM's efforts to import meteorological radars from a U.S. subcontractor, in lieu of the overdue units originally ordered from the Brazilian firm Tectelcom, was "unpatriotic" and that the Air Force should be more flexible and accommodating with national companies involved in SIVAM.[118] Ferolla had defended SIVAM's continuity in 1995, testifying to Congress that he had helped set up Tecnasa – the company that built the meteorological radars and was later acquired by Tectelcom – and ESCA S.A. the original national integrator company for SIVAM. Seeing both of the companies move towards bankruptcy was difficult for him and the Air Force, because they were supposed to be key companies in the SIVAM project.[119] Seeing Tectelcom cut out of the project struck a nerve.

Perhaps the SIVAM project biggest and most enduring critic has been Worker's Party Deputy Arlindo Chinaglia, who was elected President of Brazil's Chamber of Deputies in February 2007. During 1995, Chinaglia successfully got ESCA S.A. stripped of its duties as SIVAM's national integrator, calling attention to the firm's failure to pay social security taxes and setting off a chain reaction that ended in the firm's bankruptcy. Chinaglia persisted in an unsuccessful crusade to torpedo the SIVAM project, calling for a Commission of Parliamentary Inquiry (CPI) to investigate alleged fraud and corruption.[120] Chinaglia finally got his CPI in 2001, five years after requesting it, and while on leave from his congressional post. He returned to Congress in 2002 in time to ask pointed questions to CCSIVAM chief Teomar Fonsea Quírico

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[118] Virginia Silveira, "Sivam é acusado de privilegiar estrangeiros," *Gazeta Mercantil*, 19 March 2001; Jornal do Senado, "Requião revela crítica feita por presidente do STM ao Sivam," 8 March 2001, URL: <http://www.senado.gov.br/JORNAL/arquivos_jornal/arquivosPdf/010308.pdf>, Accessed on 22 May 2007.

[119] Câmara dos Deputados, *Projeto SIVAM: Audiências Públicas 1995 Volume I*, 130-131, 150; Jornal do Senado, "Requião revela crítica feita por presidente do STM ao Sivam."

[120] Chinaglia's exploits to undermine SIVAM have been treated at length elsewhere. See Michael S. Oswald, *The Broadening of "Security" for Brazilian Amazônia? The SIPAM/SIVAM Project and the Politics of National Security in Democratic Brazil*, M.A. Thesis chaired by Peter A. Lupsha (Albuquerque, NM: University of New Mexico, 1995), 149-153, 159; Brigagão, *Inteligência e Marketing*, 73-74, 81.

in the CPI hearings about whether the technology being used for SIVAM was obsolete, whether putting SIVAM's data in the hands of the national integrator ATECH was an unsound risk, and whether SIVAM should be built in a modular manner, rather than all at once.[121] His questions belied a deep distrust in Raytheon as a supplier, believing that Brazil would become technologically dependent on the U.S. firm, and this dependency would ultimately compromise the integrity of SIVAM's data.[122]

The representative skepticism manifest in the above critiques underscores the apparent contradiction of pursuing a policy of independent technological development while supporting military procurement from external suppliers. Brazil's National Accounting Tribunal (TCU) has documented the growth of the military's buying commissions overseas and their increasing use during a time when defense policy directives mandate greater nationalization of weapons systems and efforts to foment technological autonomy in Brazil's defense industrial sector.[123] Given these mandates and the development of the SIVAM project during the period that the PDN was issued, how did the Air Force try to remain in compliance with national policy? The next section explores Brazil's application of its offsets policy during the SIVAM project.

Modes of Technology Transfer Employed with SIVAM Procurement

In the previous chapter, the Air Force's offset policy used during SIVAM's conceptualization, planning, bidding process, and implementation was introduced. Planners from the Secretariat of Strategic Affairs (SAE) and the Air Force understood very well that the systems

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[121] Câmara dos Deputados, *CPI – SIVAM: Relatório Final* (Brasilia, DF: Serviço de Comissões Parlamentares de Inquérito, 4 June 2002), 111.

[122] Arlindo Chinaglia, "Desperdício," O Globo (online version), 21 March 2002, URL: <http://oglobo.globo.com/opiniao/18344942.htm>, Accessed on 21 March 2002.

[123] Tribunal de Contas da União, *TC-014.418/2004-1*; Tribunal de Contas da União, *TC 004.340/2001-9 – Representação – Notícias veiculadas na imprensa. Compras realizadas no âmbito das Comissões Militares sediadas no exterior*, 14 June 2006, URL: <http://www.tcu.gov.br>, Accessed on 22 May 2007.

components were too numerous and complex for Brazilian firms to design, engineer, build, and deliver within the timeframe the government needed to take action. Key system architects explained to the political decision makers that the system's hardware components were not the most important technological "value added" that SIVAM would extend to Brazil. Instead, they maintained that the true goal to pursue, and the genuine technological advantage to be passed on to industry with this project, would be the systems integration and software engineering expertise that building SIVAM would generate among Brazilian firms.[124]

While the contact signed between the Brazilian government and Raytheon Company is considered a restricted document by both parties and it is not available to the general public, several activities undertaken within the framework of the contract can be correlated with the Air Force's offset mechanisms, even if a "compensation accord" is not available for review.[125] Table 5-2 matches up the key areas of SIVAM activity with the Air Force offset mechanisms.

[124] Senado Federal, *Economic Affairs Commission Public Audience*, 34; Senado Federal, *Comissão De Relações Exteriores - Reunião 12 de Abril de 1995*, 9, 15, 17; José Orlando Bellon, "O Sistema de Vigilância da Amazônia Contribuindo para o Conhecimento da Biodiversidade"; Senado Federal, *Nota Taquigráfica da Vigésima Quinta Reunião Ordinária da Comissão de Relações Exteriores e Defesa Nacional da Primeira Sessão Legislativa Ordinária da Quinquagésima Segunda Legislatura, Realizada no Dia Seis de Novembro do Ano de Dois Mil e Três, Às Dez Horas* (Brasilia, DF: Secretaria-Geral da Mesa/Subsecretaria de Taquigrafia, 6 November 2003), 24.

[125] Specifics of "Commercial Contract CCSIVAM/RAYTHEON 01/95" have leaked out to the public domain through court and audit documents, but not enough information is cited to determine whether a formal offset agreement was part of the contract. See Tribunal Regional Federal da 4ª Região, *Apelação Cível*; Tribunal de Contas da União, *DC 0086-50/96-P*; Tribunal de Contas da União, *DC-0298-18/98-P – Decisão 298/1998 – Plenário: Inspeção. MAER. Projeto SIVAM. Contrato. Legitimidade do processo de seleção e contratação da firma vencedora para o fornecimento de equipamentos para o projeto SIVAM*, 20 May 1998, URL: <http://www.tcu.gov.br>, Accessed on 6 May 2006.

OFFSET TYPE	EXAMPLES
Co-Production:	**Software Engineering** -- ATECH Foundation engineers worked alongside Raytheon technicians in Boston and Garland to develop the software suites for the Communications Sub-Center (SCC) and the Operations Sub-Center (SCO). **Systems Integration** -- Embraer has become a partner with Ericsson Microwave Systems and Thales in building air surveillance and martime patrol aircraft which have been exported to Greece and Mexico. This partnership is based on Embraer's mastery of systems integration gained through the SIVAM project, but the hardware suppliers for these aircraft may vary, depending on the customer.
Subcontracted Production:	**System Installation** -- Infranav performed installation of most major hardware, including primary/secondary radar systems and consoles, several satellite ground stations, meteorological stations, lightning detectors, HF-DF communications exploitation sites, HF/VHF ground-air control centers and communications stations, instrument landing systems, point-to-point UHF radio, computer e-mail servers/multiplexers/LAN, cabling for surveillance centers, radio towers, and GPS/radio-determination equipment.
Financial Investment in Industrial and Technological Capabilities:	**Equipment Purchases** -- In conjunction with the SIVAM purchase of Rohde & Schwarz Series 400 U data-link systems, the German supplier invested $20 million in a communications laboratory in Brazil for testing and measurements as part of an overall investment package of $40 million that establishes a logistic infrastructure for secure communications, includes training of Brazilian personnel, and transfers the source code technology for the data-link.
Technology Transfer:	**Equipment Purchases** -- Embraer technicians worked together with Ericsson Microwave Systems on integrating PS-890 Erieye air surveillance radars into the EMB-145 airframes purchased for SIVAM by the government. They gained an in-depth knowledge of the sensor and its characteristics, and the Air Force received the source codes of the software programs for sensors and C2 systems on board the EMB-145 air surveillance aircraft. **Software Engineering** -- Raytheon transferred the source codes for the Coordination Sub-Center, which features software applications for remote sensing, image processing, data fusion, decision support, and airspace management, supported by artificial intelligence. **Systems Integration** -- Ericsson, MacDonald Dettwiler, GER Corporation, FLIR Systems, and SensyTech ostensibly opened the source codes for the software that runs each of their sensors to the Brazilian government. This would allow Brazil engineers to adapt these sensors to their needs, including R&D by military and civilian higher educational institutions. The extent of this technology transfer is unclear though. ATECH claims to have all data on the sensors' capabilities, requirements, and how their processes interface on board the R-99 aircraft variants operated by the Air Force. Personnel at CTA have claimed, however, that Brazil does not exercise control over the source code for the synthetic aperture radar in order to make adaptations.
Training of Human Resources:	**Transfer of Know-How** -- From September 1999 to September 2001 nine seminars given by U.S. specialists in remote sensing (University of Michigan, University of New Hampshire, Indiana University, UC Santa Barbara, NASA) taught over 500 Brazilian government employees how to exploit optical, radar, multi-spectral, and thermal imagery using nationally and internationally available software and Geographic Information Systems. **System Installation** -- From 1999 to 2001 Raytheon trained 50 technicians from the Infranav engineering department in the United States. They attended factory courses on remote site sensors, telecommunications networks, and surveillance centers in order to enable the firm's to installation of equipment, to perform site acceptance tests, and to train and assist in operations of the SIVAM subsystems. **Equipment Purchases** -- In March 2003, a Consulter from SensyTech Inc., the supplier of the Hyperspectral Scanner acquired by the government, provided training on the system's capabilities to representatives from a variety of Brazilian agencies, including Brazilian Army, Federal Police, Air Force, and Brazilian Intelligence Agency personnel.

Table 5-2: Compensatory Benefits to Industry in the SIVAM Project.

Sources: Câmara dos Deputados, CCSIVAM, Construtel, CTA, Defesanet/Tecnologia & Defesa, Força Aérea Brasileira, Fundação ATECH, Gazeta Mercantil, Infranav, Inovação UNICAMP, Jornal do Brasil, Rohde & Schwarz, Securities and Exchange Commission, Senado Federal, Tribunal de Contas da União.

While the table above has matched up Air Force offset mechanisms aimed at achieving technology transfer to the Brazilian state and defense industry, it is unclear which companies signed a formal compensation accord beyond Rohde & Schwarz of Germany. Joel Fieguenbaum and Ricardo Rondinel claim that Brazil's Ministry of Aeronautics only began negotiating offset accords for SIVAM when Portaria No. 749/GM4 was published in November 1997, well after the SIVAM contract was signed with Raytheon.[126] This Air Force norm establishes the competence to approve and celebrate contracts, letters of contracts, and associated expenses for the Air Force procurement authorities, and it makes negotiating offset clauses obligatory under Air Force policy. Portaria No. 749/GM4 can be considered an update to Air Force offset documents issued in 1991 and 1992. A briefing provided by CCSIVAM in November 2002 to CTA's Institute for Industrial Promotion and Coordination (IFI) establishes that negotiating offsets was optional before Portaria No. 749/GM4 was issued. The briefing identified only three offset accords signed by the Air Force with companies since the norm went into effect. Of these three, only the accord with Rohde & Schwarz – specifying preparation of Air Force officers with data-link software and telecommunications knowledge, installing equipment and infrastructure needed for maintenance, and installing a process for maintenance and training – was linked to the SIVAM project.[127]

Former CISCEA chief and SIVAM critic Ivan Frota reiterated his slights about the project in 2004, claiming that 70 percent of the loans taken on by the Brazilian government for SIVAM development and installation went to support U.S. defense industry rather than Brazilian industry due to the equipment imports tied to the loans. He also claimed that the contracts were

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[126] Joel Fieguenbaum and Ricardo Rondinel, "Acuerdos offset de compensació comercial, industrial y tecnológica: Un estudio del caso brasileño," *Observatório de la Economía Latinoamericano* No. 68, 2006, URL: <http://www.eumed.net/cursecon/ecolat/br/06/jfrr.htm>, Accessed on 25 May 2007.

[127] CISCEA/CCSIVAM, "Acordo de Compensação/'Offset'," Briefing presented to the Brazilian Institute for Industrial Promotion and Coordination, 13 November 2002, URL: <http://www.ifi.cta.br /Arq/Workshop_2002/13-11/04-CCSIVAM.pps>, Accessed on 25 May 2007.

signed without any commercial compensation or technology transfer accord.[128] If Portaria No. 749/GM4 from November 1997 was actually needed to activate the Air Force's formal offset policy, Frota's claims would seem to be supported.

However, ATECH Foundation Director Tarcisio Takaishi Muta claimed in a November 2002 interview, however, that "an important and differentiated offset" was employed in the SIVAM project, because the contract provided for effective "absorption" of technological know-how by firms such as ATECH and Embraer, which assumed the position of developers and service providers under the contract. He also stated that the Brazilian government ensured this participation – referring to the COMFIREM teams – by participating in the technology absorption process in the U.S., Canada, and Sweden.[129] So, offsets were employed in SIVAM, but it is unclear what specific compensation provisions were employed in the government's contracts with Ericsson and Raytheon.

SIVAM Technology Applied to National Defense and Defense Industry Pursuits

While it is difficult to confirm that formal offset accords were signed with each of SIVAM's major foreign suppliers without access to the contracts themselves, the transfer of technology identified in Table 5-2 is well documented. Equipment purchases that feature foreign technology that Brazilian industry had no part in designing, have offered other ways for Brazilian public and private sector institutions making up part of Brazil's Defense Industrial Base to conduct research and innovate. For example, CTA, CCSIVAM, and ATECH Foundation entered into a formal accord to establish the Laboratory for Research in Electronic Warfare and Electromagnetic Surveillance at the Air Force's Aeronautics Technological Command (CTA).

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[128] Ivan Frota, "SIVAM-Raytheon e a Deshonra!" *O Quinto Poder* Edition 0013, 30 March 2004, URL: <http://www.oquintopoder.com.br/soberania/ed13b.htm>, Accessed on 25 May 2007.

[129] Vania Mezzonato and Ciça Guedes, "A Inteligência do Sistema É uma Questão de Soberania," *O Globo Projetos de Marketing – SIPAM*, 28 November 2002.

This laboratory has been the lead unit performing research and conducting training with the R-99A, R-99B, and R-95 aircrafts' sensors for applications in remote sensing, artificial intelligence, and electronic warfare.[130] CCSIVAM supplied equipment and software for the laboratory and ATECH financed 14 grants for student research in the areas of telecommunications, remote sensing, and artificial intelligence.[131]

During the 1999-2003 period, students studying at the CTA's Aeronautics Technological Institute (ITA), which works closely with the laboratory, were conducting research or writing theses focused on the capabilities and vulnerabilities of the R-99B's sensors, on systems for filtering SAR images to avoid clutter in tactical target identification, and on signal detection using digital spectral analysis.[132] Scientific papers published by ITA indicate that the Air Force is supporting research to develop methods for using SAR to distinguish man-made objects from natural ones, to measure changes in multi-temporal SAR images to support change detection estimation, and for classifying of SAR images using supervised neural classifiers to train a neural network for better image recognition.[133]

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[130] CCSIVAM, "Inaugurado Laboratório de Pesquisa em Guerra Eletrônica e Vigilância Eletromagnética da Amazônia," n.d., URL: <http://www.sivam.gov.br/INFO/un_10.htm>, Accessed on 12 July 2001.

[131] Fundação ATECH, "Atech patrocina programas de interesse convergentes ao CTA e SIVAM," November 2000, URL: <http://www.atech.br/noticias/novembro2000/patrocinio.htm>, Accessed on 6 March 2001; CCSIVAM, "Termo de Cooperação Assinado com o CTA Abre Novas Perspectivas para o Brasil," n.d., URL: <http://www.sivam.gov.br/INFO/press.htm>, Accessed on 6 March 2001; Virginia Silveira, "Laboratório pesquisará guerra eletrônica," *Gazeta Mercantil*, 6 March 2001.

[132] Instituto Tecnológico da Aeronáutica, "Artigos Apresentados em Congressos Internacionais de 2005," n.d., URL: <http://www.ele.ita.br/2005/Relatorio_Atividades_IEE_ITA_2005.pdf>, Accessed on 28 March 2007; Instituto Tecnológico da Aeronáutica, "Resumos e impactos operacionais dos trabalhos realizados pelos alunos do CEAAE desde 1999 a 2003," n.d., URL: <http://www.ele.ita.br/ceaae/ticeaae .doc>, Accessed 16 March 2007.

[133] Rafael Z. Schneider and David Fernandes, "Entropy concept for change detection in multitemporal SAR images," European Conference on Synthetic Aperture Radar (EUSAR`2002), Cologne-Germany, 4-6 June 2002, URL: <http://www.ele.ita.br/~david/EUSAR2002.pdf>, Accessed on 28 March 2007; Karlus A. C. Macedo, David Fernandes, and Rafael Z. Schneider, "Separação entre alvos naturais e construídos em imagens SAR," Anais do X Simpósio Brasileiro de Sensoriamento Remoto, Foz de Iguaçu, 21-26 April 2001, URL: <http://www.ele.ita.br/~david/sbsr_2001.pdf>, Accessed on 28 March 2007; Alexsandro M. Jacob, Elder M. Hemerly and David Fernandes, "SAR image classification using supervised

The CTA also sponsored research that seeks to improve the Air Force's ability to improve the images it takes with the R-95's hyper-spectral scanning system. Research conducted by the CTA's Institute of Advanced Studies demonstrates use of methods to evaluate and reduce noise in the hyperspectral images that are generated by aircraft vibrations and other factors.[134] Additional research by the institute measured the sensor's effectiveness in measuring and processing thermal images emanating from the heated liquid plume discharged from the cooling system of Brazil's two nuclear power plants in Rio de Janeiro.[135]

The laboratory and ITA students also were involved, in conjunction with the Pontifical Catholic University (PUC) of Rio de Janeiro, in designing a substitute algorithm for the data-link supplied by Rohde & Schwarz.[136] Rohde & Schwarz, as part of the offset agreement, provided an open source code to the Air Force for SIVAM air-to-air and ground-to-air communications, particularly between the R-99 aircraft and other Air Force operational assets such as the service's Super Tucano light attack aircraft and F-5 Tiger II fighter aircraft.[137] In 2002 the Air Force bought 198 Rohde & Schwarz M3AR VHF/UHF airborne transceivers ("software radios") that

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neural classifier," XI Simpósio Brasileiro de Sensoriamento Remoto, Belo Horizonte, 5-10 de April 2003, URL: <http://www.ele.ita.br/~david/sbsr_03_jac.pdf>, Accessed on 28 March 2007.

[134] Ruy Morgado de Castro and others, "Avaliação do ruido em sensores eletroópticos: abordagem da imagem escura do HSS," paper presented at the Anais 12th Symposium of Remote Sensing, 16-21 April 2005 (Goiânia, Brasil: INPE, 2005), URL: <http://marte.dpi.inpe.br/col/ltid.inpe.br/sbsr/2004/11.21.15.33/doc/355.pdf>, Accessed on 25 March 2007.

[135] Eduardo Viegas Dalle Lucca, "Uso de Sensor Hiperespectral Aerotransportado no Monitoramento da Pluma Termal Oceânica Decorrente da Descarga de Refrigeração da Central Nuclear de Angra Dos Reis," *Revista Brasileira de Cartografia* Vol. 57, No. 1, 2005 (online version): 48-55.

[136] CCSIVAM, "PUC e ITA – Unidos para Segurança das Telecomunicações do SIVAM," n.d., URL: <http://www.sivam.gov.br/INFO/un_29.htm>, Accessed on 28 May 2007; José Edimar Barbosa Oliveira, "Parceria Estratégica Entre ITA e CGEGAR: Apoio à Pesquisa em Guerra Eletrônica," ITA, Briefing presented at the V Symposium on Electronic Warfare, 1 September 2003, URL: < http://www.cta.br/sige/dia1desetembro%5CSimp%C3%B3sio%20de%20Guerra%20Eletr%C3%B4nica%20(%20V%20SIGE%20).ppt>, Accessed on 24 May 2007.

[137] "Brasileiros desenvolvem sistema de comunicações inviolável para o SIVAM," *Comciência Notícias*, 16 January 2004, URL: <http://www.comciencia.br/noticias/2004/16jan04/sivam.htm>, Accessed on 25 May 2007.

run on the same encrypted "SECOS" software that the SIVAM Series 400U data-link uses.[138] The equipment features digital frequency hopping capability at a rate of 200 changes per second.[139] The data-link is extremely important to SIVAM's information security, because it provides a secure means of communication through the Brazilian telecommunications system, which SIVAM uses to transmit the bulk of its data. Senior Air Force officials have indicated that because Brazil leases transponders on foreign-owned satellites for its military satellite communications system and for SIVAM, the unencrypted communications on these systems are vulnerable to interception.[140]

The ITA-PUC effort is important beyond just SIVAM though. The Air Force's System for Communications and Data-Link (SISCENDA), using the SECOS software, is serving as a basis for a joint military secure data-link system, as Figure 5-2 illustrates.[141] The Brazilian Army's 2003 purchase of Rohde & Schwarz MT3R digital radios, which is from the same family

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[138] Rohde & Schwarz, "Rohde & Schwarz Supplies State-of-the-Art Transceivers to Brazilian Air Force: Modern Software Radios Protect Amazon Rain Forest," 7 May 2002, URL: <http://www.cmu.rohde-schwarz.com/www/press.nsf/Release/PRESS24052002102615?OpenDocument>, Accessed on 28 May 2007; Mario A. de Freitas, "Sistema de Comunicações Seguras (SECOS) da Rohde & Schwarz - Características Gerais e Implementação no Data Link do COMAER," Briefing presented at the V Symposium on Electronic Warfare, 2 September 2003, URL: <http://www.cta.br/sige/dia2desetembro/SECOS_V_SIGE_02_SET_03.ppt>, Accessed on 28 May 2007.

[139] Rohde & Schwarz, *VHF/UHF Airborne Transceiver Family R&S M3AR*, online brochure, PD 0757.7552.22, (Germany: Rohde & Schwarz GmbH & Co. KG, no date), URL: <http://www.rohde-schwarz.com>, Accessed on 16 March 2003.

[140] Senado Federal, *Nota Taquigráfica da Vigésima Quinta Reunião Ordinária da Comissão de Relações Exteriores e Defesa Nacional da Primeira Sessão Legislativa Ordinária da Quinquagésima Segunda Legislatura, Realizada no Dia Seis de Novembro do Ano de Dois Mil e Três*; Tânia Monteiro, "Aeronáutica nega ter repassado dados do SIVAM," O Estado de São Paulo (online edition), 24 July 2002, URL: <http://www.estado.com.br>, Accessed on 24 July 2002.

[141] Controladoria-Geral da União, *Balança Geral da União – 2004 – Vol. I*, no date, <http://www.cgu.gov.br/Publicacoes/BGU/Arquivos/2004/VolumeI/037.pdf>, Accessed on 15 March 2006; Controladoria-Geral da União, *Balança Geral da União – 2005 – Vol. I*, no date, <http://www.cgu.gov.br/Publicacoes/BGU/Arquivos/2005/VolumeI/037.pdf>, Accessed on 9 August 2006; Controladoria-Geral da União, *Balança Geral da União – 2006 – Vol. I*, no date, <http://www.cgu.gov.br/Publicacoes/BGU/2006/VOLUME%20I/I-V-6.pdf >, Accessed on 15 March 2006; Alexandre Lessa, "O Sistema de Comunicações por Enlaces Digitais da Aeronáutica (SISCENDA): Aspectos Relacionados com o seu Desenvolvimento," Briefing presented at the V Symposium on Electronic Warfare, 1 September 2003. URL: <http://www.cta.br/sige/dia1desetembro/TCel%20Lessa.ppt>, Accessed on 28 May 2007.

as Air Force's software radios, allows for full interoperability, and the services are debating how to exploit this compatibility for a joint tactical data link.[142]

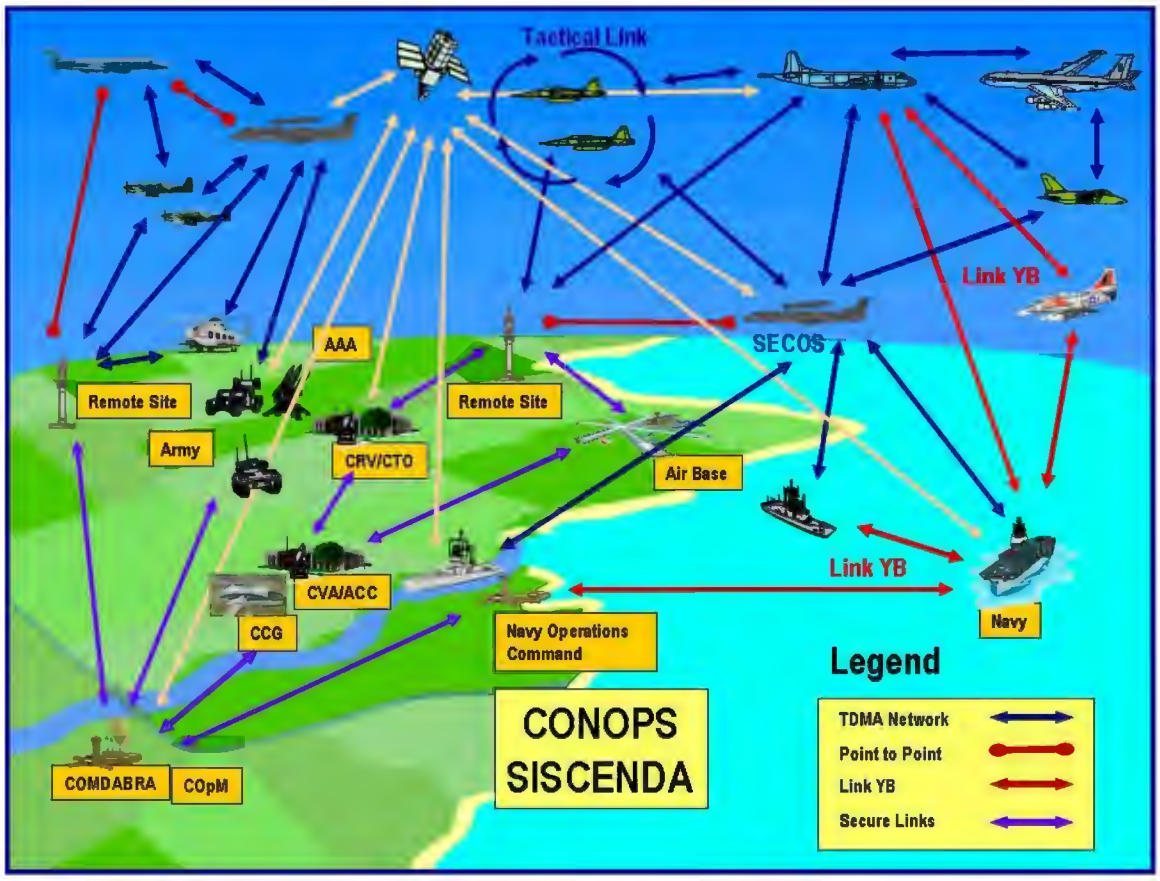

Figure 5-2: Concept of Operations for Air Force's System for Communications and Data-Link (SISCENDA).

Source: Adapted from Lessa, "O Sistema de Comunicações por Enlaces Digitais da Aeronáutica (SISCENDA): Aspectos Relacionados com o seu Desenvolvimento."

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[142] Ministério da Defesa, "Novo Sistems promete revolucionar as comunicações entre as Forças em casos de crise e até mesmo de Guerra," (Brasilia, DF: Assessoria de Comunicação Social do MD, 25 July 2006), URL: <https://www.defesa.gov.br/imprensa/mostra_materia.php?ID_MATERIA=26303>, Accessed on 02 August 2006; "CISCEA promove o I Seminário de Enlaces de Dados Operacionais" *Aeroespaço* 2, no. 12 (Rio de Janeiro, RJ: Força Aérea Brasileira/Departamento de Controle do Espaço Aéreo, October 2005): 9; Sistema de Armas, "SISCENDA," n.d., URL: <http://sistemadearmas.sites.uol.com.br/ge/dtl9fab.html>, Accessed on 13 October 2005; Rohde & Schwarz, *M3TR Multiband Multimode Multirole Tactical Radio*, online brochure, PD 0758.1758.62, (Germany: Rohde & Schwarz GmbH & Co. KG, February 2005), URL: <http://www.rohde-schwarz.com>, Accessed on 01 November 2006; "Brazil: Contract Awarded for SIVAM, Secure Army Communications" (text), São Paulo *Gazeta Mercantil*, 03 June 2003. (b) (3)

The purpose behind this public-private investment in the laboratory is to train personnel and develop research and technology that can be applied to improvement of SIVAM, as well as enhance operational support for the Air Force and establish a deeper S&T base for the service's electronic warfare systems and imagery analysis. Gaining access to technology has allowed for a qualitative leap in research at the CTA and in the private sector, including SIGINT and electronic warfare research, advances in software processing capabilities for MASINT applications, and secure communications research.[143] ATECH's interest in the endeavor anticipated recovery of some of its investment by hiring students completing their graduate education at ITA.

Equipment purchases for the SIVAM project also spurred Embraer to develop new expertise and capabilities in systems integration which it almost immediately converted into exports. Since its privatization in 1994, Embraer adopted a business model that essentially fully embraced globalization of production and moved away from the vertical model. As indicated in a 2002 UNCTAD study of Embraer's technology transfer practices, Embraer determined that trying to produce all components for aircraft was fruitless, and the company should concentrate on areas with the highest value-added for the aircraft:

> …The company's essential competence lies in the excellence of design and integration of highly complex production systems. The company focuses its activities on adding value as systems' integrator that dominates the different technical phases of the subsystems. It is not important to manufacture them, but to retain the capacity to combine and adapt them according to project requirements. As an aircraft is made up of over 28,000 part and components, the capacity to design and specify the product, and to integrate components into several subsystems in a harmonious way within the fuselage of the aircraft is both complex and difficult. Such a task is at the core of Embraer's strategy.[144]

The SIVAM project's two-year delay between the signing of the contract with Raytheon and the beginning of project installation afforded Embraer the time to revise its proposed airframe

[143] Oliveira, "Parceria Estratégica Entre ITA e CGEGAR: Apoio à Pesquisa em Guerra Eletrônica."

[144] José E. Cassiolato, Roberto Bernardes and Helena Lastres, *Transfer of Technology for successful Integration into the Global Economy: A Case Study of Embraer in Brazil* (New York and Geneva: United Nations, 2002), 24.

for the air surveillance and remote sensing aircraft, substituting the new EMB-145 jet aircraft for the EMB-120 Brasilia turbo-prop aircraft.[145] The EMB-145 aircraft was among the first of a new family of regional jets designed for the civilian market which benefited from technology developed by Embraer in the AM-X subsonic tactical combat aircraft program during the 1980s.[146] While the plane was designed to hold 50 passengers, the variants designed for SIVAM hold a relatively small crew due to the on-board systems (see Figures 5-3 and 5-4).

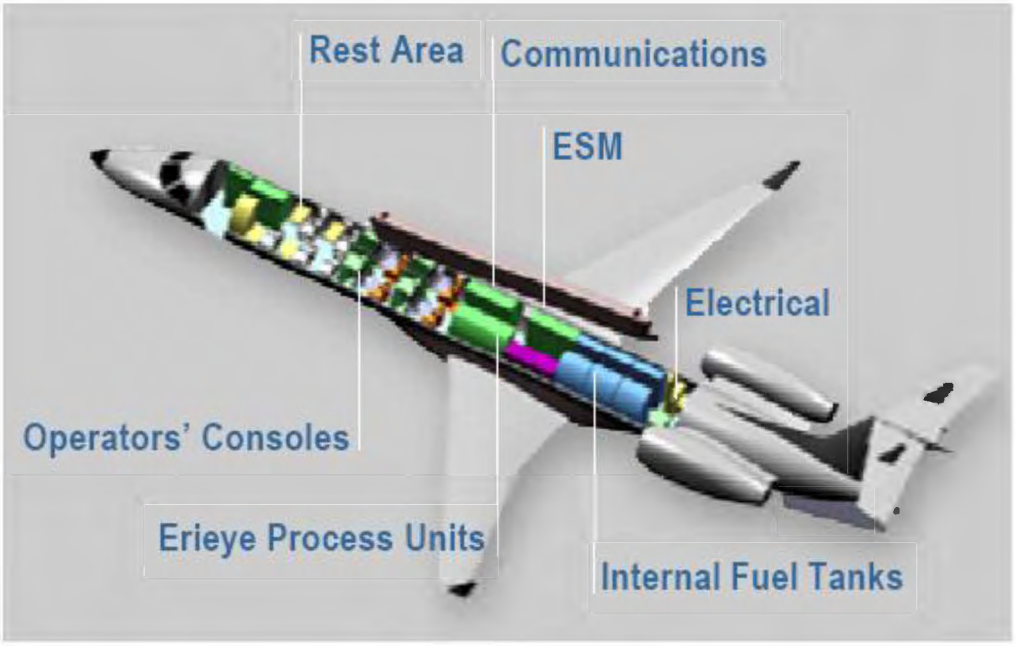

Figure 5-3: EMB-145SA Layout.

Source: Embraer.

[145] Câmara dos Deputados, *Audiência Pública No. 2183/03 – Atraso na Implantação do Sistema de Vigilância da Amazônia — SIVAM em Decorrência de Cortes de Gastos Governamentais* (Brasilia, DF: Departamento de Taquigrafia, Revisão e Redação, 3 December 2003), 3.

[146] Câmara dos Deputados, *Comissão das Relações Exteriores e Defesa Nacional - Audiência Pública No. 001162/01.*

Figure 5-4: EMB-145SA Systems and Cabin.

Source: Lessa, "O Sistema de Comunicações por Enlaces Digitais da Aeronáutica (SISCENDA): Aspectos Relacionados com o seu Desenvolvimento."

Embraer was most concerned with dominating the systems integration and software interface aspects of the EMB-145 air surveillance and remote sensing aircraft for the SIVAM project, because that is where the greatest value-added resided for future sales and for additional competencies. One former chief of the Air Force Sub-Department for Development and Programs explained Embraer`s expertise gained from SIVAM aircraft integration in this manner:

> What is this integration? The integration is making the intelligence of an airplane's software speak with this aircraft from the point of view of the platform, or rather, by means of software; when a pilot makes a curve, the software gives the correct order for the wing to lower this way or to rise that way, and so on. When a pilot presses a button or a trigger of an armament by means of software, the airplane is capable of identifying what the order means and launches the armament at the right moment, with the required precision. This is what is called integration: the capability that a company develops from making the artificial intelligence of an airplane communicate with a visible platform, and this is what Embraer has without a shadow of a doubt.[147]

[147] Câmara dos Deputados, *Commissão da Ciência e Tecnologia, Comunicação e Informática - Audiência Pública para discutir a proposta de aquisição dos caças supersônicos em substituição aos atuais Mirage, que deverão ser desativados* (Brasília: Departamento de Taquigrafia, Revisão e Redação, 6

Integration of systems into the EMB-145 airframe was taken so seriously that the Air Force sent its own personnel or engineers from ATECH personnel to Sweden, Canada, and the United States to oversee and to learn specific aspects of the integration process for the multiple sensor types: synthetic aperture radar, multi-spectral scanner, COMINT/ELINT systems, and the airborne early warning radar.[148] The government operated in this manner to ensure its key firms would benefit from all work being performed on SIVAM, and to avoid dreaded "black boxes" – technological packages that must be opened by reverse engineering in order to make adaptations. Former Director of Embraer Maurício Botelho and Embraer Vice President for International Relations Henrique Rzezinski both testified to congress about the importance of receiving sensor and weapons systems software from foreign suppliers with the source codes opened. They considered Embraer's ability to make adjustments to the software's algorithms and adapt it for Brazilian use to be a big technological advantage, because dominating the software design allowed the company to manufacture several hundred aircraft competitively, but without it their aircraft would have a hard time competing.[149]

April 2005), URL: <http://www2.camara.gov.br/comissoes/cctci/EventosLeiamaiscaca.html>, Accessed on 28 February 2006.

[148] CCSIVAM, "Embraer já entregou cinco aeronaves do SIVAM à Força Aérea," n.d, URL: <http://www.sivam.gov.br/info/un_41.htm>, Accessed on 24 May 2007; CCSIVAM, "Primeiro Imageador Multi-Espectral do SIVAM."; CCSIVAM, "Primeira aeronave de vigilância chega aos EUA."; Câmara dos Deputados, *Comissão de Defesa do Consumidor, Meio ambiente e Minorias - Audiência Pública No. 0720/00* (Brasília: Departamento de Taquigrafia, Revisão e Redação, 14 June 2000), 35-36, URL: <http://www2.camara.gov.br>, Accessed on 13 February 2003; Senado Federal, *Nota Taquigráfica da Vigésima Quinta Reunião Ordinária da Comissão de Relações Exteriores e Defesa Nacional da Primeira Sessão Legislativa Ordinária da Quinquagésima Segunda Legislatura, Realizada no Dia Seis de Novembro do Ano de Dois Mil e Três*, 13, 17; José Orlando Bellon, "O Sistema de Vigilância da Amazônia Contribuindo para o Conhecimento da Biodiversidade."; DIB & Associados, Perfil – Marcos de Castro Pacitti, n.d., URL: <http://www.dib.com.br/dib%20cd/C2005/P%C3%A1ginas/Portugu%C3%AAs/C2005_CV.htm>, Accessed on 25 May 2007; Ivo Michalick and Jorgito Maitiuzzi Stochero, "O Processo de Desenvolvimento de Uma Célula Operacional do SIVAM," Briefing presented at the Software Process Improvement Network Conference on 30 October 2003, Belo Horizonte, URL: <http://www.spin-bh.com.br/apresentacoes/spin23.ppt>, Accessed on 15 May 2007.

[149] Câmara dos Deputados, *Comissão das Relações Exteriores e Defesa Nacional - Audiência Pública No. 1915/03* (Brasília: Departamento de Taquigrafia, Revisão e Redação, 11 November 2001), 8,

Embraer ended up taking orders from both Greece and Mexico for the EMB-145SA surveillance aircraft and from Mexico a maritime patrol version of the EMB-145 remote sensing aircraft before the company had delivered fully operational aircraft to the Brazilian Air Force for SIVAM. For both of these planes Ericsson and the French company Thales served as Embraer's partners to provide the on-board sensors. The orders from overseas clients affirmed the value of Brazil's technology transfer strategy to government officials and provided Embraer with a validation of its business model for military sales. Embraer's newly developed integration expertise and ability to deliver highly sophisticated surveillance aircraft garnered the attention of potential customers in India, Malaysia, and the United States.[150] Key to Embraer's success was the ability to integrate a variety of sensors from different countries into its airframe.

The largest challenge in installing SIVAM was integration of the many subsystems with a software suite that could interact with the ground, airborne, and space-based sensors used in the project. With the exclusion of ESCA – SIVAM's original national integrator company – from the project in May 1995 and its subsequent bankruptcy and break-up, the government had to literally create a new non-profit company (ATECH Foundation) to take over as national integrator, contracting a group of ESCA engineers involved in SIVAM for this purpose. The national integrator's role was sweeping, with responsibility for development and integration of all activities including technical studies, planning and control, training of personnel, software development, integration of the system with SIPAM member organizations, and integration with

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URL: <http://www2.camara.gov.br>, Accessed on 14 May 2007; Câmara dos Deputados, *Comissão das Relações Exteriores e Defesa Nacional - Audiência Pública No. 001162/01*, 58-59.

[150] Embraer, *Prospecto Preliminar de Distribuição Pública Secundária de Ações Ordinárias de Emissão da EMBRAER – Empresa Brasileira de Aeronáutica S.A.*, 22 January 2007, URL: <http://www.merrilllynch-brasil.com.br/pdf/EMBRAER/Embraer-Prospecto_Preliminar_v.6.pdf>, Accessed on 29 May 2007; Embraer, "Press Release: Embraer Emphasizes Experience, Platform Mission Suitability in Lockheed-Martin-Led U.S. Army Bid," 11 February 2004, URL: <http://www.embraer.com>, Accessed on 29 May 2007; Embraer, "Press Release: Embraer Signs MOU with India for Development of a New AEW&C System," 8 February 2005, URL: <http://www.embraer.com>, Accessed on 29 May 2007; Embraer, "Press Release: Embraer Participates in Malaysia's DSA 2006 Exhibition," 24 April 2006, URL: <http://www.embraer.com>, Accessed on 29 May 2007.

other pertinent systems. The central software-oriented technology transfer activity that the Brazilian government relied upon ATECH Foundation for was the Coordination Sub-Center (SCC) and Operations Sub-Center (SCO) software suites.

The SCC and SCO software suites were designed by ATECH's U.S.-based subsidiary, Amazon Technologies (AmazonTech), which maintained offices in Boston and Garland either nearby or collocated with Raytheon facilities. While software development was essentially a joint effort between ATECH and Raytheon engineers, ATECH emphasizes its "exclusive" role as the primary integrator and designer of the "strategic" software that serves as the nucleus for SIVAM's operations.[151] Among the "strategic" software that ATECH developed in Garland were the territorial surveillance and electromagnetic spectrum surveillance applications that made up part of the SCC software suite. ATECH designed the SCC's analytic software to fuse multiple layers of data, including aerial images, topographic features, and other user-defined data to produce a variety of intelligence products. The software uses fuzzy logic and data merging to achieve automatic multiple image pattern recognition.[152] The technology is a key enabler for SIPAM's territorial surveillance and electromagnetic spectrum surveillance activities.

ATECH and Raytheon designed the rest of the SCC software in tandem, using a commercial-off-the-shelf operating system and infrastructure and selected applications in order to

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[151] Cosme Degenar, "O Valor de Conhecimento," *Tecnologia & Defesa*, 6 November 2003, *Defesa@Net*, URL: <http://www.defesanet.com.br/noticia/atechentre/atech.htm>, Accessed on 9 november 2003; Mônica Teixeira, "A Inovação na Atech: Organização nascida do projeto SIVAM quer inovar para diversificar negócios e dar aplicação dual a tecnologias," *Inovação UNICAMP*, 6 February 2006, URL: <http://wwwinovacao.unicamp.br/report/entre-staniscia.shtml>, Accessed on 16 February 2006; Tribunal Regional Federal da 4ª Região, *Apelação Cível*, 24.

[152] AmazonTech, "Products – Surveillance Systems," n.d., URL: <http://www.amazontech .com/english/pr_ss.htm>, Accessed on 24 December 1999; ATECH, "Business: Data Merging," n.d., URL: <http://www.atech.br/_new/en/negocios/provedoradesolucoes_conhecimentos.php?id=14>, Accessed on 28 March 2007; ATECH, "Innovation: Intelligent Image Recognition," n.d., URL: <http://www.atech.br/_new /en/inovacao/padroesemimagems.php>, Accessed on 28 March 2007; ATECH, "Business: Surveillance and Monitoring," n.d., URL: <http://www.atech.br/_new/en/negocios/provedoradesolucoes_areadeaplicacao .php?id=12>, Accessed on 28 March 2007; SIPAM, *Nota Técnica No. 04/2006*, 5-7; Michalick and Stochero, "O Processo de Desenvolvimento de Uma Célula Operacional do SIVAM."

design softwares that could be readily adapted and modified by Brazilian engineers.[153] While ATECH's personnel were working alongside their U.S. counterparts they were exchanging ideas on software design, injecting their own expertise, and capturing knowledge that they wanted to have at their disposal for future work on the system, according to former CCSIVAM chief José Orlando Bellon.[154] The SCO software, also considered "strategic" by the Brazilian government, was developed by ATECH engineers in Boston under the supervision of COMFIREM. The SCO's software was based largely on the Amazon Technologies application "Air Space Management and Control System" (ASMACS) and was designed much earlier because it had to meet with Federal Aviation Administration standards.[155] While ATECH already possessed the proprietary knowledge for air space management software developed by ESCA to serve the DACTA systems in Brazil, the addition of Raytheon and Lockheed-Martin manufactured radars to the Brazilian System for Airspace Control (SISCEAB) required some modifications because their software was different.[156]

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[153] Glenn Jones, "A Component-Based Architecture Derived from a Feature-Oriented Domain Analysis," Raytheon E-Systems, Briefing Presented at the Ground systems Architecture Workshop, 27 February 1997, El Segundo, URL: <http://sunset.usc.edu/gsaw/gsaw97/GJones.pdf>, Accessed on 29 May 2007.

[154] José Orlando Bellon, "O Sistema de Vigilância da Amazônia Contribuindo para o Conhecimento da Biodiversidade."

[155] AmazonTech, "ASMACS – Airspace Management and Control System," August 2003, URL: <http://www.amazontech.com/ASMACS.htm>, Accessed on 29 May 2007; Força Aérea Brasileira, "Aprovado software de controle de tráfego aéreo do SIVAM," *NOTAER* No. 46, 1999, URL: <http://www.maer.mil.br/Publicacao/Notaer/99not46/index.htm>, Accessed on 13 December 1999; CCSIVAM, "Plataforma de Desenvolvimento do SCO," n.d., URL: <http://www.sivam.gov.br/info/platdesenvolv.htm>, Accessed on 29 May 2007.

[156] Paullo Esteves, "Controle do espaço aéreo brasileiro – uma história que merece ser contada," *Defesa@Net*, 31 March 2005, URL: <http://www.defesanet.com.br/fab/controle.pdf>, Accessed on 29 May 2007; Tribunal de Contas da União, *AC-0087-23/96-P – Acórdão 87/1996 – Plenário – Auditoria, Ministério da Aeronáutica, Solicitação do Senado Federal, Verificação da legitimidade dos contratos e pagamentos efetuados à ESCA S.A. relativos à prestação de serviços, incluindo o projeto SIVAM*, 12 June 1996, URL: <http://www.tcu.gov.br>, Accessed on 6 May 2006; "Informações Estratégicas," *Tecnologia & Defesa* (online edition) No. 79, Ano 15, 1999, URL: <http://www.tecnodefesa.com.br/82report.htm>, Accessed on 3 September 1999.

Table 5-2 also highlights several examples of training and installation activities that benefited Brazilian firms. From a technological standpoint, the Brazilian firms that prospered most from system installation activity were Infranav, Schahin, and ATECH. Infranav was subcontracted by Raytheon to essentially act as its in-country team for installing equipment and conducting tests, since the Brazilian government was closely monitoring U.S. contractors and limiting access to some areas where work was be done. The key benefits to the company tied to its status as a subcontractor was the U.S-based training and wide-ranging installation activities that it performed – having a hand in the installation, test acceptance, training, or assisted operation for all ground-based equipment.[157] Schahin received most of the US $110 million reserved for civil works in SIVAM's external financing, and nothing in the way of offsets was tied to its duties. However, it developed deep expertise in logistics, planning, and construction for all types of infrastructure, including telecommunications facilities, energy facilities, surveillance facilities, public housing, and providing access to all of these sites in the logistically challenging Amazon region.[158]

SIVAM Project Ties to National Defense Activities

One of the many organizations putting information developed by SIVAM and SIPAM to work is the Brazilian Army. Preparation to exploit SIPAM capabilities for Army purposes have been developing since the 1990s, but from 2002-2005 the Army laid the legal and technical

[157] Infranav, "Infranav on the SIVAM Project," 2003, URL: <http://www.infranav.com.br/eng/eng_sivam.htm>, Accessed on 16 May 2007; Infranav, "Infranav's Service Array on the SIVAM Project," 2003, URL: <http://www.infranav.com.br/eng/sivam_services.htm>, Accessed on 16 May 2007; Senado Federal, *Comissão De Relações Exteriores - Reunião 12 de Abril de 1995*, 45-46.

[158] Schahin, "Engineering and Construction Portfolio: SIVAM Project," n.d., URL: <http://www.schahin.com.br/engenharia/eng/sivam.asp?secao=Portfolio>, Accessed on 16 May 2007; Schahin, "Engineering and Construction Portfolio: Operating Groups," n.d., URL: <http://www.schahin.com.br/engenharia/eng/sivam3.asp?secao=Portfolio>, Accessed on 16 May 2007; Schahin, "Engineering and Construction Portfilio: Logistics," n.d., URL: <http://www.schahin.com.br/engenharia/eng/sivam4.asp?secao=Portfolio>, Accessed on 16 May 2007; CCSIVAM, "SIVAM Leva Mais de US$ 100 Milhões de Investimentos Para a Amazônia Legal," n.d., URL: <http://www.sivam.gov.br/INFO/press14.htm>, Accessed on 16 May 2007.

groundwork to integrate SIPAM ISR capabilities with the Army's organic C³I system. For instance, the Army's 17th Jungle Infantry Brigade Command in Porto Velho installed a data link to SIPAM's three regionally-based CTOs, complementing additional antennas that connect the brigade with computer systems at the Army Integrated Electronic Warfare Center (CIGE).[159] The new telecommunications links provide the 17th Jungle Infantry Brigade access to a Regional Signals Intelligence Center Nucleus (NuCRIS) in Manaus, as well as the Central Nucleus for Signals Intelligence at CIGE in Brasilia.[160] These links and others constitute the Army's effort to integrate its SIGINT means with those available through SIPAM, within a broader "Strategic Electronic Warfare System" (SEGE). SEGE is available to Army field units through a tactical communications system (SISTAC) using multifunction digital radios that are capable of transmitting voice and data communications, and in some circumstances images.[161]

The Army also established the Army Imagery System (SIMAGEx) during this same period, with the intention to integrate SIPAM's imagery capabilities into the Army's system. The Army Commander's guiding directive since early 2003 specified that internal intelligence systems should take maximum advantage of the capabilities offered by SIPAM to optimize Army

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[159] Tribunal das Contas da União, *TC 008.947/2002-9 - Acompanhamento da implantação do projeto SIVAM relativo ao período de 15.11.2001 a 31.05.2002*, 12 March 2003, URL: <http://www.tcu .gov.br/Consultas/Juris/Docs/judoc/Acord/20030320/TC%20008.947.doc>, Accessed 01 November 2006.

[160] Controlador-Geral da União, *Balanço Geral da União 2001 – Vol. 5 – Ministério da Defesa*, (Brasilia, DF: Controlador-Geral da União, 2002), URL: <http://www.cgu.gov.br/bgu2001/VolumeI/ Capitulo%20V/V.05%20-%20MIN%20DA%20DEFESA.pdf>, C-116.

[161] Exército Brasileiro, *Boletim do Exército Nº 03/2004*, online ed., (Brasilia, DF: Secretaria-Geral do Exército, 16 January 2004), URL: <http://www.sgex.eb.mil.br/boletim/BE004/be_pdf/be03-04.pdf>, Accessed on 02 November 2006; "Brazil: Contract Awarded for SIVAM, Secure Army Communications" (text), São Paulo *Gazeta Mercantil*, 03 June 2003. (b) (3) [redacted]; Exército Brasileiro, *Boletim do Exército Nº 15/2006*, online ed., (Brasilia, DF: Secretaria-Geral do Exército, 13 April 2006), URL: <http://www.sgex.eb.mil.br/boletim/BE2006 /be_pdf/be15-06.pdf>, Accessed on 01 November 2006; Marco Damiani, "Poder: Dor de Cabeça," *IstoÉ Dinheiro* 278, 26 December 2002, online ed., URL: <http://www.Istoedinheiro/278/poder/index.htm>, Accessed on 01 November 2006; Rohde & Schwarz, *M3TR Multiband Multimode Multirole Tactical Radio*, online brochure, PD 0758.1758.62, (Germany: Rohde & Schwarz GmbH & Co. KG, February 2005), URL: <http://www.rohde-schwarz.com>, Accessed on 01 November 2006.

intelligence, electronic warfare, and C² capabilities in the Amazon region.[162] So, along these lines, the Army's Ground Operations Command (COTER) has implemented a plan to integrate the Ground Forces Command and Control System (SC2FTer) with SIPAM and other systems.[163] The internal regulation that reorganized SIMAGEx in 2003 specified that strategic directives within the system should be aligned with SIPAM initiatives to improve remote sensing, cartography, and military meteorology.[164] In practice this meant that in the past several years the Army visited Air Force's R-99B squadron to learn how it conducts air reconnaissance and collects images with the R-99B's SAR, FLIR, and multi-spectral imaging sensors.[165] The Army also developed an "Operational Intelligence Portal" to make imagery and cartographic products available between the three military services.[166]

Since 2002, The Army has trained with the Air Force and Navy in the Amazon basin using its "Resistance" strategy in a yearly exercise named "Operation Ajuricaba."[167] The exercise generally features both "Blue" and "Red" forces, and the second iteration of the exercise in 2003

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[162] Exército Brasileiro, *Diretriz Geral do Comandante do Exército/2003*, (Brasilia, DF: Comando do Exército, 2003), URL: <http://www.exercito.gov.br/01instit/CmtEx/Mensagens/diretriz.htm>, Accessed on 31 October 2006.

[163] Exército Brasileiro - Comando de Operações Terrestres (COTER), *Projeto C2 em Combate: Sistema de Commando e Controle do Exército e da Força Terrestre (Principais Aspectos)*, online ed. (Brasilia: Comando de Operações Terrestres, n.d.), URL: <http://www.coter.eb.mil.br>, Accessed 30 September 2006.

[164] Exército Brasileiro, *Boletim do Exército Nº 15/2006.*

[165] Força Aérea Brasileira, "Militares do Exército visitam Esquadrão Guardião."

[166] Controlador-Geral da União, *Balanço Geral da União 2005 – Vol. 5 – Ministério da Defesa*, (Brasilia, DF: Controlador-Geral da União, 2006), URL: <http://www.cgu.gov.br/bgu2005/VolumeI/Capitulo%20V/V.05%20-%20MIN%20DA%20DEFESA.pdf>, C-130.

[167] The Resistance Strategy – also known as GAMA R – is the ground force's means of defending the nation from a superior military power. The strategy essentially employs guerrilla warfare tactics to achieve a victory by moral, physical, and material weakening of the enemy, by disarticulating the enemy strategically and tactically, and by securing political support and international solidarity. The strategy in better defined in Ministério da Defesa, *PORTARIA NORMATIVA Nº 113/SPEAI/MD – Dispõe sobre a Doutrina Militar de Defesa – MD51-M-04*, (Brasilia, DF: Gabinete do Ministro, 31 July 2001), URL: <https://www.defesa.gov.br/bdlegis/dados_norma.php?numero=113&ano=2007&serie=A>, Accessed on 14 February 2007; and in Exército Brasileiro - Comando de Operações Terrestres, *Manual de Campanha C 124-1 - Estratégia*, online ed. (Brasilia: Comando do Exército, 2001), URL: <http://www.coter.eb.mil.br/1sch/manuais/C%20124-1.pdf>, Accessed 10 April 2007.

allowed SIPAM to be tested as a support to national defense activity. For instance, the SIPAM Planning and Control Cell at the Manaus-based CTO provided an alternate location for military personnel to monitor field based observers during the exercise. The observers were equipped with an INMARSAT-compatible Radio Determination Satellite Service (RDSS) Suitcase provided by SIPAM.[168] This allowed observers to relay observations about the simulated conflicts back to the exercise director in real time. The invading Red force, which played the part of a technologically superior military opponent, received assistance from the Air Force's R-99A and R-99B aircraft. The aircraft helped the Red force air components gain air superiority and helped Red force ground troops locate the Blue force enemy with data from on-board SIGINT and IMINT sensors that targeted Blue force movements and whereabouts. The IMINT and SIGINT resources in the SIPAM CTO were also used to help the Red force gain dominance of the electromagnetic spectrum in the operations area.[169]

For their part, the Blue force used a number of communications methods to evade the Red force troops. First, they used new Rohde & Schwarz digital radios that have frequency-hopping and encryption features so their communications could not be intercepted. The Blue force also used its indigenous conscripts as radio operators because they can speak in obscure dialects that the invading force could not understand. Finally, Blue forces used unorthodox, low-tech communications approaches, such as sending messages with carrier pigeons, to negate the Red force SIGINT direction finding advantage.[170] The Blue force also launched a massive

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[168] SIPAM, "No Combate a Ilícitos – 7. Operação Ajuricaba II do Exército Brasileiro," n.d., URL: <http://www.sipam.gov.br/Placon/combate_a_ilicitos.html>, Accessed on 13 September 2004; CCSIVAM, "Tecnologia: Radiodeterminação," n.d., URL: <http://www.sivam.gov.br/TECNO/subrec26.htm>, Accessed on 20 August 2003.

[169] Força Aérea Brasileira, "Operação Ajuricaba II: Perguntas mais frequentes," n.d., URL: <http://www.fab.mil.br/fab/operacaoaerea/ajuricaba/perguntas.htm>, Accessed on 4 November 2006; "Brazil: Military Commander of Amazon Boasts 'No One Beats Brazil' in Jungle" (text), Rio de Janeiro *Segurança e Defesa* 77, November 2003. (b) (3) ; Exército Brasileiro, "Braço Forte – Operações e Exercícios; Operação Ajuricaba II (2003)."

[170] "Brazil: Military Commander of Amazon Boasts 'No One Beats Brazil' in Jungle."

propaganda campaign designed to conquer and maintain support of the local population, using leaflets, billboards, posters, and radio and television announcements. They also performed civic action duties such as providing free health care, recreational activities for children, and other services, and reaching out to community leaders for their unconditional support against the invading forces.[171] The objective of these activities within the "Resistance" strategy, according to two former Amazon Military Commanders, is to guarantee that the local population is a force multiplier for the Blue force "guerrilla" warriors who are outmatched in conventional military might by the Red force.[172] SIPAM's ISR capabilities played a similar role in the 2005 Ajuricaba exercise. The Air Force's R-99A and R-99B aircraft were used to locate Blue force's encampments, depots, fugitive units and other tasks. The RDSS Suitcase communications sets were deployed with observers again in order to accompany the troops in the Blue force.[173]

Brazilian military forces have exercised in a loosely coordinated manner for years, but lack of a Ministry of Defense inhibited the services from developing a joint approach to many types of operations. Investments in new C³I capacity, such as the SIVAM infrastructure and its sensors managed by SIPAM, as well as Army investments in integration of its systems with SIPAM, are moving the services towards more regular joint operations.

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[171] Exército Brasileiro, "Braço Forte – Operações e Exercícios: Operação Ajuricaba II – Ação Cívico-Social da Força de Resistência," n.d., URL: <http://www.exercito.gov.br/03Brafor/operacoes/ajuricaba/n08d12.htm>, Accessed on 04 November 2006; Exército Brasileiro, "Braço Forte – Operações e Exercícios: Operação Ajuricaba II – Campanha de Operações Psicológicas da Força de Resistência do partido Azul," n.d., URL: <http://www.exercito.gov.br/03Brafor/operacoes/ajuricaba/n07d11.htm>, Accessed on 04 November 2006; "Brazilian Army Developing New Military Doctrine for Amazon Region" (text), São Paulo *Folha de São Paulo*, 14 November 2004. (b) (3) [redacted]; "Brazil: Army Exercise Reportedly Simulated Amazon Defense Against US Invasion." (text), São Paulo *Correio Braziliense*, 10 October 2004. (b) (3) [redacted]

[172] "Brazil: Military Commander of Amazon Boasts 'No One Beats Brazil' in Jungle."; FIEC, "Seminário 'Amazônia é Vida. Amazônia é Brasil: Palestra do General Valdesio Guilherme de Figueiredo," 24 September 2001, URL: <http://www.sfiec.org.br/palestras/amazonia/Amaz%F4nia%20%E9%20Vida_arquivos/Palestra_Gen_Valdesio.htm >, Accessed on 4 November 2006.

[173] Exército Brasileiro - Comando de Operações Terrestres (COTER), "Operação Ajuricaba IV – Exercícios Combinados, Apresentação."

Another example of activity consistent with directives stated in the 1996 and 2005 PDNs has been the Brazilian government's efforts to integrate its neighboring nations into the SIPAM concept and Brazil's paradigm of Amazon region security. The government does this by sharing SIVAM data and selling them aircraft and surveillance systems that are compatible with SIVAM and SIPAM. Brazil sees these activities as consistent with the values of the Amazon Cooperation Treaty and as a means of expanding its influence and defense relations within South America.[174]

One action completed to date has been the negotiation, signing, and ratification of a treaty with Peru to allow them access to SIVAM data and to help them build a system similar to SIVAM.[175] The Brazilian national integrator company for SIVAM, ATECH Foundation, is also assisting Venezuela in designing a territorial surveillance system compatible with SIVAM and the company has already helped Venezuela upgrade the air traffic control systems at Maiquetia Airport in Caracas which allow Brazil and Venezuela to exchange radar data.[176] Brazil's Air Force also conducted bilateral airspace management and policing exercises with neighboring Amazonian nations, beginning with Venezuela in 2000, with Peru in 2003, with Colombia in

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[174] Presidência da República/Casa Civil, "A Integração dos Paises Amazônicos ao SIPAM," Centro Gestor e Operacional do Sistema de Proteção da Amazônia, November 2003, URL: <http://www.sipam.gov.br>, Accessed on 22 January 2004; Organización del Tratado de Cooperación Amazónica (OTCA), *Acta de la I Reunión de Ministros de Defensa Sobre Defensa y Seguridad Integral de la Amazonia de la Organización del Tratado de Cooperación Amazónica - (OTCA)*, 13 July 2006, URL: <http://www.otca.org.br/en/institucional/index.php?id=1413>, Accessed on 9 February 2007; Ministério da Defesa, IV Conferência Ministerial de Defesa das Americas – Declaration of Manaus, 19 October 2000, URL: <http://www.exercito.gov.br/defesa/decmanausin.htm>, Accessed on 19 October 2000.

[175] Presidência da República, *Decreto Nº 5.752, de 12 de Abril de 2006 - Promulga o Memorando de Entendimento entre os Governos da República Federativa do Brasil e da República do Peru sobre Cooperação em Matéria de Proteção e Vigilância da Amazônia, celebrado em Lima, em 25 de agosto de 2003* (Brasilia, DF: Casa Civil/Subchefia para Assuntos Jurídicos, 2006), URL: <http://www.planalto.gov.br/ccivil_03/_Ato2004-2006/2006/Decreto/D5752.htm>, Accessed on 12 February 2007.

[176] "Brazil: Nine Amazon Countries Want to Use SIPAM as Integration Model." (text) Rio de Janeiro *Gazeta Mercantil Latinoamericano*, 24 January 2006. (b) (3) [redacted]; "Venezuela, Brazil Integrate Maiquetia, Amazon Air Traffic Control Areas." (text) *Aeroespaço*, 14 March 2007. (b) (3) [redacted].

2005, and with French Guiana in 2007.[177] SIVAM's R-99A aircraft are a key support to these exercises as well as ground-based radar assets in selected border areas.

Summary of Findings

One question this technological case sought to address was how closely the military follows defense policy directives and other guidance to define its technological needs to accomplish its mission. This chapter has revealed that even though SIVAM was conceived, planned, and bid for before the 1996 PDN was issued, military decision makers involved in the project's execution were sensitive to the national policies, directives, and guidance that governed the era during which the project was implemented. Much of the guidance that the Air Force and Secretariat of Strategic Affairs used to orient SIVAM procurement came from pre-PDN documents, but as new norms and policies were issued, the managers of the SIVAM project made adjustments to secure as much technology transfer as possible to the defense industrial base. The offset mechanisms employed allowed both Embraer and ATECH Foundation to develop sophisticated activities, products, and capacities not previously present in the country.

In terms of the range of supply options that the military decision makers and the defense leadership considered when planning to acquire the SIVAM equipment and technology for the project's needs, the 1993 evaluation and decision by the CDN to go with a foreign supplier to provide SIVAM's hardware limited the extent to which national industry could play a part in the project and contribute to increasing Brazil's technological autonomy. This does not mean that national industry played no role. Not being able to depend on the national treasury to fund long-term, complex projects of this nature, however, is a severe constraint to establishing true autonomy.

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[177] Controladoria-Geral da União, *Balança Geral da União – 2001 – Vol. I*; Controladoria-Geral da União, *Balança Geral da União – 2004 – Vol. I*; Controladoria-Geral da União, *Balança Geral da União – 2005 – Vol. I*; Força Aérea Brasileira, "CECOMSAER - Sala de Imprensa: Termina Operação Urubu 2007," 15 March 2007, URL: <http://www.fab.mil.br/imprensa/Noticias/2007/03_mar/1503_urubu_termina.htm>, Accessed on 15 March 2007.

With respect to the explicit rules and mechanisms derived from the defense policy and whether they helped or hindered the national defense industry's ability to secure military orders and pursue R&D opportunities for the SIVAM project, the record is mixed. One could view the Air Force's offset procedures as an effective means of securing technology transfer, but one that does so at the cost of having to import foreign technology. At this point it might be premature to evaluate whether national industry actors, apart from Embraer and ATECH, have been hindered by the state's turn to foreign suppliers. It seems clear that government decision makers evaluated national industry's capabilities to produce SIVAM, as well as their own ability to fund its construction over the long-term, and found industry's capabilities and the government's own capacity severely wanting in both circumstances.

In order to probe this matter further, Chapter 7 examines the demand and supply factors in play between the political leadership, the military and the domestic defense industry, as well as the institutional focuses and international structures that affected the actors' decision making. First, however, Chapter 6 examines the Air Force's AL-X program as the second part of the collective case study.

CHAPTER 6

AIR FORCE TECHNOLOGY PROCUREMENT AND THE AL-X PROGRAM

A second technological project related to the SIVAM case, but more exclusively related to the Air Force mission, is the AL-X light attack aircraft development and acquisition program. In examining the ALX program, this chapter seeks to clarify how closely the Air Force followed defense policy directives in defining their technology needs to accomplish the service's mission.[178] This chapter also seeks to establish the range of supply options Air Force planners considered when evaluating light attack aircraft available and their associated electronic systems and technology for the service's operational needs. This chapter seeks to define the explicit rules and mechanisms derived from the defense policy that helped or hindered the national defense industry's ability to secure military orders and pursue R&D opportunities in the AL-X program. Finally, the chapter presents the AL-X programs links to PDN directives in greater detail that apparent from Table 4-1 in Chapter 4.

The AL-X program also has it roots in the early 1990s, far predating the issuing of the 1996 PDN, but its planning, development, and execution was mostly consolidated during the 1995-2006 period and its links to Air Force national defense pursuits in the Amazon basin, to international export activity, and to development of the defense industrial base make it a worthwhile case to examine. The program was designed in tandem with SIVAM, and was meant

[178] The Air Force's mission includes: formulate military policy for aeronautics; proposing force structure, organization, training, and equipping of the Air Force; formulate strategic plans and execute activities related to the defense of the nation, in the aerospace field; operate the national air mail system; provide incentive and execute the activities of research and development related to aerospace activity; stimulate the aerospace industry; promote air navigation security; and other subsidiary activities established in Complementary Law No. 97 of 9 June 1999. Source: Brazilian Air Force web site, URL: <http://www.fab.mil.br>, Accessed on 4 June 2007.

to complement SIVAM activities and interact with its assets as well as contribute to other Air Force activities.

AL-X Program Genesis and Description

Brazil's Air Force had been planning to develop and procure a more potent version of the Tucano trainer aircraft for use in the Amazon basin airspace interdiction mission at since the early 1990s, to work in conjunction with its Amazon Surveillance System (SIVAM). Early on Embraer had planned to develop a more robust version of the T-27 Tucano trainer in order to compete in the U.S. Air Force Joint Primary Aircraft Training System competition. Simultaneously, Air Force officers working in the General Air Staff received a proposal for a strengthened Tucano aircraft from Aeronautics Minister Sócrates da Costa Monteiro that had been passed to him by the Embraer's president with an accompanying order to prepare "Preliminary Operational Requirements" for the aircraft with the framework of DMA 400-6, the Air Force's guidance on the life cycle of air force materiel and systems.[179] Subordinate units in DEPED prepared the preliminary requirements specifying the following competencies for a combat pilot to have:

1. Tactical navigation at low altitude in the daytime and at night (FLIR, NVG, INS, and GPS);
2. Tactical formations (datalink, encrypted radios, and multifunction displays);
3. Air-to-Air and Air-to-Ground employment of weapons;
4. Air combat;
5. Flight by instrumentation; and
6. Combat tactics.[180]

The same officers who drafted these requirements also suggested that beyond the light attack mission parameters of merely policing of airspace in the Amazon basin, this new aircraft could help alleviate the pilot training burden of the AT-26 Xavante aircraft in Natal, which was

[179] "Intensified Border Control Planned to Curb Drug Flow" (text), São Paulo *Agênica Estado*, 8 November 1994). (b) (3) [redacted]; Carlos Lorch, "Tucano Operacional! Entra em seviço na FAB o A-29," *Revista Força Aérea* 9, no. 33, Dec/Jan/Feb 2003/2004, 23-45; Jackson Flores, "Brazil's new teeth," *Flight International* 26 May-1 June 1999, 48.

[180] Lorch, "Tucano Operacional!' 33.

reaching the end of its operational life.[181] While sectors of the Air Force intended to have Embraer develop and produce a "super" Tucano all along, Air Force planners developed the additional requirement for the resulting AL-X to serve as a replacement trainer aircraft for its aging AT-26 Xavante aircraft.[182]

With the basic mission parameters defined, the Air Force drafted "Preliminary Technical, Logistic, and Industrial Requirements" responding to the earlier preliminary operational requirements. The design of the AL-X aimed to incorporate the components and technology listed in Table 6-1. The rationale for advanced technology of this nature in a trainer aircraft was because the Air Force was moving away from analog systems and most of the Air Force's future purchases or upgrades, such as the 46 F-5 aircraft the service planned to modernize, would feature advanced avionics with the hand-on-throttle-and-stick (HOTAS), head-up display (HUD), and computerized attack modes (CCIP, CCRP, etc.). Training in an aircraft without these systems would do Air Force pilots little good in the Air Force's calculus.[183]

[181] Lorch, 34.

[182] Senado Federal, *Nota da Comissão Permanente do Senado Federal Referente a 22a Reunião Extraordinária de 18/09/2001 da Comissão*, 4-5.

[183] Lorch, 39.

Avionics	Pilot Protection	Weapons
Laser inertial navigation system (INS)	On-board oxygen generating system (OBOGS)	Computerized weapons control system
Global positioning system (GPS)	Kevlar armoring	Infrared air-to-air missiles
Computerized electronic flight information system	Radar warning receiver (RWR)	Air-to-surface missiles
MIL-STD-1553B data bus	Traffic Alert and Collision Avoidance System	.50 caliber guns
Head up display (HUD)	Chaff and flare countermeasures	Laser designator for laser-guided munitions
Color multifunction displays	Zero-Zero Ejection System	70mm rocket
VHF/UHF digital tactical radios with a secure data-link	Built-in Test Equipment (BITE)	General purpose bombs
Digital video camera and recorder	All-glass canopy	
Night Vision Goggle III compatibility (NVG)		
Auto-pilot		
Forward looking infrared sensor (FLIR)		
Helmet mounted display		
Hand on throttle and stick system (HOTAS)		

Table 6-1: AL-X Technological Requirements.

Sources: Embraer, Flight International, Revista Força Aérea, Air Force Technology.

Government Options

After surveying the systems available on the global market, including the T-6A Texan II from the U.S., the MB-339 from Italy, and the Aero L-159 from the Czech Republic, Air Force officials resolved that to acquire the number of aircraft (99 units) it needed, and to obtain the technology desired, the service would have to contract Embraer to develop and build the AL-X.[184] Embraer signed a research and development contract with the Air Force in August 1995 to design the AL-X prototype, which was based off of Embraer's EMB-312H but had some stronger features, and eventually became known as the EMB-314. Embraer needed to find partners during 1996-1997 that could help it adapt modern avionics to the EMB-314 and design modern software for the AL-X prototype. The company faced another challenge – the Air Force's development

[184] Lorch, 40.

contract for the AL-X required that subcontractors working with Embraer do so with no additional costs to the Air Force, in other words, at their own risk.[185]

Embraer had been making its aircraft with capital input from overseas suppliers since its inception. The AL-X would necessarily be a highly globalized product because of the state-of-the-art electronic systems required by the Air Force. Component and system subcontractors were already established for much of the aircraft, because the AL-X shared a great deal with its predecessor the EMB-312 Tucano. For avionics the competition included Sextant from France, Smiths Aerospace and GEC-Marconi from the Great Britain, Elbit Systems from Israel, and Aeronautics Corp. from the United States. For radio systems, including a data-link, the public biding featured Collins Radio, Hazeltine Corp., Rohde & Schwarz, Tadiran Communications, and Thomson.[186]

The key Air Force consideration was obtaining the best avionics with the greatest benefit to national industry. Air Force engineer Sérgio Horta, who served as technical manager for the AL-X program, indicated the Air Force could either put the avionics together in a piecemeal manner from a number of suppliers, or it could seek a complete system from a sole supplier, but the team in DEPED's Sub-Department for Development and Programs decided to explore both options. Fellow DEPED engineer, Leonel Ferreira, explained the result of the department's efforts: "We visited all of the companies checking the documentation and the quality of the equipment and that was it. The choice was the same throughout the Brazilian Air Force. Really, Elbit had the best proposal."[187] Air Force Minister Lôbo stressed during a 1997 interview that benefiting national industry was the primary concern:

> …The second problem that worries us deeply is the question of how we bring Brazilian industry into the process, a step that we consider absolutely essential. We will do this in connection with the F-5, the P-X future transport plane, and the F-X future fighter plane. Domestic industry will

[185] Lorch, 42.

[186] Lorch, 41-42.

[187] Lorch, 41.

> be present in all of those programs; that is the goal in the field of re-equipment. It is precisely with that in mind that we are developing the AL-X.[188]

AL-X Program Development, Offset Application, and Financing Obstacles

While all competitors for systems in the AL-X program's development phase fielded sophisticated technology, their ability to meet the Air Force's compensatory demands was the critical factor in defining the "best offer" in the service's view. The Ministry of Aeronautics' Portaria No. 747/GM-2 of 1992 was in force and defined the offset mechanisms that the Air Force needed to follow in order to improve Embraer's capacity to meet Air Force operational needs, while simultaneously improving the nation's aerospace industrial base. While Elbit Systems won the bid to develop the avionics suite for the AL-X prototype, another Israeli firm El-Op Electro-Optronics Industries Ltd. won a separate US $10 million subcontract with Embraer in May 1997 to supply high altitude cockpit displays for the AL-X. In 2000, El-Op merged with Elbit.[189] During roughly the same time period, Elbit signed a contract to perform an upgrade to the avionics systems in Brazil's fleet of F-5 Tiger II fighter aircraft. These contracts included offset clauses that were related to the AL-X program, which are summarized in Table 6-2.

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[188] "Lobo on FAB Modernization, MAA-1 Missile," (text) São Paulo *Tecnologia & Defesa* 14 No. 73, 27 October 1997. (b) (3) [redacted]

[189] "Elbit in Brazil Avionics Deal" (text). Jerusalem *The Jerusalem Post* (internet version) 2 May 1997. (b) (3) [redacted]; Dror Marom, "El-Op to Help Upgrade Brazilian Fighter Plane" (text). *Tel Aviv Globes* (internet version) 20 May 1997. (b) (3) [redacted]; Securities and Exchange Commission, *Elbit Systems Ltd. Form 20-F, Filing Date: 06/14/2004*, EDGAR Online, 14 June 2004, URL: <http://sec.edgaronline.com/2004/06/14/0000910680-04-000611/section5.asp>, Accessed on 24 January 2007.

OFFSET TYPE	EXAMPLES
Financial Investment in Industrial and Technological Capabilities:	**Equipment Purchases** – In conjunction with the AL-X purchase of 198 Rohde & Schwarz M3AR data-link "software radios" the German supplier invested $20 million in a communications laboratory in Brazil for testing and measurements as part of an overall investment package of $40 million that establishes a logistic infrastructure for secure communications, includes training of Air Force personnel, and transfers the software source code for the Air Force's System for Communications and Data-Link (SISCENDA). **Investments in Productive Capacity** – In July 2001 Elbit acquired Grupo Aeromot, which is the major shareholder for Aeroeletrônica. The investment turned Aeroeletrônica into an Elbit subsidiary and afforded the Porto Alegre based firm the ability to produce Mission Display Processors, Color Multi-Function Displays, Digital Video Recorders, and Station Interface Units for the AL-X program as well as the F-5 and AM-X aircraft modernization programs. **Investment in Services** – Elbit's investments also enabled Aeroeletrônica to assume the duties for maintenance and logistic support for these aircraft systems.
Technology Transfer:	**Systems Integration** – With the AL-X integration activities, Embraer now dominates the ability to integrate Advanced Mission Computers, Color Multi-Function Displays, Head Up Display, Navigation Systems, Digital Video Recorders, and Embedded GPS/INS Radio Altimeters into a variety of aircraft. The Air Force has also woven use of simulators, planning mission stations, and debriefing stations into its training and operational routine. **Software Engineering** – Embraer technicians trained at Elbit facilities in Israel, participating in software development specifically for the AL-X. The resulting research of this activity was transferred to Embraer in its entirety, affording the company a proprietary product that it can export to other countries.

Table 6-2: Offset Benefits in the AL-X Program.

Sources: Aeroeletrônica, Câmara dos Deputados, EMAER/Força Aérea Brasileira, Gazeta Mercantil, Rohde & Schwarz, Securities and Exchange Commission, Senado Federal.

The offsets that the Israeli companies agreed to were a major victory for Embraer and for the Brazilian government. First, El-Op agreed to transfer the manufacturing know-how of the high altitude cockpit display to Embraer's Brazilian aerospace sector partner Aeromot, which El-Op has worked with before in Brazil's AM-X fighter/bomber program.[190] In July 2001, as part of the offsets clause, Elbit invested an initial US $2.5 million in Aeroeletrônica, a subsidiary of the Brazilian company Aeromot, to become Elbit's local partner to develop specific avionics systems (mission display processor, color multifunction display, digital video recorder, and station interface unit) for the AL-X. Aeroeletrônica also gained the task of providing logistic support for these systems to the Brazilian Air Force for the AL-X in conjunction with parent company

[190] Marom.

Elbit.[191] The investment by Elbit in Aeroeletrônica was part of a "buy back" provision in the offset clause, which obligated Elbit, "to make or facilitate local purchases or goods and services only if local suppliers can meet the commercial and technical competitive terms of the specific procurement."[192] Elbit's willingness to make concessions like this to Brazil, in addition to the quality of its technology and technical proposal, was the key factor to the Air Force granting them their contract.

Transfer of know-how and investments to the AL-X program has provided numerous benefits for Brazil's aerospace industry. During testimony to the Senate in December 2005, Air Force Commander Luiz Carlos da Silva Bueno stated that Aeroeletrônica was producing the avionics for the Air Force's F-5 upgrade, A-1/AM-X upgrade, and production of the AL-X aircraft components in a factory built by Elbit in Rio Grande do Sul state, which had the responsibility for producing some 700 color multi-function displays for Elbit.[193] All three planes used a common avionics schema with the AL-X conceived as the trainer aircraft for the other two fighter aircraft. Figures 6-1 and 6-2 show the AL-X Super Tucano aircraft and its avionics layout.

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[191] Securities and Exchange Commission, *Elbit Systems Ltd.*; Senado Federal, *Nota da Comissão Permanente do Senado Federal Referente a 22a Reunião Extraordinária de 18/09/2001 da Comissão*; Aeroeletrônica, *Press Release - Aeroeletrônica Indústria de Componentes Aviônicos S/A*, n.d., URL: <http://www.aeroeletronica.com.br/Press%20Release%20-%20Port.pdf>, Accessed on 7 February 2006.

[192] Securities and Exchange Commission, *Elbit Systems Ltd.*

[193] Senado Federal, *Notas Taquigráficas da Trigésima Reunião Extraordinária da Terceira Sessão Legislativa Ordinária da Quinquagésima Segunda Legislatura da Comissão de Relações Exteriores e Defesa Nacional, Realizada do Dia Quatorze de Dezembro do Ano de Dois Mil e Cinco, Às Nove Horas e Trinta Minutos*, (Brasilia, DF: Secretaria-Geral da Mesa/Subsecretaria de Taquigrafia, 14 December 2005): 6-10, URL: <http://www.senado.gov.br>, Accessed on 29 August 2006; Câmara dos Deputados, *Comissão das Relações Exteriores e Defesa Nacional - Audiência Pública No. 001162/01* (Brasília: Departamento de Taquigrafia, Revisão e Redação, 18 October 2001), URL: <http://www2.camara.gov.br>, Accessed on 13 February 2003.

Figure 6-1: AL-X Super Tucano Light Attack Aircraft.
Source: Força Aérea Brasileira.

Figure 6-2: AL-X Avionics Layout.
Source: EMAER/Força Aérea Brasileira.

In 2001 Defense Minister Geraldo Quintão stressed in Senate testimony that Air Force investments were paying great dividends in technology transfer as Embraer employees traveled to Israel for training with Elbit in software development for the AL-X. In testimony a month later, the Air Force's Director of the Department of Research and Development reiterated this to congress adding that the research done in Israel on software for the AL-X already resides in Brazil with Embraer. The expertise gained allowed Brazil to successfully compete for a US$ 150 million contract to Venezuela's Air Force to supply AM-X jet trainers with avionics, software, and equipment identical to the AL-X.[194] However, this deal was ultimately scuttled in 2006 because of end-use export restrictions on technology levied against Brazil by the U.S. government.[195]

Brazil's Air Force managed to avoid footing the bill for the development of the AL-X program, with the Science and Technology Ministry's Studies and Projects Financing Agency (FINEP) backing 55 percent of the costs and Embraer absorbing the rest.[196] The Air Force also had to scramble to secure external financing for production of the AL-X and to assure program continuity during a period of tight national budget resources. The Brazilian National Controller's Office, in its annual report on each ministry's programs and spending, tracked the progress of the AL-X program noting that the aircraft's production was contingent on finding external financing.

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[194] Senado Federal, *Nota da Comissão Permanente do Senado Federal Referente a 22a Reunião Extraordinária de 18/09/2001 da Comissão.*

[195] "Brazil: Amorim to Raise Case of Embraer Sales to Venezuela With Portman, Rice" (text), São Paulo *Agência Estado*, 24 January 2006. (b) (3) "Brazil: WTO Reportedly Unable to Mediate Embraer Aircraft Sale to Venezuela." São Paulo *O Estado de São Paulo*, 24 January 2006. (b) (3) Claudi Dantas Sequeira, "Dependência garantida," Correio Braziliense, 29 January 2006, Defesa@Net, URL: <http://www.defesanet.com.br/intel/crise_al_57.htm>, Accessed on 4 October 2006; Câmara dos Deputados, *Comissão das Relações Exteriores e Defesa Nacional - Audiência Pública No. 001162/01.*

[196] Damarice Alves, "Embraer fará Super Tucano," *O Vale Paraibano* (online edition), 11 July 1997, URL: <http://jornal.valeparaibano.com.br/1997/07/11/sjc/embr.html>, Accessed on 31 May 2007; Securities and Exchange Commission, *Embraer – Empresa Brasileira de Aeronáutica S.A. Form 20-F, Filing Date: 06/30/2006*, Embraer website, 30 June 2006, URL: <http://www.embraer.com/ri/english/inc/df.asp?caminho=home/doc/20f_2005.pdf>, Accessed on 15 October 2006.

Despite completion of two AL-X prototypes in 1998 and their successful testing in 1999, problems with disbursing budget resources in 2000 and failure to finalize the external financing contracts until November 2001 built a two-year delay into the AL-X's production, which only began in 2002.[197]

The overall contract for acquisition of the AL-X amounted to US $420 million for 76 aircraft, including four years of logistic support and five simulators.[198] An option to purchase 23 more aircraft was initiated in October 2005 at a cost of US$ 120 million.[199] Obtaining external financing for foreign components was necessary for production to begin, with Canadian, British, German, and Israeli banks involved.[200] The Air Force also obtained an external bank loan from a consortium of banks led by the Deutsche Bank in Uruguay to provide the initial funds for AL-X production. External credits applied toward AL-X production are presented in Table 6-3.

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[197] Controladoria-Geral da União, *Balança Geral da União – 1998 – Vol. I*, no date, URL: <http://www.cgu.gov.br/Publicacoes/BGU/Arquivos/1998/aero.zip>, Accessed on 15 March 2006; Controladoria-Geral da União, *Balança Geral da União – 1999 – Vol. I*, no date, URL: <http://www.cgu.gov.br/Publicacoes/BGU/Arquivos/1999/vol1.zip>, Accessed on 15 March 2006; Controladoria-Geral da União, *Balança Geral da União – 2000 – Vol. I*, no date, URL: <http://www.cgu.gov.br/Publicacoes/BGU/Arquivos/2000/Volume%20I/ParteIII/Ministerio%20da%20Defesa.pdf>, Accessed on 15 March 2006; Controladoria-Geral da União, *Balança Geral da União – 2001 – Vol. I*; Controladoria-Geral da União, *Balança Geral da União – 2002 – Vol. I*, no date, <http://www.cgu.gov.br/Publicacoes/BGU/Arquivos/2002/VolumeI/037.pdf>, Accessed on 15 March 2006.

[198] Tribunal de Contas da União, *TC 012.799/2002-0 - Representação feita pela 3ª Secex em cumprimento ao item 8.3 da Decisão nº 795/1999TCU-Plenário - Programa de Reaparelhamento da FAB*, 28 November 2002, URL: <http://www.tcu.gov.br>, Accessed on 6 May 2006.

[199] Iara Gomes, "FAB vai comprar 23 AL-X da Embraer por US$ 120 milhões," *Vale Paraibano*, 28 October 2005, NOTIMP No. 301, URL: <http://www.aer.mil.br/imprensa/enotimp/2005/10-OUT/enotimp301.htm>, Accessed on 25 June 2007.

[200] Senado Federal, *Resolução No. 66 – de 2002: Autoriza a União a contratar quatro operações de crédito externo, cujos recursos destinam-se à aquisição de equipamentos para o Projeto ALX, no âmbito do Programa de Fortalecimento do Sistema de Controle do Espaço Aéreo Brasileiro*, 20 December 2002, URL: <http://www.senado.gov.br>, Accessed on 24 January 2007.

Source of Approval	Bank	Amount of Credit	Stated/*Probable Use*
Senate Resolution No. 37 of 2001	Deutsche Bank S/A – Uruguay, I.F.E.	US$ 156,000,000	Partial AL-X Program Financing
Senate Resolution No. 66 of 2002	Export Development Canada (EDC)	US$ 47,496,124	Supplied Goods (*Pratt & Whitney Aircraft Engines - PT6A-68*)
Senate Resolution No. 66 of 2002	Deutsche Bank AG – London Branch and Exports Credit Guarantee Department	US$ 16,031,966	Martin-Baker Ejection Seats (127 units)
Senate Resolution No. 66 of 2002	Deutsche Bank AG	US$ 8,377,222 and Euros 880,000	Rohde & Schwarz Communications Equipment
Senate Resolution No. 66 of 2002	Banco BNP Paribas S/A and Bank Leumile-Israel B.M.	US$ 47,803,393	Supplied Goods (*Avionics – Advanced Mission Computers, Color Multi-Function Displays, Head Up Display, Navigation System, Digital Video Recorder, Embedded GPS/INS Radio Altimeter, Simulators, Planning Mission Stations, Debriefing Stations*)

Table 6-3: External Financing for AL-X Program.

Sources: Senado Federal, Securities and Exchange Commission.

The AL-X Program, National Defense Goals, and Defense Industrial Sales

As was briefly mentioned at the beginning of Chapter 5, the late 1980s and early 1990s served as a period of great angst for Brazilian national security decision makers given the world's attention on Brazilian stewardship of the Amazon region and the state's seeming inability to respond to problems there. While SIVAM was a multi-sector approach to the region's problem, the AL-X program was one the Air Force's key activities designed to address illicit air traffic and sovereignty concerns in the Amazon basin's airspace.

The 1996 PDN captured Air Force concerns in several of its directives, and continuity of the AL-X program was funded by the government precisely because the program effectively addressed many of the directives in the policy. Most observers could draw a clear connection between the AL-X program and directives featuring Amazon protection, enhancing the border control system, and increasing military presence in strategic areas. Less obvious, however, are the program's roles in stimulating scientific research to reduce dependence on external defense

equipment, enhancing regional integration and in the defense sector, and fostering peace and cooperation along Brazil's borders.

The AL-X program allowed the CTA's subordinate institutions to undertake activities related to the aircraft's development which can be applied in other areas. For instance, the requirement to incorporate armor into the Super Tucano's structure was a task handed over to the Materials Division of the Institute of Aeronautics and Space (IAE). The effort, designated "Project MARIMBA," developed removable armor shielding for the aircraft capable of stopping a .50 caliber round using ceramic materials. The Air Force's investment cost R$ 1.5 million over four years. The material ranges from 6-12 millimeters thick, weighs 36-38 kilograms per square meter, and can be adapted to use with helicopters or other airplanes.[201]

As early as November 2000, Brazil's defense leadership identified a promising export market for the Super Tucano.[202] Key in Brazil's calculus was the notion that the countries bordering Brazil's Amazon basin would eventually show a strong interest in buying Super Tucanos, because they faced the same threat of illicit air traffic and the Super Tucano was an aircraft specifically designed to deal with the threat. Sales of Super Tucano aircraft also supported interoperability of the Amazon Cooperation Treaty's member nation air forces and supported the PDN's directives in terms strengthening regional integration, expanding exchange programs with friendly regional Armed Forces, and enhancing surveillance, control, and defense of Brazil's borders and airspace. During his 2003-2004 tenure as Defense Minister, José Viegas

[201] Força Aérea Brasileira, "AL-X faz ensaio em vôo de blindagem," *NOTAER* No. 16, 3 October 2003, 5; Força Aérea Brasileira, "Entrvista: Francisco Lourenço de Melo e Pedro Paulo de Campos – Pesquisadores do CTA," *Revista Aerovisão* Ano 31, No. 207, July-September 2003, 3-4.

[202] Câmara dos Deputados, *Audiência Pública No. 001162/01*, 5; Senado Federal, *Nota da Comissão Permanente do Senado Federal Referente a 19a Reunião Extraordinária de 22/11/2000 da Comissao: CRE - Comissão de Rel. Exteriores e Def. Nacional* (Secretaria-Geral da Mesa/Subsecretaria de Taquigrafia, 13 November 2000), 13.

Filho systematically lobbied the air forces in neighboring countries to acquire Super Tucano aircraft.[203]

Although the Brazilian government struggled to support investment, research, and development for the AL-X program, defense leaders' efforts to promote aircraft exports have been steady and effective. Support to aircraft exports has a long history in Brazil, but developments in defense policy during the past decade have accelerated this propensity. The Foreign Ministry and the Ministry of Development, Industry, and Commerce assist in promoting overseas sales, but the Defense Ministry is the key entity in assisting sales of Brazilian aircraft through its bilateral and multilateral interactions with other governments' defense establishments. With continuity of approximately 2000 jobs involved in manufacturing Super Tucano aircraft at stake, securing additional orders to keep the production line open beyond the FAB order of 99 aircraft is of enduring economic and political interest to Brazil's leaders.[204]

Defense Minister Quintão testified to Congress in September 2001, that before Brazil even had a production contract for its own order of AL-X aircraft, the Dominican Republic had placed an US$ 85 million order for 10 Super Tucano aircraft.[205] Subsequent efforts to secure sales of the Super Tucano took a while to develop, partially because Embraer faced some impediments in securing contracts due to U.S. resistance to certain AL-X deals. The earliest case occurred at the end of the President Cardoso's administration. The Colombian Air Force had sought to purchase 40 units of the EMB-314 Super Tucano for US$ 234 million in 2002, but the U.S. SOUTHCOM Commander sent a memorandum to Colombia's air force commander registering concern about the plan because the U.S. government was paying to upgrade

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[203] Senado Federal, *2ª Reunião Ordinária da Sessão Legislativa Ordinária da Comissão de Relações Exteriores e Defesa Nacional* (Secretaria-Geral da Mesa/Subsecretaria de Taquigrafia, 11 March 2004), 15.

[204] Câmara dos Deputados, *Audiência Pública No. 001162/01.*

[205] Senado Federal, *Nota da Comissão Permanente do Senado Federal Referente a 22a Reunião Extraordinária de 18/09/2001 da Comissão.*

Colombian OV-10 and A-37 aircraft, and possibly because a U.S. company was fielding the T-6 Texan II aircraft as a competitor in the bidding process.[206] Rather than forcefully protest U.S. leverage on Colombia's decision makers, Brazil's Foreign Minister Celso Lafer decided to begin an effort to support Embraer's efforts to sell the AL-X to Colombia, which he turned over to the new Lula government in 2003.

Brazil's Air Force began participating in airspace management and control exercises beginning with Venezuela in 2000, with Peru in 2003, and with Colombia in 2005.[207] In order to market the Super Tucano, A-29 aircraft were on operational display during the exercise with Colombia's Air Force in 2005, and Colombia's pilots and observers were suitably impressed with the performance of Brazil's aircraft.[208] Brazil's interests in getting its neighbors to buy Super Tucano aircraft served the multiple goals of interoperability with neighbors, business for Embraer, and the potential for their greater participation in Brazil's Amazon Protection System, with which the AL-X was designed to be an integral part of.[209] Brazil eventually succeeded in its

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[206] Roberto Godoy, "EUA tentam barrar venda de aviões da Embraer," *O Estado de São Paulo* (internet version), 10 November 2002, URL: <http://www.estado.com.br>, Accessed on 10 November 2002; Roberto Godoy, "EUA disputam com Brasil venda para Colômbia," *O Estado de São Paulo* (internet version), 13 November 2002, URL: <http://www.estado.com.br>, Accessed on 13 November 2002; Hélio Contreiras, "Economia & Negócios: Bloqueio americano," *IstoÉ Senhor* 1730 (internet version), 28 November 2002, URL: <http://www.zaz.com.br/istoe1730/economia/1730_bloqueio_americano.htm>, Accessed on 24 November 2002.

[207] Controladoria-Geral da União, *Balança Geral da União – 2001 – Vol. I*; Controladoria-Geral da União, *Balança Geral da União – 2004 – Vol. I*; Controladoria-Geral da União, *Balança Geral da União – 2005 – Vol. I*.

[208] Força Aérea Brasileira, "Piloto colombiano acompanha interceptação a bordo do A-29," 24 May 2005 URL: <http://www.fab.mil.br/fab/operacaoaerea/colbra/PORTUGUES.htm>, Accessed on 9 February 2007.

[209] Presidência da República/Casa Civil, "A Integração dos Paises Amazônicos ao SIPAM," Centro Gestor e Operacional do Sistema de Proteção da Amazônia, November 2003, URL: <http://www.sipam.gov.br>, Accessed on 22 January 2004; Organización del Tratado de Cooperación Amazónica (OTCA), *Acta de la I Reunión de Ministros de Defensa Sobre Defensa y Seguridad Integral de la Amazonia de la Organización del Tratado de Cooperación Amazónica - (OTCA)*, 13 July 2006, URL: <http://www.otca.org.br/en/institucional/index.php?id=1413>, Accessed on 9 February 2007; Ministério da Defesa, IV Conferência Ministerial de Defesa das Americas – Declaration of Manaus, 19 October 2000, URL: <http://www.exercito.gov.br/defesa/decmanausin.htm>, Accessed on 19 October 2000.

efforts sell Super Tucano aircraft to Colombia in December 2005, with the first of 25 units to be delivered the Colombian Air Force starting in December 2006.[210]

Brazil also attempted Super Tucano sales to Venezuela's air force. During February 2005, Brazil's Ministry of Foreign Relations announced that President Luiz Inácio Lula da Silva would speak to Venezuelan President Hugo Chávez about the Venezuelan Air Force purchasing a total of 24 Super Tucano aircraft as part of a "strategic alliance" between the two countries, which would improve their combined counter-drug cooperation efforts.[211] At the time, a U.S. Deputy Assistant Secretary of Defense was quoted in the Brazilian press saying that the sale of Brazil's Super Tucano aircraft to Venezuela did not concern Washington, because Venezuela had legitimate needs to patrol its airspace and the Super Tucano was a good tool for this mission.[212] Eleven months after the announcement of the Brazil-Venezuela deal for Super Tucano and other Embraer aircraft, Venezuela announced that the U.S. had placed a veto on Embraer's sale of aircraft to Venezuela's air force. The U.S. Department of State claimed Embraer's sale of Super Tucano aircraft to Venezuela could help fuel an arms race in South America, and therefore it would block the transfer of U.S. technology to Venezuela, because of Chávez's unclear use of the military aircraft.[213]

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[210] Folha Online, "Embraer vende 25 aviões Super Tucano para Colômbia por US$ 235 mi," 8 December 2005, URL: <http://www1.folha.uol.com.br/folha/dinheiro/ult91u103171.shtml>, Accessed on 9 February 2007; Embraer, "Embraer Delivers Five Super Tucano Aircraft to Colombia," *Defesa@Net*, 7 December 2006, URL: <http://www.defesanet.com.br/zz/emb_st_fac_1_e.htm>, Accessed on 7 December 2006.

[211] Ministério das Relações Exteriores, "Nota No. 65 – 10/02/2005 -- Visita do Presidente Luiz Inácio Lula da Silva à Venezuela." Defesa@Net. 10 February 2005. URL: <http://defesanet.web .terra.com.br/intel/lulavenezuela>. Accessed 4 October 2006.

[212] Paulo Sotero, "Venda de Supertucano não preocupa EUA." *O Estado de São Paulo*, 16 February 2005. URL: <http://www.aer.mil.br/imprensa/enotimp/2005/02-FEV/enotimp047.htm#oesp>. Accessed 15 October 2006.

[213] Department of State, *Daily Press Briefing, January 13, 2006* (Washington, DC: DoS, 2006), URL: <http://www.state.gov/r/pa/prs/dpb/2006/59186.htm>. Accessed 13 October 2006; Department of State, *Daily Press Briefing, January 20, 2006* (Washington, DC: DoS, 2006), URL: <http://www.state.gov /r/pa/prs/dpb/2006/59543.htm>, Accessed 13 October 2006.

As of early 2007, the Brazilian Air Force was attempting to convince the Bolivian Air Force to purchase Super Tucano aircraft. Bolivian Air Force chief of staff General Carlos Daniel Salazar Osório was recently granted a one hour flight aboard a Brazilian Air Force A-29 Super Tucano aircraft at Natal Air Base. General Salazar's purpose was to learn about the technical characteristics of the plane given his service's intent to acquire this category of aircraft. After the flight in Natal, he was given a demonstration session in the Super Tucano simulator and traveled to the Gavião Peixoto plant in São Paulo state, where Embraer manufactures the aircraft.[214]

As a "globalized" product, the Super Tucano features component inputs from a number of countries, including Canada, Great Britain, Germany, Israel, Brazil, and the United States. Several components, including the propeller, an infrared sensor, the engines, and elements of the Super Tucano's avionics are either produced in the U.S. or under license in third countries with technology subject to U.S. end-use controls.[215] But clearly the government is beginning to nationalize some parts of this aircraft through the defense policy provisions, such as the software and avionics, as explained above. Brazil's link between policy goals and defense industrial activities appears to be gaining traction, but there will continue to be problems that inhibit the government from achieving the level of autonomy it strives for. In terms of continued exports, given Brazil's interest in involving other neighbors in Amazon basin security activities, and its interests in continued sales of its AL-X aircraft to an international market estimated at US$ 2.1

[214] Força Aérea Brasileira, "CECOMSAER - Sala de Imprensa: General Boliviano Voa no A-29 Super Tucano," 16 April 2007, URL: <http://www.fab.mil.br/imprensa/Noticias/2007/04_apr/1604_bant.htm>, Accessed on 18 April 2007.

[215] Hugo Studart and Leonard Attuch, "O pouso forçado da Embraer," *IstoÉ Dinheiro*, online ed., 18 January 2006, URL: <http://www.terra.com.br/istoedinheiro/435/economia/pouso_forcado_embraer.htm>, Accessed 13 October 2006; "Brazil: Expert Views Reasons Behind Veto on Embraer Plane Sale to Venezuela" (text), Porto Alegre *Zero Hora*, 13 January 2006. (b) (3) [redacted]

billion, with potential sales in Turkey and Indonesia, Embraer is likely to hold off pursuing sales to Venezuela in the short-medium term.[216]

Summary of Findings

This chapter examined how closely the Air Force followed defense policy directives and other guidance to define their technology needs in support of their missions. A clear correlation can be drawn between what the Air Force hoped to achieve with the AL-X program and what defense policy directives from the 1996 PDN specify. In terms of developing an aircraft with a high level of technological content, that met the operational criteria related to mission needs, and which featured a central role for domestic defense industry, the Air Force's AL-X program achieved these aims. The AL-X program did show itself to be dependent on some external technology, although the Air Force took aggressive measures to mitigate that dependence through offset mechanisms.

In terms of the range of supply options that Air Force decision makers and the defense leadership considered, the circumstances seem to have been fixed to favor Embraer and a national solution all along. Since the AL-X concept was derived from an existing Embraer prototype airframe (the EMB-312 Tucano), acquiring aircraft from an external supplier would not make logistic sense. This was reflected in the "Preliminary Technical, Logistic, and Industrial Requirements," for the AL-X program, drafted by the Air Staff and DEPED, and defined narrowly enough that no other supplier would have a viable solution.

The rules and mechanisms derived from the defense policy that helped national defense industry's ability to secure military orders and pursue R&D opportunities for this project are evident in the heavy application of offset mechanisms for the portions of the aircraft that Embraer could not deliver on, such as modern avionics, the data-link, and the supporting software.

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[216] "Embraer corre atrás de Mercado de US$ 2,1 bilhões para o Super Tucano," Vale Paraibano, 7 January 2007, NOTIMP, URL: <http://www.fab.mil.br>, Accessed on 7 January 2007.

Aeroeletrônica was a clear beneficiary of this policy, receiving substantial investments to conduct production, maintenance, and logistics activity that would not have been viable without support from its new parent company Elbit. Embraer is perhaps the largest beneficiary, given that Air Force investments have allowed the company to design a software to run the Super Tucano's systems (and those of the modernized F-5 and A-1/AM-X aircraft), that belongs to Brazil, as well as to master systems integration of state-of-the-art avionics previously unavailable in Brazil.

If there is one area that can be faulted from a standpoint of technological independence, it is Embraer's strategy for building aircraft. Embraer operates on the assumption that hardware will be available to the company to build its aircraft and that systems integration and software design are the key technologies to master domestically. The many foreign components in the AL-X and its other aircraft allow Embraer to share risk with foreign partners, but because some of the technology is subject to end-use restrictions, other nations may be able to control the company's commercial pursuits when they deem it in their interest, as the failed Super Tucano sale to Venezuela illustrates. A strategy of vertical production would increase the company's risk, but it would afford more independence. This is will be discussed more in Chapter 7.

CHAPTER 7

DEFENSE INDUSTRY, STATE ASSISTANCE, AND INFLUENCE

This chapter's purpose is to address two key questions presented in Chapter 1 of this study. The first of these two questions was concerned with how Brazil's defense industry influences the defense policy process or the principal actors who make that policy. The second question concentrated on what national and international resources are available to Brazil's defense industry in order to allow its firms to develop military technology.

In Chapter 2 Amit Gupta's 1997 study of defense industries was discussed highlighting the usefulness of his analytic framework for examining the interplay between the political sector, the Armed Forces, and defense industries in defining the direction of defense industrial policy. Gupta specified that these three sets of actors had different motives and bargaining capabilities in the formulation of their decisions which are shaped by demand and supply factors. The demand factors that condition motives for acquiring or developing weapons systems break down between threats on the regional or global scene, which are either real or perceived, or organizational ambitions held by the political or military sectors. Gupta's supply factors that condition bargaining capabilities included the availability of resources and the existence of external suppliers who would either provide weapons systems or transfer technology for domestic development of the systems needed.[217]

Chapter 2 also introduced Ken Conca's framework for examining Brazil's defense industrialization. Conca's framework emphasized developments at both the domestic and

[217] Gupta, 11-21.

international structural level, which he called "domestic politics" and "global markets" and which were both important because the former defined who controls defense industrial policy and the latter defined whether industry could gain access to technology, investment capital, or export markets. The domestic institutional focus of Conca's framework featured examining the roles, rules, and procedures in the defense sector. The international structural focus of the framework emphasized industry's access to resources needed to sustain the defense industry's activities.[218]

Building upon the base discussion of state policies, norms, and procedures issued presented in Chapter 4, this chapter aims at examining those policies conditioning the behavior of defense industry companies, their military clients and allied organizations, and the political sector, as well as the defense industry's success in shaping the evolution of these documents. The chapter also examines the SIVAM project and the AL-X program using Gupta's and Conca's frameworks after a more general discussion of how the defense industry exerts influence in Brazil.

Defining the Defense Industrial Base

The July 2005 PNID defined Brazil's defense industrial base as "the collection of state and private enterprises, as well as civilian and military organizations, that participate in one or more stages of research, development, production, distribution, and maintenance of strategic defense products."[219] This broad definition apparently aimed at including a vast swath of public and private entities in defense industry activity in order to more flexibly extend the benefits flowing from the new norm to whatever firm, research center, or educational institution needed it. Brazil's defense sector is made up of an enormous amalgam of organizations known as the Defense Industrial Base (BID).

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[218] Conca, 10-13.

[219] Ministério da Defesa, "Portaria Normativa No. 899/MD, de 19 de Julho de 2005," *Revista Jurídica do Ministério da Defesa* No. 4, November 2005, 167.

Preparation to adopt this broad definition began at roughly the same time that a host of other guidance on defense industry activities was issued. In January 2002, the defense ministry issued initial guidance defining the military organizations that would be classified as "industrial organizations" for the purpose of complying with the Law 8.666 on Public Biddings. The Navy designated 6 organizations, the Army designated 5 organizations, and the Air Force only designated 3 organizations, and most of these were either materiel parks or maintenance depots.[220] In May 2005, Portaria Normativa No. 577/MD was issued, revising the previous norm, classifying more military organizations as industrial organizations including each service's science and technological centers, logistic and maintenance facilities, and military-controlled arms factories, among other units.[221] This norm designated 12 Navy organizations, 13 Army organizations, and 6 Air Force organizations as industrial in nature, shortly before the National Policy for Defense Industry (PNID) was issued. Finally, in September 2006, the defense ministry published an update to Portaria Normativa No. 577, which greatly expanded the number of military organizations that were be classified as industrial organizations. While there was no change in the organizations designated by the Navy, the Army number expanded to 29 different organizations, and the Air Force number expanded to 12 organizations.[222]

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[220] Ministério da Defesa, *Portaria Normativa No. 11/MD de 11 de Janeiro de 2002 – Classifica as Organizações Militares, no âmbito do Ministério da Defesa, como organizações industriais, para efeito do disposto no § 6º do art. 23 da Lei no. 8.666, de 21 de Junho de 1993* (Brasilia, DF: Gabinete do Ministro, 11 January 2002), URL: <https://www.defesa.gov.br/bdlegis/dados_norma.php?numero=11&ano=2002 &serie=A>, Accessed on 10 June 2007.

[221] Ministério da Defesa, "Portaria Normativa No. 577/MD, de 6 de Maio de 2005," *Revista Jurídica do Ministério da Defesa* No. 3, July 2005, 157.

[222] Ministério da Defesa, *Portaria Normativa No. 1242/MD de 21 de Setembro de 2006 – Classifica as Organizações Militares como organizações industriais, no âmbito do Ministério da Defesa, e da outras providências* (Brasilia, DF: Gabinete do Ministro, 21 September 2006), URL: <https://www. defesa.gov.br/bdlegis/dados_norma.php?numero=1242&ano=2006&serie=A>, Accessed on 14 February 2007.

The Defense Industrial Lobby in Brazil

Players. Brazil's defense industry lobby is made up of the individual public and private companies involved in the production of arms, weapons systems, and their components, the private consulting groups they hire to look after their interests, and the larger associations that look out after the entire sectors interests. While the Armed Forces often act to "lobby" policy makers and the Congress in support of their corporate interests, this should be distinguished from the defense industry's lobbying efforts, even though the Armed Forces and the defense industrial lobby are natural allies on many issues. This section examines mainly private sector actors.

Andréa Cristina de Jesus Oliveira, a scholar at the State University of Campinas (Unicamp), divides Brazilian lobbying activity into four groups. "Public lobbying" activity features formal parliamentary advisory detachments from the major ministries, agencies, and other state organs. "Institutional lobbying" activities are conducted by the in-house corporate issues departments that are commonly found inside private businesses, which interact directly with different spheres and levels of government. "Class lobbying" is typically conducted by large associations or consortiums that defend the interests of its member businesses, usually within a particular sector of the economy. In the Brazilian case, some notable examples are the São Paulo State Federation of Industries (FIESP), the National Confederation of Industry (CNI), the Brazilian Society for Progress in Science (SBPC), and the Parliamentary Advisory Body of the Inter-Union Department (DIAP). Finally, "private lobbying" refers to the unregulated activities of private consulting offices, which often include deep interaction with publicity agencies, public relations firms, and law offices.[223]

For this study's purposes, the most transparent and measurable lobbying efforts in the defense industrial sector are undertaken by the several large private associations that play a

[223] Paulo César Nascimento, Estudo avalia impactos da atuação de lobistas," *Jornal da Unicamp* (online ed.) Edition 254, 31 May - 4 June 2004, URL: <http://www.unicamp.br/unicamp/unicamp_hoje/ju/Junho2004/ju254pag3.html>, Accessed on 8 June 2007.

sector-wide approach, such as FIESP's Committee for the Productive Chain of Defense Industry (COMDEFESA), the Brazilian Association of Aerospace Industries (AIAB), and the Brazilian Association of Defense Material Industries (ABIMDE). These associations make up part of the "class lobbying" effort on behalf of firms like ATECH, Aeroeletrônica, Embraer, and others.

The military services belong the "public lobbying" group. According to University of Brasilia scholar Maria Helena de Castro Santos, the military services always act as institutional actors in their lobbying activities, monitoring legislation that affects their corporate interests in a systematic and comprehensive manner. Not having any partisan agenda, the services engage with all political parties and negotiate based on the technical merit of their arguments. The three Armed Forces actually maintained offices inside the facility housing the Senate and Chamber of Deputies in the past, and even with the creation of the Ministry of Defense, Castro Santos maintains that little has changed in terms of their modus operandi.[224]

Venues of Activity. The defense industrial lobby exercises influence in multiple venues, the most visible of which are the many symposiums, conferences, trade shows, and public hearings where they make their case to adjust policies and procedures to the military and political sectors in conjunction with broader audiences. Some of the forums the defense industrial lobby members have used to air arguments and voice needs during the 1995-2006 time frame include: congressional hearings they are invited to; conferences and symposiums hosted by the military services, defense ministry, or other ministries; trade shows such as the Latin American Aero & Defense show (LAAD) held in Rio de Janeiro every two years; and conferences held by public interest groups such as Projeto Brasil, which discuss public policy issues in a setting open to the public.

[224] Maria Helena de Castro Santos, "The Brazilian Military in Post-Democratic Transition," *Revista Fuerzas Armadas y Sociedad* 18, No. 3-4, July-December 2004: 139-144.

Table 7-1 provides a breakdown of some of the forums where the defense industry lobbyists have been featured as prominent speakers since the Defense Ministry was created. In most cases the individuals come from one of the class lobbying groups or from private industry. In some cases those making presentations were from militarily managed public companies, such as IMBEL and EMGEPRON. The table is a representative sample, rather than a comprehensive picture, of one type of lobbying activity over the 2000-2006 period, which demonstrates an intense concern on the part of the sponsors for the defense industry's capability to serve military logistic needs. A heavy presence of Embraer at these forums is noteworthy. As the most successful defense firm in the industrial sector and the favorite of many in government and congress, Embraer was repeatedly invited by several congressional committees to provide updates on specific activities – ranging from the company's activities in the SIVAM project, to its thoughts on defense industrial policy, to its military aircraft manufacturing plans. Interaction between the defense industrial lobby, the military, and congressional members at several of the non-congressional forums in Table 7-1 was common too, since parliamentary members were generally on the guest list.

Date	Forum	Sponsoring Organization	Featured Industrial Lobby Speaker(s)
6-Apr-2000	Public Hearing: Considerations About the Brazilian Aerospace Sector	Chamber of Deputies: Foreign Relations and National Defense Commission	Walter Bartels - AIAB President
14-Jun-2000	Public Hearing: Discussion About the Sale of Part of the Controlling Shares of Embraer, the Consequences for Consumers, and the Eventual Environmental Impact with Relation to the SIVAM/SIPAM Project	Chamber of Deputies: Consumer Defense, Environment & Minorities Commission	Mauricio Botelho - Embraer President
18-Oct-2001	Public Hearing: Debate About an Industrial Policy in the Area of National Defense	Chamber of Deputies: Foreign Relations and National Defense Commission	Henrique Rzezinski - Embraer VP for International Relations; Vicente Bicudo - Strategic Affairs Advisor for CGT (Brazilian General Center of Workers)
6-Mar-2002	1st National Meeting for Military Logistics	Brazilian Defense Ministry	Joao Verdi de Carvalho Leite - AVIBRAS President; Horacio Lafer Piva - FIESP President; Domingos Aderbal Olivieri - ABIMDE President; Walter Bartels AIAB President; Fernando Luiz Gonçalves Bezerra - CNI President; Tarcisio Takashi Muta - ATECH CEO; Henrique Rzezinski - Embraer VP for International Relations
3-Dec-2002	National Defense and Industrial Policy Seminar	Agência Dinheiro Vivo	Claudio Miguel Barreto Viana - Aeromot President; Tarcisio Takashi Muta - ATECH CEO; Claudio Moreira - Embraer Director of Strategic Relations; Jairo Candido INBRAFILTRO President; Joao Verdi de Carvalho Leite - AVIBRAS President
11-Nov-2003	Public Hearing: Clarifications About Embraer's Activities	Chamber of Deputies: Foreign Relations and National Defense Commission	Mauricio Botelho - Embraer President
6-Mar-2004	Cycle of Debates: The Armed Foces and the Scientific and Technological Development of the Country	Brazilian Defense Ministry	Jose Albano do Amarante - IMBEL President; Jairo Candido - IBRAFILTRO Group President

6-Apr-2005	Public Hearing: Discussion of the Proposed Acquisition of Supersonic Fighter Aircraft for Substitution of Mirage Aircraft	Chamber of Deputies: Science, Technology, Communication & Informatics Commission	Walter Bartels - AIAB President
26-Oct-2005	Seminar: Mobilization of Defense Materiel	Chamber of Deputies: Foreign Relations and National Defense Commission	Paulo Skaf - FIESP President; Roberto Guimarães de Carvalho - ABIMDE President; Walter Bartels AIAB President
18-Nov-2005	23rd Forum Projeto Brasil - Military Technology	Agência Dinheiro Vivo/Projeto Brasil	Claudio Carvas - ATECH Director; Eduardo Marson - EADS Brasil President
31-May-2006	Symposium: National Defense Industry	Brazilian Naval War College	Jairo Candido - COMDEFESA President; Joao Verdi de Carvalho Leite - AVIBRAS President; Gilberto Salm - CBC President; Álvaro Henrique Vianna de Moraes - IMBEL Director; Napoleão Bonaparte Gomes - EMGEPRON Director
23-Nov-2006	38th Forum Projeto Brasil - Military Industrial Policy: Foundations for a New Strategy	Agência Dinheiro Vivo/Projeto Brasil	Paulo Gastão da Silva - Embraer Manager for Strategic and Market Planning

Table 7-1: Selected Forums for Defense Industry Lobbying Activity.

Sources: Agência Dinheiro Vivo, Câmara dos Deputados, Escola de Guerra Naval, Ministério da Defesa.

Industry Concerns and Gripes. The defense industry class lobby association like ABIMDE and AIAB generally take advantage of forums to point out the disadvantages and weakness that its private sector associates face in dealing with the internal and external market. Both the Ministry for Development, Industry & Commerce and the Ministry of Defense recognized many of these vulnerabilities, and have become sympathetic over time. Table 7-2 provides a summary of the industry's main concerns.

Internal Market Concerns (Poor state support domestically)	➢ Flagging resources from Armed Forces for yearly investments. ➢ Excessive tax burden on domestic defense materiel. ➢ Privileged treatment of foreign suppliers, who do not face the same tax burden. ➢ Lack of programs to guarantee materiel supply over multiple years. ➢ Government's failure to release funding until the year's end, contributing to financial imbalances while delivering orders. ➢ Lack of financing from national financial institutions for development and production activities. ➢ Failure by the government to provide advanced publicity for military acquisition programs. ➢ Non-existence of technological partnerships between industry and military technological and engineering centers/institutes for developing new weapons systems and defense items.
External Market Concerns (What state neglects to provide)	➢ Lack of commercial attachés in Brazilian missions in key overseas markets for Brazilian defense goods. ➢ Failure to support publicity for products overseas through the embassies and attachés. ➢ Lack of government support for defense industry participation in international trade fairs. ➢ Non-existence of guaranteed bank loans from government financial institutions to finance sales of defense goods abroad. ➢ Lack of government-supported financing program to buy technology and components necessary to execute contracts signed with overseas customers. ➢ Failure to provide subsidies for exporting defense goods to the same level that overseas competitors do. ➢ Lack of a financial compensation clause in contracts with foreign suppliers. ➢ Ineffective participation in offset programs.

Table 7-2: Key Defense Industry Concerns and Perceived Disadvantages.

Sources: ABIMDE and AIAB, adapted from Defesa@Net, 04 November 2003.

Brazil's defense industrial lobby has made several of the arguments in Table 7-2 above in a consistent manner indicating the state needs to better support national defense procurement efforts by making public lines of credit available. In 2004, as a part of a "Cycle of Debates" on defense policy sponsored by the Brazilian Defense Ministry, Grupo Inbrafiltro President Jairo Cândido claimed Brazil's defense firms are extremely vulnerable because of an excessive tax burden that stifles their ability to become profitable. Consequently, he argued, the defense

industry's companies need protection that will allow them to invest and perform R&D.[225] Briefing at a symposium a couple of years later at the Brazilian Naval War College as the Coordinator for COMDEFESA, Cândido argued that Brazil's defense firms need access to financing in order to conduct R&D for equipment prototypes that the military needs. His presentation suggested that without regular budget resources and Armed Forces investments the defense industrial base would cease to exist.[226]

In a mid April 2004 presentation to BNDES, AIAB President Walter Bartels made similar arguments, stressing that although external financing was available to procure defense equipment, it was tied to buying other nations' goods. The consequences were a loss of high-tech jobs, technology development taking place overseas using Brazilian money, a loss of position in world markets, and failure to comply with Brazilian laws and regulations stressing increased industrial autonomy.[227] In front of Congress in April 2005, Bartels argued that the government had to define what posture it would assume with respect to sovereign defense of Brazil; meaning devoting adequate resources to programs like the AL-X. He also said the government's economic team needed to decide if it would continue to let long-term debt considerations delay programs like the AL-X, even though investment resources are available.[228] The point of the defense industry lobby was clear – the government was not doing enough to help out industry in this area.

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[225] Jairo Cândido, "Indústria Brasileira de Defesa: Uma Questão de Soberania e de Autodeterminação," in *As Forças Armadas e o desenvolvimento científico e tecnológico do País – Pensamento brasileiro sobre defesa e segurança Vol. 3*, 59-60.

[226] Escola de Guerra Naval, "Simpósio Indústria Nacional de Defesa – Comitê da Cadeia Produtiva da Indústria da Defesa COMDEFESA," Briefing presented to the Naval War College Symposium on National Defense Industry, Rio de Janeiro, 31 May 2006, URL: <http://www.egn.mar.mil.br/industriaNacionalDefesa/jairoCandido.zip>, Accessed on 15 November 2006.

[227] AIAB, "Cenário Atual e Perspectivas da Indústria Aeronáutica Brasileira – Associação das Indústrias Aeroespaciais Do Brasil," Briefing presented at BNDES for the Seminar on Thickening the Aerospace Industry Productive Chain, 15 April 2004, URL: <http://www.bndes.gov.br/conhecimento/seminario/aer_AIAB.pdf>, Accessed on 2 October 2006.

[228] Câmara dos Deputados, *Commissão da Ciência e Tecnologia, Comunicação e Informática - Audiência Pública para discutir a proposta de aquisição dos caças.*

Defense industry lobbying efforts seems to have gained traction inside the defense ministry. Several of the industry gripes in Table 7-2 are reflected in presentations by the Defense Ministry's Secretariat for Logistics, Mobilization, Science, and Technology and its subordinate entities at some of the same forums listed in Table 7-1. For instance, during May 2006 the director of the defense ministry's Department of Logistics, José Roberto Scheer, indicated that domestic defense firms are beset by many difficulties, including: incapacity to sustain a stable base of demand for their defense products; a reduced capacity for investment in scientific and technological research; failure of the government to provide incentives to export to external markets in order to help establish a more balanced playing field against foreign competitors; incidences of a heavy tax burden; limited official support for publicity efforts and international negotiations with potential customers; and restrictions on public financial institutions providing financing and contractual guarantees to domestic firms.[229]

The Ministry of Development, Industry, and Commerce detailed the aerospace industry's difficulties in a March 2002 report on the sector. Besides some of the difficulties already mentioned above, the report stated that a reduction in government programs to modernize national defense and reequip the Armed Forces has hamstrung the sector, and the public bidding law's provisions for waiving internal competition requirements has allowed the military to routinely buy its products overseas. The report also indicated that the government's proclivity for purchasing foreign supplied aerospace goods that are similar to Brazilian manufactured goods has the effect of reducing the credibility of Brazil's products on the international scene.[230]

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[229] Escola de Guerra Naval, "Simpósio Indústria Nacional de Defesa – Ministério da Defesa: Estrutura e Orientação Relacionadas com a Base Industrial de Defesa," Briefing presented to the Naval War College Symposium on National Defense Industry, Rio de Janeiro, 31 May 2006, URL: <http://www.egn.mar.mil.br/industriaNacionalDefesa/brigadeiroScheer.zip>, Accessed on 15 November 2006.

[230] Ministério do Desenvolvimento, Indústria e Comércio Exterior, *Devenvolvimento de Ações de Apoio à Cadeia Produtiva da Indústria Aeroespacial* (Brasilia, DF: Ministério do Desenvolvimento, Indústria e Comércio Exterior, March 2002), 39-40.

This same point was emphasized by Ozires Silva during the March 2004 "Cycle of Debates" to discuss reform of Brazil's national defense policy. Silva – a former Minister of Infrastructure, President of Petrobras, President of Embraer (1970-86, 1991-94) – stated the military had developed the habit of importing goods from overseas because they do no trust the quality and reliability of the domestic defense industry's products and over time service culture and doctrine has developed that is more attuned to continuing purchases from abroad than to adapt to domestic suppliers and their supply concepts. Silva maintained that this bias even harms Brazilian defense suppliers' external sales prospects, because the Brazilian Armed Forces tend not to do any proving or testing activities on goods they do not procure, and since external customers need to see a proven product before purchase, the military's failure to demonstrate a product in regular military operational use harms industry.[231]

Influence on Policy. The defense industrial lobby presented a litany of complaints, most of which centered on the government's policies which either make operation inside Brazil hard or which fail to support domestic industry's competitive bids in external markets. So have the defense industrial base's sustained arguments over the past several years paid off? Linking industry pressures to changes in policy is hard to measure, but some episodes may provide insight into how effective or ineffective the pressure has been.

Science and technology (S&T) policy is an area that lies at the heart of industrial capability. Several chapters ago Table 4-1 indicated that the defense ministry made a string of revisions to the Armed Forces' overarching S&T policy since March 2001. The Defense Ministry under Geraldo Quintão's tenure issued Portaria No. 188/MD in March 2001 to replace the dated 1992 policy which the Armed Forces General Staff Ministry published during the Collor administration. Just eight months later, in November 2001, the Defense Ministry

[231] Ozires Silva, "A Indústria de Defesa," in *As Forças Armadas e o Desenvolvimento Científico e Tecnológico do País*, 49-50, 52-53.

published another S&T policy for the Armed Forces, which is virtually identical – the only substantive change being its name, from "Defense Policy for the Area of Science and Technology" to "Policy of Science and Technology of the Armed Forces."[232]

Both policy documents specified objectives and directives for the military services to pursue common interests in the areas of research, development, technological preparation, and industrial promotion. It is unclear how deeply involved the defense industry was in shaping the content of these documents. Several directives in these documents place an emphasis on activities that assist and stimulate domestic industry to assume the role of foreign suppliers:

- Training of human resources for military-related S&T activities through exchanges and partnerships with industry and the universities;
- Developing R&D and project engineering activities that replace foreign supplied materials with national materials developed by the Armed Forces;
- Stimulating the participation of private sector firms in military industrial activity in order to involve them in the nationalization effort and adapt their existing civilian products and technology to military use;
- Seeking to identify the military R&D efforts and possible spin-off products and technology that could immediately be turned over to the private sector for civilian use;
- Encouraging the sharing of the technology and know-how gained from military R&D programs with national industry;
- Stimulating dedicated national defense firms to perform R&D and providing incentives for national production of components of interest to the Armed Forces;
- Seeking scientific and technological knowledge through relationships with research and educational institutions both domestically and abroad; and
- Promoting the collection of scientific and technological information by means of military representations in Brazilian foreign missions.[233]

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[232] Ministério da Defesa, *Portaria Normativa No. 740/GABINETE de 26 de Novembro de 2001* (Brasilia, DF: Gabinete do Ministro, 26 November 2001), URL: <https://www.defesa.gov.br/bdlegis/dados_norma.php?numero=740&ano=2001&serie=A>, Accessed on 27 December 2006; Ministério da Defesa, *Portaria No. 188/MD de 15 de Março de 2001* (Brasilia, DF: Gabinete do Ministro, 15 March 2001), URL: <https://www.defesa.gov.br/bdlegis/dados_norma.php?numero=188&ano=2001&serie=A>, Accessed on 27 December 2006.

[233] Ministério da Defesa, *Portaria Normativa No. 740/GABINETE de 26 de Novembro de 2001*; Ministério da Defesa, *Portaria No. 188/MD de 15 de Março de 2001*.

While the policy documents specified these activities, other important partners in government, such as the Ministry of Science and Technology, were not mentioned, hinting at a lack of coordination. One year later, the Ministries of Defense and Science and Technology launched a joint publication called "Science, Technology and Innovation: Proposed Strategic Directives for National Defense," apparently to solve this shortcoming and subjected it to public scrutiny during a seminar where the National Confederation of Industry (CNI) provided the industry perspectives on the document's content during a 26 November 2002 seminar.[234] The CNI essentially embraced the directives in the document. The organization stressed, however, that the government should avoid specific solutions for general questions. CNI also highlighted the importance of using national demand to help industry with R&D partnerships, exploring development of dual-use technologies, and give national industry preference. Finally, CNI stressed that measures to protect industry could not conflict with international rules and Brazil's economic integration into global markets.[235]

Examination and debate of these proposed directives was an initial activity of the defense ministry when José Viegas assumed his post as defense minister in early 2003. His ministry teamed up with the Ministry of Science and Technology and eventually issued the document, "Strategic Concept: Science, Technology and Innovation of Interest to National Defense" in late 2003. While this document reflected many of the same objectives and directives in prior military S&T policy, it was significant in that it identified the specific technologies of interest to Brazil's

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[234] Ministério da Defesa/Ministério da Ciência e Tecnologia, *Ciência, Tecnologia e Inovação: Proposta de Diretrizes Estratégicas para a Defesa Nacional* (Brasilia, DF: Editora CGEE, 26 November 2002).

[235] Ministério da Ciência e Tecnologia Centro de Gestão e Estudos Estratégicos, "Seminário sobre Diretrizes Estratégicas de CT&I para a Defesa Nacional - Painel: Visão da Indústria," Briefing presented by CNI to the Seminar on Strategic Directives for Science, Technology and Innovation for National Defense, Brasilia, 26 November 2002, URL: <http://www.cgee.org.br/arquivos/CTDefesa_4_cni.pdf>, Accessed on 11 June 2007.

national defense efforts as well as why the Defense Ministry considered them important, using the U.S. Government's Military Critical Technologies List as one of its models. The document also provided the specifics of the "Defense Science, Technology, and Innovation System" which was identified as a goal in the 2002 proposed strategic directives document, which made many of the directives from the earlier S&T policies issued by the defense ministry operational, and which institutionalized a network of cooperation between the Defense Ministry's Secretariat for Logistics and Mobilization, the Armed Forces, industry, and academia.[236]

Much clearer efforts and successes at influencing policy involved industry efforts to shape the content of the National Policy for Defense Industry (PNID). In 2001, the defense ministry created the Military Commission for Defense Industry and the Defense Industry Forum which were new organizations linked to the ministry's Secretariat for Logistics and Mobilization and which signaled the defense ministry's initial commitment to address the weaknesses in the defense industrial base.[237] Defense industry firms and large consortiums like ABIMDE, AIAB, and COMDEFESA began taking advantage of the new mechanisms to drill home their points to the defense ministry and to set a plan in motion for a new policy to help the sector and address many of their largest concerns. ABIMDE included the shaping of the new policy in its 2003 goals, and minutes from ABIMDE meetings reveal four areas that ABIMDE and its industry partners pushed: a fund for financing the development of products, a "buy Brazil" law, an initiative to integrate with industry within MERCOSUR, and a dedicated budget for the Armed Forces that could not be cut.[238]

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[236] Ministério da Defesa/Ministério da Ciência e Tecnologia, *Concepção Estratégica: Ciência, Tecnologia e Inovação de Interesse da Defesa Nacional*; Maurício Pazini Brandão, "Ciência, Tecnologia, Inovação e a Defesa Nacional," *Parcerias Estratégicas* No. 20, June 2005, 831-860.

[237] Robério da Cunha Coutinho, "O Verdadeiro Desafio da 'Caixa Preta'," Paper presented to the Naval War College for the "Evolution or Revolution in Military Affairs" Symposium, Rio de Janeiro, August 2002, URL: <http://www.emgepron.mar.mil.br/simposio.pdf>, Accessed on 14 June 2007.

[238] ABIMDE, "Declaração da Associação Brasileiras das Indústrias de Material de Defesa – ABIMDE: Aprovada a Política Nacional da Indústria de Defesa – PNID," *Defesa@Net*, 20 July 2005, URL: <http://www.defesanet.com.br/md/pnid.htm>, Accessed on 14 June 2007; ABIMDE, "Ata de

During 2004 and the first half of 2005 ABIMDE coordinated efforts among its members and with its other defense industrial lobby associations to keep the pressure on the defense ministry. Former ABIMDE President Roberto Guimarães de Carvalho informed his colleagues during an August 2004 meeting that the defense lobby proposals for the draft policy were discussed in the Lula government's Social and Economic Development Commission, with a general acceptance of the content.[239] A report on ABIMDE's accomplishments during the 2003-2004 timeframe lists ABIMDE participation in the elaboration for the draft PNID.[240] A proposal for the PNID's objectives and directives that ABIMDE drafted in June 2004 listed all seven of the objectives, verbatim, which were ultimately adopted in the final PNID published in July 2005. The directives which fall under each objective in the same document are strikingly similar to those presented in Portaria No. 586/MD, published in April 2006, which established the strategic actions that made the PNID operational.[241]

On 1 September 2005, the Presidents of ABIMDE, COMDEFESA and FIESP, and the Syndicate for Industries of Defense Materials (SIMDE) visited then Defense Minister and Vice President José Alencar to discuss the follow-on actions for making the PNID operational. ABIMDE records indicate Alencar indicated in a note afterwards that he had sent the proposed measure to strengthen the defense industrial base on to President Lula, the Finance Ministry, the

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Reunião do Conselho Diretor da ABIMDE," 26 May 2004, URL: <http://www.abimde.com.br>, Accessed on 14 June 2007.

[239] ABIMDE, "Ata de Reunião do Conselho Diretor da ABIMDE e Direitoria de SIMDE," 19 August 2004, URL: <http://www.abimde.com.br>, Accessed on 14 June 2007.

[240] ABIMDE, "Plano de Metas da ABIMDE para 2005/2006," 25 October 2004, URL: <http://www.abimde.com.br>, Accessed on 2 August 2006.

[241] ABIMDE, "Proposta de Política Nacional da Indústria de Defesa – PNID," 24 June 2004, URL: <http://www.abimde.com.br>, Accessed on 23 March 2006; Ministério da Defesa, "Portaria Normativa No. 899/MD, de 19 de Julho de 2005."; Ministério da Defesa, "Portaria Normativa No- 586/MD, de 24 de Abril de 2006 - Aprova as Ações Estratégicas para a Política Nacional da Indústria de Defesa," *Diário Oficial da União* No. 78, 25 April 2006.

Development, Industry and Commerce Ministry, and BNDES.[242] ABIMDE clearly was working together with other parts of the industry lobby and the Brazilian Defense Ministry to shape the policy and ensure it moved forward.

Embraer's President, Maurício Botelho, did his part to look out after his company's and the aerospace industry's interests during the same period and managed to get on President Lula's schedule for individual meetings in 2003 and 2004, as well as have the president visit Embraer's facilities in São José dos Campos, São Paulo in 2004.[243] Embraer, a member of both ABIMDE and AIAB, was President Lula's third largest campaign donor during the 2002 presidential campaign, but in 2003 his company was faced with the prospect of cutting jobs, and he sought Lula's audience to secure financing from BNDES.[244] In November 2003, Botelho took his case to Congress arguing that BNDES was having a hard time continuing to support Embraer and the aerospace sector with export credits because the bank had to adhere to the liquidity rules set by the Central Bank and could not function like the U.S. Eximbank, Germany's Hermes, Canada's EDC, and others that are backed by national treasuries.[245]

Botelho's complaints about securing financing are often repeated by the defense industry's members. At the heart of the matter has been the military's inability to count on the national budget to secure military hardware. Since their only recourse is to seek external

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[242] ABIMDE, *SEMANA ABIMDE No. 564 – 28 de Setembro de 2005*, 28 September 2005, URL: <http://www.abimde.com.br>, Accessed on 14 June 2005.

[243] Presidência da República, *Agenda do Senhor Presidente, Sexta-Feira, 07 de Março de 2003*, n.d., URL: <http://www.inf.planalto.gov.br/static/inf_AgendaPesq.htm>, Accessed on 14 June 2007; Presidência da República, *Agenda do Senhor Presidente, Sexta-Feira, 09 de Fevereiro de 2004*, n.d., URL: <http://www.inf.planalto.gov.br/static/inf_AgendaPesq.htm>, Accessed on 14 June 2007; Presidência da República, *Agenda do Senhor Presidente, Sexta-Feira, 25 de Março de 2004*, n.d., URL: <http://www.inf.planalto.gov.br/static/inf_AgendaPesq.htm>, Accessed on 14 June 2007.

[244] "Embraer se Reúne hoje com Lula para Discutir Crise no Setor Aeronáutico," *Vale Paraibano*, 7 March 2003, Defesa@Net, URL: <http://www.defesanet.com.br/noticia/vpembraerlula/>, Accessed on 12 June 2007.

[245] Câmara dos Deputados, *Comissão das Relações Exteriores e Defesa Nacional - Audiência Pública No. 1915/03*, 3.

financing to buy equipment, the services are normally obligated to purchase foreign goods. This ends up undermining the health of domestic defense firms, which try to compete for the military's business but do not have access to financing at favorable terms like foreign suppliers can offer. Domestic firms also face a tax burden that foreign suppliers do not, and many of them import components from abroad to produce their weapons systems which carry duties on them. The high burden on domestic industry allows little room for R&D spending. Consequently, firms fail to stay up to date technologically, they cannot compete successfully, and they eventually fail. The defense industry's firms see their access to resources, whether through the military's ability to spend or the government's ability to finance them, as their lifeline.

Resources Available for Defense Industry Technology Development

Brazil's economic policy since 1999 has featured withholdings from every ministry in order to run a primary surplus to pay down debt and persuade global markets that Brazil is economically stable. In compliance with this government policy and because of its high payroll and pension obligations, the Defense Ministry must extract its contribution to the primary surplus from its discretionary spending, which has a marked impact on each service's operations, maintenance, and investment funding.[246]

National Budget Limitations. The military budget has been inadequate for the each of the services procurement and modernization plans since 1995. Lack of resources has not prevented the services from buying weapons systems on the global arms market with foreign

[246] Câmara dos Deputados, *Audiência Pública No. 2183/03 – Atraso na Implantação do Sistema de Vigilância da Amazônia — SIVAM em Decorrência de Cortes de Gastos Governamentais*, 3, 11; Ministério da Defesa, "Secretaria de Organização Institucional (SEORI) – Orçamento de Defesa," Briefing presented to the Course for Defense Resources and Management (CEGRD 2006), São Paulo, 22 August 2006, URL: <http://www.abimde.com.br/palestra22ago06_Rosiere.ppt>, Accessed on 8 May 2007; Câmara dos Deputados, *Comissão de Relações Exteriores e de Defesa Nacional – Audiência Pública No. 000880/01.*

financing or from gaining certain systems through military assistance programs. These defense materials, however, do not typically contribute to growing national autonomy, nationalization of military means, or R&D that strengthens national industry as Complementary Law 97 of 1999 – which orients the organization, preparation, and employment of the Armed Forces – dictates.[247]

In concrete figures the defense budget has grown since 1995. Figure 7-1 provides defense budget figures from 1995-2006. While the chart shows an upward trajectory in absolute terms, the numbers are deceptive. The purchasing power of the Brazilian currency over this entire period was not stable. From 1995-1998 the currency was fairly stable ranging from R$ 1.04 to R$ 0.86 per US$, but in late 1998 economic instability forced the Real to devalue by January 1999, seriously eroding the military's buying power. From 1999-2004 the Real plummeted in value vis-à-vis the US$ down to an annual average low of R$ 0.33 per US$, rebounding slightly in 2005 and 2006.[248]

[247] Presidência da República, *Lei Complementar No. 97 de 9 de Junho de 1999* (Brasilia, DF: Casa Civil/Subchefia para Assuntos Jurídicas, 9 June 1999), URL: <http://www.planalto.gov.br/ccivil/LEIS/LCP/Lcp97.htm>, Accessed on 15 June 2007.

[248] Foreign exchange yearly average exchange rates were calculated over a 365 or 366 day calendar year using a foreign exchange conversion tool at URL: <http://www.oanda.com>.

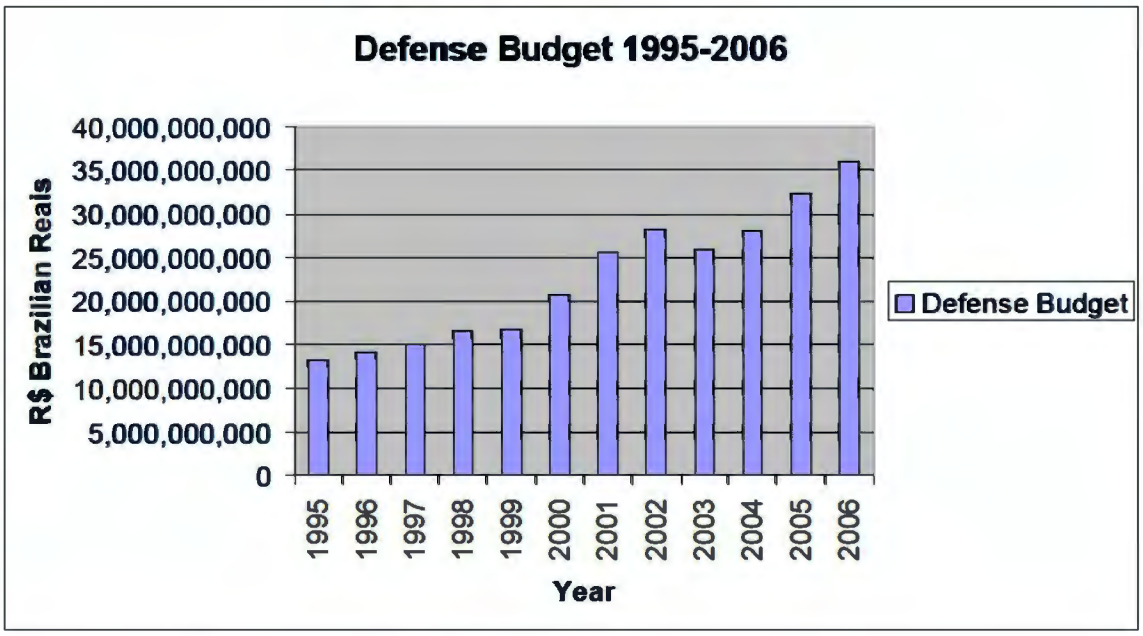


Figure 7-1: Brazilian Defense Budget 1995-2006.[249]

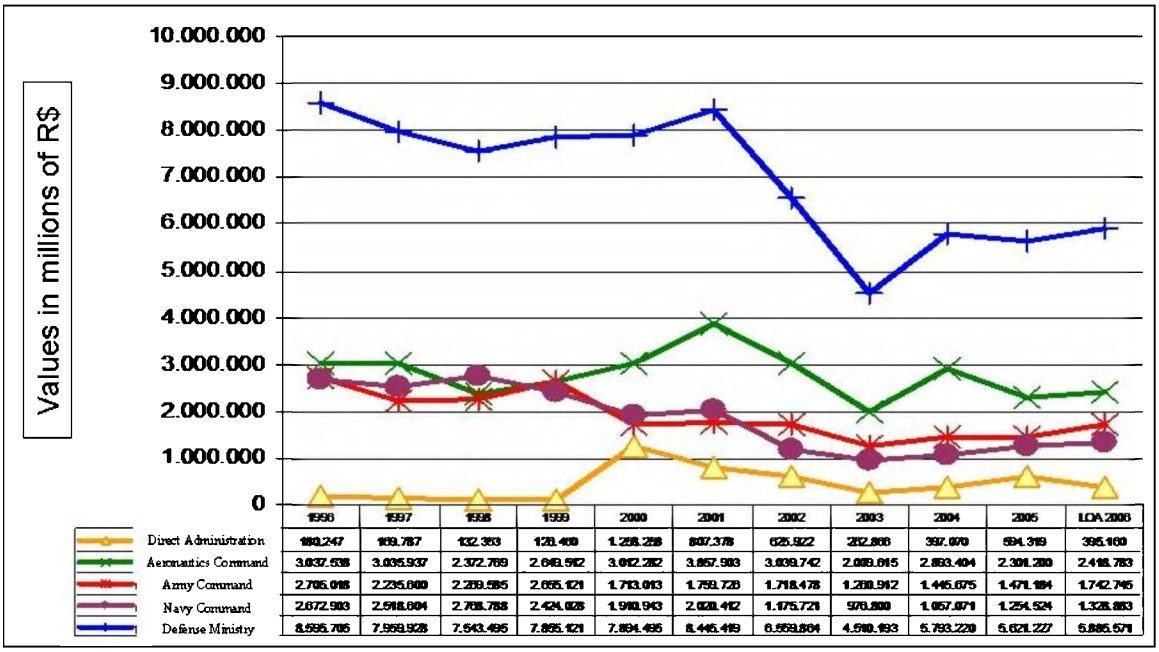
Sources: Jorge Zaverucha, *FHC, Forças Armadas e Polícia: Entre o Autoritarismo e a Democracia, 1999-2002* (Rio de Janeiro: Editora Record, 2005), 96-119; Diário Oficial da União; Senado Federal/SIAFI.

More telling in terms of the military's actual spending power is Figure 7-2, which shows the discretionary spending available for each military service and for the Defense Ministry overall. From 1999 forward a yearly procession of the military's and defense ministry's highest officials testified to Congress about the difficulties of operating under a reduced budget.[250] The

[249] Defense budget figures for 1995-1999 are the consolidated total of the Army Ministry, the Navy Ministry, the Aeronautics Ministry, and the Armed Forces General Staff Ministry, whose budgets were absorbed by the Defense Ministry in mid 1999. Budget figures for 1995-2003 are actual expenditures. Figures from 2004-2006 are derived from the approved national budget published in the Official Gazette, and are not actual expenditures.

[250] Câmara dos Deputados, *Comissão de Relações Exteriores e de Defesa Nacional – Seminário No. 0752/02* (Brasília: Departamento de Taquigrafia, Revisão e Redação, 20 August 2002), URL: <http://www2.camara.gov.br>, Accessed on 10 February 2003; Senado Federal, *19ª Reunião Extraordinária da 2ª Sessão Legislativa da 51ª Legislatura da Comissão de Relações Exteriores e Defesa Nacional do Senado Federal* (Brasilia, DF: Secretaria-Geral da Mesa/Subsecretaria de Taquigrafia, 22 November 2000), URL: <http://www.senado.gov.br>, Accessed on 2 March 2003; Câmara dos Deputados, *Comissão de Relações Exteriores e de Defesa Nacional – Audiência Pública No. 0617/2003* (Brasília: Departamento de Taquigrafia, Revisão e Redação, 28 May 2003), URL: <http://www2.camara.gov.br>, Accessed on 1 July 2003; Senado Federal, *Notas Taquigráficas da Trigésima Reunião Extraordinária da Terceira Sessão Legislativa Ordinária da Quinquagésima Segunda Legislatura da Comissão de Relações*

Air Force fared the best of the services as is evident from Figure 7-2, but it is also the most dependent on high technology to conduct its mission, and the higher level of funding available for investments was granted because of the Plan for the Strengthening and Control of the Brazilian Airspace Control System, approved by President Cardoso in 2000.[251]



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	LOA 2006
Direct Administration	180.247	189.787	132.353	128.469	1.258.258	807.378	625.922	282.866	397.070	694.319	395.169
Aeronautics Command	3.037.538	3.035.937	2.372.769	2.649.562	3.012.282	3.857.983	3.039.742	2.089.615	2.853.404	2.301.280	2.418.783
Army Command	2.705.015	2.235.609	2.259.585	2.055.121	1.713.013	1.759.726	1.718.478	1.280.912	1.445.675	1.471.184	1.742.745
Navy Command	2.672.903	2.518.604	2.708.788	2.424.025	1.980.943	2.020.412	1.675.721	970.800	1.057.071	1.254.524	1.328.883
Defense Ministry	8.595.705	7.959.928	7.543.495	7.855.121	7.894.495	8.445.419	6.559.804	4.580.193	5.753.220	5.621.227	5.885.579

Figure 7-2: 1996-2006 Defense Spending on Operations, Maintenance and Investments.

Source: Ministério da Defesa/ Secretaria de Organização Institucional (SEORI).

State Organizations Providing Additional Assistance. In order to make up for scarce military funding and allow the defense industry to undertake selected R&D activities, other state agencies have been able to supply financing that allows development of dual-use technology for military systems to move forward. During a May 2006 presentation, COMDEFESA coordinator

Exteriores e Defesa Nacional, Realizada do Dia Quatorze de Dezembro do Ano de Dois Mil e Cinco, Às Nove Horas e Trinta Minutos.

[251] Tribunal das Contas da União, *TC 009.958/2003-5 - Relatório de Auditoria. Estado-Maior da Aernáutica. Programa de Reaparelhamento da Força Aérea Brasileira (FAB)*, 14 October 2003, URL: <http://www.tcu.gov.br>, Accessed on 14 June 2007; Tribunal das Contas da União, *TC 012.799/2002-0.*

Jairo Cândido admitted that while the São Paulo State Federation of Industries (FIESP) and the Defense Ministry were doing their best to support the defense industrial base, the Brazilian National Bank for Economic and Social Development (BNDES) had recently extended two lines of financing to COMDEFESA. Even so, he claimed it was no substitute for a stable national budget that could be relied on to fund defense spending with public money. His presentation suggested that without regular budget resources and Armed Forces investments the defense industrial base would cease to exist.[252]

Advisor to the president of BNDES, Sérgio Varella Gomes, indicated to Congress during March 2006 that earlier that year the bank opened two new lines of credit – the first for research, development, and innovation, and the second for production innovation – that could be used to fund defense industry activities. The first of these lines of financing spreads risk over 12 years and provides loans of up to R$ 10 million (roughly US$ 5 million) for projects directly related to substantial research efforts, technological development, and innovation applied to products and processes that will make a firm more competitive. The second line of credit spreads risk over 10 years and provides loans of up to R$ 10 million for projects that are related to: a) incremental innovation in products and processes; b) complementary investments associated with building innovative capabilities and environments; or c) innovative processes that foster improved production or commercialization capabilities.[253]

The BNDES, which is subordinate to the Ministry of Development, Industry, and Commerce, played a key role in financing development of the ERJ-145 civilian regional jet

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[252] Escola de Guerra Naval, "Simpósio Indústria Nacional de Defesa – Comitê da Cadeia Produtiva da Indústria da Defesa COMDEFESA." Briefing presented to the Naval War College Symposium on National Defense Industry, Rio de Janeiro, 31 May 2006," URL: <http://www.egn.mar.mil.br/industriaNacionalDefesa/jairoCandido.zip>, Accessed on 15 November 2006.

[253] Câmara dos Deputados, "Política da Indústria de Defesa terá projeto," Commissão das Relações Exteriores e de Defesa Nacional, 29 March 2006, URL: <http://www2.camara.gov.br/comissoes/credn/inddefes>, Accessed on 9 February 2007; Câmara dos Deputados, "O BNDES e o Financiamento da Indústria de Defesa Brasileira," BNDES briefing presented to the Brazilian Chamber of Deputies Foreign Relations and National Defense Commission, 14 March 2006, URL: <http://www2.camara.gov.br/comissoes/credn/publicacao/bndes/view>, Accessed on 14 November 2006.

aircraft which Embraer has exported with great success and which also serves as the airframe for the military air surveillance and remote sensing aircraft used in SIVAM. In 1995 Embraer received a loan of US$ 115 million from BNDES to help finance the development of the ERJ-145. BNDES also has played a major role in financing the sales of ERJ-145 civilian aircraft to external markets through its export promotion program (PROEX), providing over US$ 5.5 billion in financing for the ERJ-145 and other commercial aircraft sales between 1995 and 2003.[254]

Another key state institution supplying financing for R&D is FINEP, which is part of the Ministry of Science and Technology. FINEP has been financing Brazilian R&D projects for many years and is what Emanuel Adler called, "a major instrument of in Brazil's quest for technological self-determination, linking technology and the industrial sector."[255] FINEP has exercised two lines of activity historically. The first function is as an agency for S&T promotion providing non-reimbursable financing for science, technology, and innovation to non-profit organizations. The second function is as a promotion bank, providing reimbursable credit to finance companies that develop innovative projects.[256] While the amount of resources provided by FINEP has varied through the years, during the early 1990s the financing available through FINEP all but dried up, leaving state enterprises that depended on the institution, like Embraer, in a difficult situation. Embraer President Maurício Botelho indicated in testimony to Congress that FINEP's inability to make funds available for R&D financing during 1989-1990 was one of two

[254] Câmara dos Deputados, *Comissão das Relações Exteriores e Defesa Nacional - Audiência Pública No. 1915/03*, 2; Roberto Bernardes, "O Caso EMBRAER – Privatização e Transformação da Gestão Empresarial: Dos Imperativos Tecnológicos à Focalização no Mercado," *Cadernos de Gestão Tecnológica 46* (São Paulo: CYTED – PGT/USP, 2000), 55-63.

[255] Adler, 184.

[256] Ministério da Ciência e Tecnologia, "A Ciência, a Física, e a Tecnologia no Desenvolvimento do Brasil," Briefing presented by Minister Sergio Machado Rezende to the Technological Institute for Aeronautics (ITA), São José dos Campos, 28 February 2005, URL: <http://www.ita.br/online/2005/eventos05/fevereiro05/apressergiorezende.pdf>, Accessed on 18 June 2007.

crises that pushed the company to privatize.[257] Figure 7-3 shows the historical trajectory of financing available through FINEP's National Fund for Scientific and Technological Development in the current day's currency, corrected for inflation.

Figure 7-3: Historical Funding for FINEP's National Fund for S&T Development

Source: Ministério da Ciência e Tecnologia, "Ciência, Tecnologia e Inovação para o Desenvolvimento Nacional," Briefing presented by Minister Sergio Machado Rezende to the Olimpíada Brasileira de Matemática das Escolas Públicas, Recife, 13 April 2007, URL: <http://agenciact.mct.gov.br/upd_blob/0041/41194.ppt>, Accessed on 18 June 2007.

Figure 7.3 reveals a clear rebounding of FINEP financing from the low levels of the 1990s. Since funding recovered in 2000, a number R&D projects associated with technologies used in the SIVAM project and the AL-X program have been financed by FINEP. The industry's lobbying efforts played a part in this rebound.

[257] Câmara dos Deputados, *Comissão das Relações Exteriores e Defesa Nacional - Audiência Pública No. 0299/00 – Esclarecimentos sobre venda de ações da Empresa Brasileira de Aeronáutica – EMBRAER* (Brasília: Departamento de Taquigrafia, Revisão e Redação 13 April 2000), 7.

A final type of state support worth mentioning is the military's own R&D efforts. Earlier in this chapter the defense industry lobby listed among its complaints that there was a dearth of technological partnerships between industry and military technological and engineering centers/institutes for developing new weapons systems and defense items. In roughly the same period the defense ministry published an S&T policy for the Armed Forces that stressed encouraging the sharing of the technology and know-how gained from military R&D programs with national industry. The policy also stressed identifying military R&D efforts and possible spin-off products and technology that could immediately be turned over to the private sector for civilian use. Given these seemingly conflicting perspectives, determining whether the military is currently following this policy may help determine whether attitudes have changed with the creation of a defense ministry.

Demand and Supply Factors in the SIVAM and AL-X Cases

Chapters 1 and 5 introduced some of the factors motivating political and military actors to conceptualize, plan, develop, and execute the SIVAM project. Amit Gupta's framework divided demand factors between threats and organizational pressures or ambitions. The political leadership, the military, and the defense firms involved in pushing the SIVAM project forward had different notions of threat motivating them and different organization pressures as well. While there was some overlap between the three sets of actors, the motivating factors were different enough that they require examination here.

Political Leadership Threat Perception and Organizational Ambitions. The perception of threat that compelled the political leadership to approve the concept and implementation of SIVAM and SIPAM is based on the very core of a state's being – territorial control and sovereignty. Brazilian concerns about protecting the region's resources reached a fever pitch in the early 1990s as U.S. government counter-narcotics activities in countries

neighboring Brazil, with heavy Department of Defense involvement, spooked Brazil's military. One 1993 operation in Guyana caught civilian leaders off guard. While the military was notified about the exercise, then Foreign Minister, and later President, Fernando Henrique Cardoso had not been notified.[258] By mid 1993, the Army had testified to Congress about U.S. military presence in neighboring countries and President Itamar Franco had met with his National Defense Council to discuss U.S. military exercises in Guyana close to the border with Brazil, as well as mechanisms for a long-term defense of Brazil's Amazon region.[259] Within this context, commencement of SIVAM was approved by President Franco and his National Defense Council in August 1993.

From the mid 1990s through the current juncture Congress has held regular hearings where the threat of internationalization of the Brazilian Amazon region was discussed. Senior diplomats present at the hearings discussed the Ministry of Foreign Relations' strategy to refute any proposals that hinted at limiting Brazilian sovereignty over its Amazonian territory.[260] Hearings of this nature have tended to repeat old fears, most of which are related to protecting natural resources from a covetous group of developed nations, which use NGOs as their conspiratorial tool to map and pirate Amazon basin biodiversity and to serve as a mouthpiece that

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[258] "Foreign Minister Reportedly 'Unaware'," PY1705142493 (text) Rio de Janeiro *O Globo*, 15 May 1993, 3 (b) (3) [redacted]; "U.S. Exercises in Guyana Said No Cause for 'Concern'," PY1905001193 (text) São Paulo *O Estado de São Paulo*, 18 May 1993, 6. (b) (3) [redacted] "Maneuvers Possibly Part of Antidrug Effort," PY180501293 (text) Rio de Janeiro *O Globo*, 16 May 1993, 11. (b) (3) [redacted]

[259] Câmara dos Deputados, *Comissão de Defesa Nacional Audiência Pública No. 253/93 – O Projeto Calha Norte e a Presença de Tropas Estrangeiras na Amazônia* (Brasilia, DF: Departamento de Taquigrafia, Revisão e Redação, 12 August 1993): 15-16; "Editorial Comments on U.S. Military Exercise, Border Issue," PY1905024293 (text) São Paulo *O Estado de São Paulo*, 18 May 1993, 3. (b) (3) [redacted] "Franco Discusses National Defense With Military," PY1905012193 (text) Rio de Janeiro Rede Globo Television in Portuguese, 2300 GMT, 18 May 1993. (b) (3) [redacted]

[260] Senado Federal, *Ata da Comissão Permanente do Senado Federal Referente a 30ª Reunião Ordinária de 16/11/1999 da Comissão de Relações Exteriores e Defesa Nacional*; Guimarães, *Desafios Brasileiros na Era dos Gigantes*; Senado Federal, *Nota Taquigráfica da Quarta Reunião Ordinária da Terceira Sessão Legislativa Ordinária da Quinquagésima Segunda Legislatura da Comissão De Relações Exteriores e Defesa Nacional*.

colors Brazil as an irresponsible steward of the region. With each public hearing new political pressure is placed on the senior political leadership. Executive Branch depositions in congress routinely cite statements dating from the 1980s up until the present, by former Norwegian Prime Minister Gro Harlem Brundtland, former British Prime Ministers Margaret Thatcher and John Major, former U.S. Vice-President Al Gore, former Soviet Premier Mikhail Gorbachev, former French President Francois Mitterrand, former DIA Director Patrick Hughes, and former European Trade Commissioner Pascal Lamy as evidence that the developed world has designs on the Amazon region.[261]

President Cardoso's commitment to supporting the SIVAM/SIPAM project and the AL-X program was firmly linked to the directives in his 1996 National Defense Policy, in terms of guaranteeing law and order, contributing to regional integration, protecting the Amazon region, enhancing surveillance and control of borders and airspace, and promoting domestic R&D to reduce dependence on foreign suppliers for defense materials. In inaugural ceremonies for the R-99 aircraft squadron and the SIVAM CTO in Manaus, Cardoso cited all of these goals, as well as the challenges that Brazil faced with respect to narcotics trafficking, controlling borders and airspace, and guaranteeing sovereignty in the Amazon basin.[262] Cardoso was present at the project's creation and felt a duty to save the project when scandal hit:

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[261] Senado Federal, *Ata da Comissão Permanente do Senado Federal Referente a 30ª Reunião Ordinária de 16/11/1999 da Comissão de Relações Exteriores e Defesa Nacional*; Guimarães, *Desafios Brasileiros na Era dos Gigantes*; Senado Federal, *Nota Taquigráfica da Quarta Reunião Ordinária da Terceira Sessão Legislativa Ordinária da Quinquagésima Segunda Legislatura da Comissão De Relações Exteriores e Defesa Nacional*; FIEC, "Seminário 'Amazônia é Vida. Amazônia é Brasil: Palestra do General Valdesio Guilherme de Figueiredo."; Luiz Alberto Moniz Bandeira, *As Relações Perigosas: Brasil – Estados Unidos (de Collor a Lula, 1990-2004)* (Rio de Janeiro: Civilização Brasileira, 2004): 273, 282; Senado Federal, *Comissão Parlamentar de Inquérito destinada a apurar as denúncias veiculadas a respeito da atuação irregular de Organizações Não-Governamentais – Relatório Final*; Câmara dos Deputados, *Comissão de Relações Exteriores e Defesa Nacional – Audiência Pública No. 1619/03 – Informações sobre os Resultados Desenvolvidos pelo Referido Comando Militar na Operação para Combater Refluxos do Narcotráfico e da Guerrilha colombiana na Fronteira entre o Brazil, Colômbia e o Peru*; Senado Federal, *Ata da Comissão Permanente do Senado Federal Referente a 31ª Reunião Extraordinária de 17/11/1999 da Comissão de Relações Exteriores e Defesa Nacional*.

[262] Radiobras, "Discurso do Presidente da República, Fernando Henrique Cardoso, na Ceremônia 'Batismo do Aviões' – Anápolis/GO," 24 July 2002, URL: <http://www.radiobras.gov.br/integras/02/

> The SIVAM project's continuity was in play, at that moment in a cross-fire between those who had lost the competition and in bad faith certain ultranationalistic circles that preferred to develop our own technology for surveillance radars instead of buying them abroad, overwhelmingly because the winning firm was North American.[263]

Cardoso's familiarity with the AL-X aircraft, gained during a September 1999 visit to the Brasilia Air Base, was one element convincing him to launch the Program for the Strengthening of the Brazilian Airspace Control System in July 2000 (PFCEAB). Cardoso stated during December 2000 that it was the right moment to launch a progressive program to substitute for the Air Force's aging fleet, valued at US$ 2.613 billion over eight years, even though budgets were extremely tight. The AL-X was the second most expensive of the nine programs in the PFCEAB and among the first of the production contracts to be signed.[264]

While threat-related motivations for the political leadership were clear and simple to identify, the organizational pressures and ambitions were somewhat more complex. Senior political leaders had to be convinced that SIVAM and SIPAM were the right concept and solution for the problems in the Amazon region. The original Exposition of Motives that introduced these systems to the President in 1990 was presented by President Collor's own Secretariat for Strategic Affairs (SAE), whose principal function was to elaborate strategic projects to defend national security, in conjunction with the Aeronautics Ministry and the Ministry of Justice. The organizations presenting the concept to new President Collor gained traction because SIVAM, as

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integra_2407_3.htm>, Accessed on 25 June 2007; Radiobras, "Discurso do presidente da República, Fernando Henrique Cardoso, na cerimônia de ativação do primeiro Complexo Operacional - Sipam/Sivam - Manaus/AM," 26 June 2002, URL: <http://www.radiobras.gov.br/integras/02/integra_2607_1.htm>, Accessed on 25 June 2007.

[263] Fernando Henrique Cardoso, *A Arte da Política* (Rio de Janeiro: Editora Civilização Brasileira, 2006), 271.

[264] Radiobras, "Sinopse: Jornal de Brasília," 7 September 1999, URL: <http://www.radiobras.gov .br/anteriores/1999/sinopses_0709.htm>, Accessed on 25 June 2007; Radiobras, "Intégras: Discurso do Presidente da República, Fernando Henrique Cardoso, no almoço com oficiais-generais – Clube do Exército," 12 December 2000, URL: <http://www.radiobras.gov.br/integras/00/integra_1212 _2.htm>, Accessed on 25 June 2007; Tribunal de Contas da União, *TC 012.799/2002-0 – Representação feita pela 3ª Secex em cumprimento ao item 8.3 da Decisão nº 795/1999TCU-Plenário. Programa de Reaparelhamento da FAB*, 28 November 2002, URL: <http://www.tcu.gov.br>, Accessed on 15 June 2007.

a technological project, was unique in the world. President Cardoso stated in his memoirs that he had seen the project develop from his posts as Ministers of Foreign Relations and Finance in 1993-1994 during President Franco's government, doing his best to help the external financing get approved by the Senate. In 1995 as President, Cardoso felt obligated to provide continuity for the project as it came under fire during separate 1995 scandals, the first involving fraud by the project's national integrator and the second featuring supposed trafficking of influence by a presidential aide.[265]

For its part, SIPAM, as an interagency management and coordination organization, was a new approach for Brazil, whose agencies typically operated in an isolated manner unless cooperation was imperative. Both or these aspects appealed to President Collor's sense of new ambitious undertakings for Brazil and placed the SAE in the leadership position for SIPAM, which would take control of SIVAM assets, once installed. SIPAM and SIVAM were subsequently showcased at the U.N. Conference on Environment and Development, hosted by Brazil in June 1992. President Cardoso officially created SIPAM's operational entity in April of 2002. He indicated during the inauguration of SIVAM and SIPAM's initial operational capability that the work of the new agency and it support system would transform Brazil during the 21st century.[266]

Military Threat Perception and Organizational Ambitions. The perception of threat that buttressed the Air Force's motivations to devise and forcefully push SIVAM were tied to the combination of illicit activities in the Amazon basin that obligated military action there, the lack

[265] Cardoso, *A Arte da Política*, 270-274.

[266] Presidência da República, *Decreto nº 4.200, de 17 de abril de 2002* (Brasilia, DF: Casa Civil/Subchefia para Assuntos Jurídicos, 17 April 2002), URL: <http://www.planalto.gov.br/ccivil /decreto/2002/D4200.htm>, Accessed on 25 June 2007; Radiobras, "Discurso do presidente da República, Fernando Henrique Cardoso, na cerimônia de ativação do primeiro Complexo Operacional - Sipam/Sivam - Manaus/AM."

of timely intelligence about what was going on in the region and in border areas, and the embarrassment of losing a commercial passenger flight in the region. Former Aeronautics Minister Sócrates da Costa Monteiro claimed:

> In that era, the airport in Boa Vista represented the second largest movement in the country. More than 200 flights per day were registered, saying they were on course to Santa Helena Farm, but flying themselves to only God knows where. Add this to the public declarations of world leaders who commented on the importance of Amazônia for the world, their emitting the concept of Restricted Sovereignty, besides the Joint Military Maneuvers that friendly countries, neighbors, conducted along our borders. All of this really made us uncomfortable and it was a challenge to the imagination.[267]

Then CCSIVAM President Marcos Antônio de Oliveira testified to congress in November 1994 and again in March 1995 that in 1991 the Air Force transferred a mobile radar to Boa Vista temporarily to get a view of the airspace picture there. In just one month, the Air Force detected 800 irregular flights, four hundred of which the service attributed to prospector flights but the other 400 flights were of unknown origin. Since the unknown flights flew faster and higher than prospector flights typically did, Oliveira and the Air Force suspected they were drug traffickers exploiting Brazilian Amazonian airspace.[268]

Minister Sócrates' successor as Aeronautics Minister, Lélio Viana Lôbo, testified to congress in November 1994 that losing track of a VARIG airlines flight in 1989 over the state of Mato Grosso highlighted Brazil's lack of a proper air traffic control system. Underscoring his point, in August 1995 then DEPED director Sérgio Xavier Ferolla stated to congress, "When that flight from VARIG got lost the following rationale emerged: we must have radars in Amazônia. Beyond the illicit flights avoiding us, we needed to control that region, which is ours."[269]

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[267] Karina Barros, "Os Olhos da Floresta," *Revista Aerovisão* No. 214, October-December 2005: 32.

[268] Câmara dos Deputados, *Comissão de Defesa Nacional Audiência Pública No. 54/95*, 19-20; Senado Federal, *Economic Affairs Commission Public Audience*, 9.

[269] Câmara dos Deputados, *Projeto SIVAM: Audiências Públicas 1995 Volume I*, 156.

The Air Force designed the AL-X from the beginning to respond to the airborne drug trafficking threat in Amazonian airspace. The "Preliminary Operational Requirements" document that served as the basis for the AL-X program's initiation cited the Brazilian state of Rondônia as a major concern of the Air Force and a key transit corridor for cocaine bound for world markets.[270] The Air Force envisioned enforcing sovereignty of Amazonian airspace as the primary mission for the AL-X, because of the aircraft's ability to fly at slow speeds and low altitudes like most drug trafficking flights, its ability to operate and track targets at night, its ability to receive vectoring information from R-99A aircraft, and its formidable armament and electronic systems, which could provide a viable deterrent to other threats that might emerge.[271]

There were clear organizational pressures and ambitions behind SIVAM's installation and behind the AL-X program's development. SIVAM was the missing piece of nationwide airspace control system in 1990. Aeronautics Minister Sócrates knew that the Air Force had reached its limits in terms of depending on the national treasury to complete the nationwide network, recalling, "I knew the difficulties, principally the financing. The Air Force had invested a lot in the implantation of the Integrated Centers for Air Defense and Air Traffic Control (CINDACTA). In this form I was conscious that we would not have enough funds available for another project."[272] Financing for the project had no easy solution, and required some innovation. In 1995 recently retired chief of the SAE, Mário César Flores, testified to congress that in the early 1990s neither Eximbank (from the U.S.), Japanese, or Swedish financiers would provide financing for strictly military projects.[273] Hence, the Aeronautics Minister and his subordinates

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[270] Lorch, "Tucano Operacional!" 30.

[271] CCSIVAM, "Os Super Tucanos," n.d., URL: <http://www.sivam.gov.br/TECNO/equip5.htm>, Accessed on 25 June 2007; Ricardo Moscoso, "A-29: Sofisticado, preciso, letal," *Aerovisão* No. 212, Oct-Dec 2004, 30-31.

[272] Barros, "Os Olhos da Floresta," 33.

[273] Câmara dos Deputados, *Comissão de Defesa Nacional Audiência Pública No. 53/95 – Esclarecimentos sobre licitacão para a consecucão do SIVAM* (Brasilia, DF: Departamento de Taquigrafia, Revisão e Redação, 15 March 1995), 124.

had to conceive of a manner of long-term financing that would allow for development of a CINDACTA in the Amazon basin and that could be supported by international financing.

In order to secure international financing, Minister Sócrates and his staff decided to broaden the mission beyond Air Force competencies by getting the SAE involved to design a national coordination system, which would become SIPAM, and incorporating a number of technologies not traditionally used in a CINDACTA in a broader integrated system that could serve multiple agencies. The integrated system was SIVAM. According to Sócrates' successor, Lélio Viana Lôbo, the ministry had to come up with some radical financing requirements to make the system's execution viable:

> We demanded some interesting conditions: besides global financing we asked for financing deadlines different from anything we had ever been in the habit of requesting. The normal financing deadlines were around seven or eight years, with one or two years without interest. We thought that it was incompatible with the stature of the program, with the volume of the necessary resources and with the conditions that the country was encountering. We stipulated conditions in the range of 20 years of financing, with 8-10 years without interest.[274]

Besides finding a way overcome the state's inability to fund a fourth CINDACTA for the Amazon region, key military personnel in the SIVAM project clearly aimed at establishing C⁴ISR capabilities for military operations in the Amazonian theater. CCSIVAM Chief Oliveira testified to the Senate that SIVAM would provide user organizations with a means of generating current knowledge of the region, of systematizing control, oversight, and monitoring, of expanding and improving communications, and of integrating different technical resources.[275] At the end of the installation process, one of Oliveira's successors as chief of CCSIVAM, Alvaro Luiz Pinheiro da Costa cataloged the national C⁴ISR improvements that could be attributed to SIVAM. He identified INPE's tenfold improvement in capacity for processing satellite imagery, the system

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[274] Castro and D'Araujo, *Militares e Política na Nova República*, 237.

[275] Senado Federal, *Comissão De Relações Exteriores - Reunião 12 de Abril de 1995*, 6.

for imagery processing designed by CTA, the national system for analysis of signals intelligence, the air surveillance and remote sensing aircraft that now compete for sales in the global arms market, the transportable data-link system, and the associated systems integration and software engineering capabilities developed.[276] In essence under SIVAM's umbrella, the Air Force got all of the tools the organization needed, as well as new national capabilities that would benefit the intelligence capabilities of the other military services.

The AL-X was one of the Air Force's key programs for reigniting technological R&D activities in Brazil's aerospace industry. There was no clearer organizational ambition than developing a modern aircraft with state-of-the-art systems, whose operational software was Brazilian designed and controlled, and whose technology was largely of Brazilian design and manufacture. As mentioned in Chapter 6, the AL-X also solved the organizational problem of providing a trainer aircraft that would use essentially the same avionics and electronic systems as the bulk of Brazil's fighter/bomber aircraft inventory. Pilot training would be more practical and effective since the systems were the same.

Industry Threat Perception and Organizational Ambitions. The first half of this chapter dealt with general threat perception that the defense industry in Brazil holds, particularly the aerospace sector. Their main concerns are essentially the inability to secure orders and get paid for them, losing market share, inability gain access to capital and successfully compete, and consequently going into bankruptcy in the face of foreign competition for Brazil's domestic market. Each of these concerns can be considered threats, because they can mean life or death for the firm involved. The main Brazilian defense firms involved in the SIVAM project were Embraer, ESCA, ATECH Foundation, Infranav, Tectelcom, and to a lesser extent, IBM of Brazil. For the AL-X program the key firms were Embraer, Aeroeletrônica (Grupo Aeromot), and a number of small component makers that supply Embraer for the Super Tucano aircraft.

[276] Alvaro Luiz Pinheiro da Costa, "Nós estávamos preparados?" 15.

Two poignant examples of industry difficulties surfaced in the SIVAM project. The first concerns the removal of ESCA from the role of national integrator of the SIVAM project, its stripping of personnel and patrimony by the Air Force, and its subsequent bankruptcy. Having been caught in a scandal for failing to pay social security taxes over several years, ESCA was deemed unsuitable for public contracts, and nearly all of the firm's business was cancelled. ESCA had specialized on large projects that mainly served the Air Force, such as CINDACTA 2 and 3, and was dependent on public money to remain financially solvent. The bad press from ESCA's fraudulent activities created pressures from ESCA's creditors, the firm could not secure loans, and a liquidity crisis resulted propelling the firm to bankruptcy.[277] During this period, the Air Force essentially commandeered the equipment, software, computer disks, and data bases that were critical to Air Force interests and developed by ESCA for SISCEAB and SIVAM.[278] The Air Force also directly contracted about 100 former ESCA engineers who had been assigned SIVAM duties as a technical team to continue working on the project, which formed the nucleus that ATECH Foundation, a non-profit entity, was based upon.[279]

The second example concerns the firm Tectelcom, introduced in Chapter 5, which was supposed to supply the meteorological radars for SIVAM. The company was supposed to supply 10 radars as well as 32 VHF communications systems, but after investing US$ 20 million it ran into problems with obtaining additional credits to finance the industrialization of the units, and consequently an American firm, Enterprise Electronics Corp., supplied the remaining units.[280]

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[277] Oswald, *The Broadening of "Security" for Brazilian Amazônia?*, 127-128, 156.

[278] Câmara dos Deputados, *Projeto SIVAM: Audiências Públicas 1995 Volume I*, 189; Tribunal de Contas da União, *AC-0087-23/96-P Auditoria – Verificação da legitimidade dos contratos e pagamentos efetuados à ESCA S.A. relativos à prestação de serviços incluindo o projeto SIVAM*, 12 June 1996, URL: <http://www.tcu.gov.br>, Accessed on 25 June 2007.

[279] O Estado de São Paulo, "Carta Aberta: ATECH Fundação Aplicações de Tecnologias Críticas," 6 December 2000, NOTIMP No. 228, URL: <http://www.aer.mil.br/Publicacao/NOTIMP/notimp228/05.htm>, Accessed on 6 December 2000.

[280] Virginia Silveira, "Sivam é acusado de privilegiar estrangeiros."; Virginia Silveira, "A Tectelcom pode ficar fora so Sivam," *Gazeta Mercantil*, 12 March 2001.

While Tectelcom was caught up in bankruptcy hearings, ATECH worked with Enterprise and German software manufacturer GAMIC mbH, who were subcontractors to supply the hardware and software for the weather radars. ATECH absorbed both subcontractors' technology, developed a digital processor, and in partnership with Omnisys, developed a prototype S-band Doppler meteorological radar with a supposed 95 percent Brazilian content. ATECH Foundation was able to inherit much of Tectelcom's expertise while working with Enterprise in 2002, and in conjunction with partner Omnisys, started a spin-off company called ATMOS in 2004 to manufacture S-band Doppler weather radars for the Brazilian market.[281]

Although in both cases Brazilian industry was able to salvage the situation to a certain extent, the two cases make clear how vulnerable Brazilian defense industry firms are to capital flows and corruption. Without a constant flow of orders or financing to innovate and develop products of use to the military or other customers, firms like ATMOS might eventually disappear. Even ATECH Foundation, whose non-profit status obligates the foundation to invest all profits back into itself, its U.S. subsidiary (AmazonTech), or other ventures, could become vulnerable if business flags.

In terms of organizational ambitions, while the firms involved in both projects had their efforts directed primarily to servicing their domestic government client, Embraer and ATECH Foundation clearly had designs to export the products they developed from the SIVAM project

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[281] Teixeira, "A Inovação na Atech: Organização nascida do projeto SIVAM quer inovar para diversificar negócios e dar aplicação dual a tecnologias."; CCSIVAM, "Concluído o teste de aceitação do segundo radar meteorológico do SIVAM."; Yuri Vasconcelos, "Weather Radar: São Paulo Company Develops and is Going to Manufacture Novel Meteorological Equipment in Brazil," *Revista Pesquisa FAPESP*, No. 117, November 2005, URL: <http://revistapesquisa//fapesp.br>, Accessed on 18 June 2007; Virginia Silveira, "Atech fabricará o primeiro radar totalmente nacional," *Gazeta Mercantil*, 12 September 2005, URL: <http://www.defesanet.gov.br/fab/atech_radars.htm>, Accessed on 25 June 2007; Martin Malkomes, Fábio Fukuda, and others, "The Sivam Project: Weather Radar Network for the Amazon Region," *Proceedings of ERAD (2002)*: 331-334, URL: <http://www.copernicus.org/erad/online/erad-331.pdf>, Accessed on 25 June 2007; Janaina Coelho, "Tectelcom pede concordata à Justiça," *Vale Paraibano* (online ed.), 1 April 2000, URL: <http://jornal.valeparaibano.com.br/2000/04/01/sjc/tecsat .html>, Accessed on 25 June 2007; Iberoamérica Empresarial, "Justiça suspende a falência da Tectelcom," *Gazeta Mercantil*, 12 February 2004, URL: <http://www.iberoamericaempresarial.com/edicion/noticia/ 0,2458,445931,00.html>, Accessed on 25 June 2007.

and the AL-X program before they had completed servicing the government's needs. This is clear from the government's support of both firm's search for new markets and their inclusion of both firms in plans for regional cooperation with neighboring countries.

Views on Resource Availability and External Suppliers. The impact of supply side factors on all three sets of actors (political leadership, military, and industry) during the SIVAM project and the AL-X program reveal differing levels of bargaining power. From a simplistic view, the structure of financing for the SIVAM project might lead an observer to believe that resource availability presented no problems for the Brazilian private sector defense industry firms, because the financial package covered 100 percent of the project's costs. The truth is more complex, however, and all actors involved felt the pinch of tight resources during SIVAM and AL-X execution.

SIVAM managers used ingenuity and employed a number tactics to keep their project going during tight budget years. José Orlando Bellon, the President of CCSIVAM from 1998-2001, testified to congress in 1999 that he applied different gambits to influence the political leadership to release funds, as well as to influence industry to keep costs on the SIVAM civil works contained. One tactic included taking advantage of President Fernando Henrique Cardoso's September 1999 visit to the Brasilia Air Base, where he was scheduled to see the prototypes of the R-99 and AL-X aircraft, in order to make a plea for more budget resources for the Air Force in order to fund the AL-X program and keep SIVAM moving along.[282] Bellon also held firm against Brazil's three largest civil engineering companies, who had formed a consortium together during the SIVAM civil works bidding in 1998 to try to wrestle a higher price from the government than CCSIVAM wanted to pay. The three companies argued that a

[282] Câmara dos Deputados, *Comissão de Amazônia e de Desenvolvimento Regional Audiência Pública No. 0891/99 – Debate Acerca do Objetivos e resultados do Projeto de Ficalizacão e Vigilância da Amazônia* (Brasilia, DF: Departamento de Taquigrafia, Revisão e Redação, 22 September 1999), 20-21.

budget ceiling of R$ 430 million should be set, while Bellon's ceiling was R$ 300 million. In the end, only one company, Schahin, bid under Bellon's budget ceiling and consequently won the bid.[283]

Bellon's successor as CCSIVAM chief, Ramón Borges Cardoso, expressed his frustration with slow disbursements from the Lula government in December 2003 in an interview and in front of congress. He claimed that the Ministry of Planning, Budget, and Management only afforded a paltry R$ 9 million budget for SIVAM in 2004, when his needs were R$ 225 million. He traced the problem back to its roots in 1999, when the Ministry of Defense was created and it absorbed the SIVAM budget, which was managed by the Presidency's Extraordinary Ministry of Special Projects and its predecessor agency, the Secretariat of Strategic Affairs. With the transfer of the SIVAM accounts to the defense ministry they became more vulnerable to the contingencies the Finance Ministry placed on ministerial budget allotments to feed its primary surplus policy. The lack of budget disbursements for discretionary spending, usually delayed until the end of the year, left CCISVAM in an uncomfortable position, because if the government was late on payment for equipment and services it had received for more than 90 days, it would be in breach of contract and could be liable to immediately pay the full cost of the contract and lose its Eximbank financing altogether.[284]

Air Force Commander Luis Carlos da Silva Bueno blamed several delays in SIVAM's implementation partially on the lack of resources. He stated to congress in November 2003, referring to delayed SIVAM disbursements, that "Eternally we have fought with the government with respect to budgets necessary to fulfill the contracts we already have signed. This is the big

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[283] Senado Federal, *Ata da Comissão Permanente do Senado Federal Referente a 30ª Reunião Ordinária de 16/11/1999 da Comissão de Relações Exteriores e Defesa Nacional* (Brasilia, DF: Secretaria-Geral da Mesa/Subsecretaria de Taquigrafia, 16 November 1999), 29.

[284] Câmara dos Deputados, *Audiência Pública No. 2183/03 – Atraso na Implantação do Sistema de Vigilância da Amazônia — SIVAM em Decorrência de Cortes de Gastos Governamentais*, 3-5; Marcelo Rafael Rech, "Sivam 2: Falta de Recursos Pode Paralisar Implantação," *Defesa@Net*, 12 December 2003, URL: <http://www.defesanet.com.br/bsb/sivam2/>, Accessed on 6 February 2004.

problem – that the contract is signed already and we remain in default. But normally, in the last hour, or a little afterwards, we receive the money."[285]

A perfect example of Bueno's characterization occurred just two years later. During August 2005, CCSIVAM President Álvaro Luiz Pinheiro da Silva consulted with the TCU on problems he was having in securing supplemental resources to pay for contractual obligations in the SIVAM contract. Pinheiro had requested an additional R$ 70 million in funds in January of 2005, foreseeing a looming problem in meeting CCSIVAM's contractual commitments in paying off the balance of the main SIVAM contract. The request got mired in bureaucracy, and by the beginning of August CCSIVAM began to worry about the 31 August deadline for paying money owed to firms covered by the SIVAM financing. The government would then enter into default and have 90 days to pay up, or lose ten years of SIVAM financing at low interest rates completely.[286] Pinheiro likely was betting that since the TCU had a congressionally-mandated role of regularly auditing SIVAM, it could provide an important voice in raising this important oversight with the administration leaders. By 24 November 2005, just days before the government would enter into breach of contract, the presidency signed a law releasing the requested R$ 70 million to pay off SIVAM contractual obligations.[287]

While SIVAM managers repeatedly complained about money, when they really wanted to tread beyond the bounds of the SIVAM financing that was provided in the main SIVAM contract (Contrato No. 1/95-CCSIVAM/RAYTHEON/ATECH/EMBRAER), they were able to find money to achieve their aims and benefit national industry. The clearest case of this occurred

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[285] Senado Federal, *Nota Taquigráfica da Vigésima Quinta Reunião Ordinária da Comissão de Relações Exteriores e Defesa Nacional da Primeira Sessão Legislativa Ordinária da Quinquagésima Segunda Legislatura, Realizada no Dia Seis de Novembro do Ano de Dois Mil e Três*, 25.

[286] Tribunal de Contas da União, *TC-014.681/2005-4 - Consulta. Comissão para Coordenação do Projeto do Sistema de Vigilância da Amazônia – CCSIVAM*, 24 August 2005, URL: <http://www.tcu.gov.br>, Accessed on 18 November 2005.

[287] Presidência da República, *Lei nº 11.199, de 24 de Novembro de 2005* (Brasilia, DF: Casa Civil/Subchefia para Assuntos Jurídicos, 24 November 2005), URL: <http://www.planalto.gov.br/ccivil_03/_Ato2004-2006/2005/Lei/L11199.htm>, Accessed on 27 June 2007.

with the substitution of the EMB-120 Brasilia turboprop aircraft with EMB-145 jet aircraft for the air surveillance and remote sensing missions. In November 1999 and in June 2000, CCSIVAM President Bellon told the Senate and the Chamber of Deputies, respectively, that the substitution of aircraft had been paid for with approximately US$ 100 million from the Air Force's Aeronautics Fund, which receives its revenue inputs from airport taxes collected by the Brazilian Airport Infrastructure Company (INFRAERO).[288] The clearest industry beneficiary of this move was Embraer, which gained not only a bigger sale to the government, but also developed a niche product for export in the military aircraft market.

Airport tax revenues, which go by the names ATAERO, TAN, and TAT, are not considered a normal part of the budget, and consequently they are not subject to the contingencies placed on defense ministry spending by the Finance Ministry.[289] The Air Force used these resources to pay for other parts of SIVAM where external financing was insufficient. The TCU indicated in a June 2000 audit of SIVAM's progress that ATAERO revenues were used to pay for the difference between the US$ 110 million of external financing for SIVAM civil works and the actual price of the R$ 287.5 million paid to Schahin Engineering.[290] The report stated that since the contract for these civil works included engineering services, energy systems, fire detection and alarm, access control to national facilities, closed circuit television, oversight and control of utilities, air conditioning, and prescribed subsystems for SIVAM, and since the civil works have

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[288] Senado Federal, *Ata da Comissão Permanente do Senado Federal Referente a 30ª Reunião Ordinária de 16/11/1999 da Comissão de Relações Exteriores e Defesa Nacional*, 27-28; Câmara dos Deputados, *Relatório Final da Comissão Externa Controle do Tráfego Aéreo* (Brasilia, DF: Câmara dos Deputados, December 2006), 18.

[289] Câmara dos Deputados, *Comissão de Defesa do Consumidor/Comissão de Relações Exteriores e Defesa Nacional - Audiência Pública No. 1366/06 – Exposições e Debates sobre Segurança de Vôo e Tráfego Aéreo no Brasil* (Brasilia, DF: Departamento de Taquigrafia, Revisão e Redação, 22 September 1999), 10-11.

[290] Tribunal de Contas da União, *DC-0540-27/00-P - Auditoria. Acompanhamento do Sistema Integrado de Vigilância da Amazônia*, 12 June 2000, URL: <http://www.tcu.gov.br>, Accessed on 26 June 2007.

much to do with the overall security of the overall system, the requirement to obey strict bidding rules in accordance with Law 8.666 could be waived for national security reasons.[291]

In terms of actors weight in deciding on external suppliers for the SIVAM project, both the senior political leadership and the military had a say in the decision to dispense with formal public bidding procedures. The National Defense Council (CDN) meeting which decided that SIVAM would be bid out to international suppliers instead of a strictly "national" solution included the civilian and military attendees identified Table 7-3.[292]

CIVILIAN ATTENDEES	MILITARY ATTENDEES
President Itamar Franco	Army Minister Zenildo Zoroastro de Lucena
Vice President – Post Vacant	Navy Minister Ivan Serpa
Chamber of Deputies President Inocêncio Oliveira	Aeronautics Minister Lélio Viana Lôbo
Senate President Humberto Lucena	EMFA Minister Arnaldo Leite Pereira
Foreign Relations Minister Celso Amorim	†Secretary of Strategic Affairs Mário César Flores
Planning Minister Alexis Stepanenko	
Justice Minister Maurício Correa	
*Finance Minister Fernando Henrique Cardoso	

Table 7-3: National Defense Council Meeting Members Debating SIVAM in 1993.

Source: Oswald, *The Broadening of Security for Brazilian Amazônia?*, 113.

Defense industry actors were clearly absent from the decision making about SIVAM's source of hardware, which reveals their weakness in terms of bargaining power and influence during this juncture. While they were not present at the CDN meeting, certain actors associated with industry were clearly involved in influencing events. For instance, Líder Táxi Aéreo President José Affonso Assumpção had been working as an associate of Raytheon Company in

[291] Tribunal de Contas da União, *DC-0540-27/00-P*.

[292] The Defense Minister post did not exist at this time, but since 1999 it has replaced the EMFA as a statutory member. The Army, Navy, and Aeronautics Ministers were replaced in 1999 with the Army, Navy, and Aeronautics Commanders. * Finance Minister Cardoso was invited to the meeting because of his critical role in economic matters, not as a statutory member. † The Secretary of Strategic Affairs served as Executive Secretary of the CDN from 1990-1999 and was replaced by the president's Institutional Security Chief.

Brazil since the late 1980s, when then Aeronautics Minister Octávio Moreira Lima assured Assumpção that bidding for a fourth DACTA system for the Amazon region would not be automatically granted to Thomson-CSF like the previous DACTA systems. Shortly after a new administration took control in 1990 and Aeronautics Minister Sócrates gained approval to develop SIVAM in lieu of a fourth DACTA, Assumpção became a contracted representative of Raytheon to follow the Aeronautics Ministry's planning and help the company position itself.[293]

As Raytheon's representative and a savvy aerospace business insider, Assumpção knew that Aeronautics Ministry favorite ESCA would be called upon to serve as the national integrator for the SIVAM project, because it had served this role in the previous two DACTA systems working with Thomson-CSF and no other firm in Brazil was its equal. ESCA had a deep preexisting relationship with Thomson-CSF, another competitor for the SIVAM bid, whose attempt to buy ESCA in 1993 before the bidding began was vetoed by the Presidency's Secretariat of Strategic Affairs.[294] For reasons of this nature, Líder Táxi Aéreo and Raytheon sought out ESCA and signed a "Letter of Intent" in June 1992 to form a consortium as a type of preemptory co-optation of the firm.[295] While the Aeronautics Ministry directed ESCA to dissolve this agreement and other similar associations with SIVAM competitors, this episode reveals that defense industry actors in Brazil are capable of exerting influence in the government's choice of foreign suppliers.[296]

In terms of being the kingmaker in the SIVAM bidding, perhaps no Brazilian firm was better positioned than ESCA. The firm had been deeply involved in Air Force projects since its

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[293] Câmara dos Deputados, *Projeto SIVAM: Audiências Públicas 1995 Volume I*, 212-213.

[294] Gustavo Krieger, "Empresa é Estratégia," *Folha de São Paulo*, 5 April 1995.

[295] Brigagão, *Inteligência e Marketing: O Caso SIVAM*, 83; Câmara dos Deputados, *CPI – SIVAM: Relatório Final*, 117-119.

[296] Humberto José Lourenção, *A Defesa Nacional e a Amazônia: O Sistema de Vigilância da Amazônia (SIVAM)*, Masters Dissertation chaired by Eliézer Rizzo de Oliveira (Campinas, SP: UNICAMP, 2003), 144; Senado Federal, Senado Federal, *Relatório SIVAM*, 39; Brigagão, *Inteligência e Marketing: O Caso SIVAM*, 85.

creation with Air Force assistance in 1976 and it was trusted almost as a government entity, as made clear in its perfunctory designation as SIVAM national integrator in December 1993. CCSIVAM President Oliveira justified ESCA's selection during 1995 for several reasons:

> ESCA was chosen because it unites the greatest quantity of attributes, and it unites unbeatable attributes, such as trustworthiness in the maintenance of secrecy of information of a military nature, for example, our Navy's Corvettes and our Air Defense System. The software of the air defense of this country was developed by ESCA. And this software has to be integrated with the surveillance and air traffic control software in the Amazon. Besides this, ESCA developed all of the simulation systems we have for air traffic control in Brazil. It developed all of the technique for making American, Italian, and French radars compatible. This would permit us, if in the bidding we were to gain a German radar, to be able to make the German radar "talk" with the French radar, which is already installed in the country. ESCA unties a very large quantity of attributes, and its selection focused on this.[297]

With such a distinguished profile, ESCA employees were given a privileged position in choosing the winning consortium. As a trusted partner of the Air Force, ESCA had a running contract with the Aeronautics Ministry which allowed the Air Force to use the firm to indirectly contract technically qualified professionals for specific projects as "consultants" without passing through the bureaucratic process of publishing a "convening proclamation" and receiving bids for each new need.[298] Aeronautics Minister Lôbo stated in 1999 that this was a normal work-around used by diverse areas of government to retain highly qualified and trusted technicians, and the Air Force employed this strategy because it could not rely on normal budget resources to contract the right number of highly qualified personnel.[299] The problem with this type of arrangement is that the intended flexibility and expedience it affords can be exploited for corrupt purposes, and several lawmakers in the congress interpreted it in this manner. For instance, of the nine technicians contracted to select the national integrator for the SIVAM project in September 2003, six of them were on ESCA's payroll, and of course ESCA won.[300] In addition, within the team of

[297] Senado Federal, *Comissão De Relações Exteriores - Reunião 12 de Abril de 1995*, CC-10.

[298] Senado Federal, *Relatório SIVAM*, 32.

[299] Castro and D'Araujo, *Militares e Política na Nova República*, 239.

[300] Senado Federal, *Relatório SIVAM*, 27.

technicians that evaluated the technical proposals from competing consortiums, several were contracted by ESCA in its role as national integrator for SIVAM. ESCA's own employees were involved in evaluating the bids as well.[301]

ESCA's successor, ATECH Foundation, made itself ubiquitous during SIVAM implementation and essentially established government dependence on it for a number of functions. The TCU recounted that as early as 2002 ATECH had signed a contract to perform specialized technical services for the activation of the SIPAM regional surveillance center (a.k.a. CTO) and logistic support center in Manaus. The non-profit organization assumed functions inside the SIPAM facilities which were supposed to be filled by civil servants in order to compensate for government staffing problems. The TCU identified SIPAM's dependence on ATECH labor to be a problem because the potential for the firm to exceed the mandate for which it was contracted was great.[302] Several years later, an internal audit by the Management and Operations Center of SIPAM (CENSIPAM) found that the combination of outsourcing government work to ATECH, combined with an ineffective rotational system for government workers at SIPAM facilities, contributed to "a significant loss of the government's efficient use of technologies and operational procedures installed in the system."[303]

Defense industry played no similarly visible role in the AL-X program. Public accounts reveal no abnormalities in the bidding process. No allegations of malfeasance or having the deck stacked in Embraer's favor surfaced during the development process for the AL-X or during the bidding for its production contract. Embraer, as Brazil's crown jewel in the aerospace sector, was an unlikely target for internal political attacks, since it had just emerged weakened from privatization and the company's status was much more cherished than ESCA's.

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[301] Câmara dos Deputados, *Comissão de Defesa Nacional Audiência Pública No. 54/95*, 59; Senado Federal, *Comissão De Relações Exteriores - Reunião 12 de Abril de 1995*, CC-11.

[302] Tribunal de Contas da União, Tribunal das Contas da União, *TC 015.444/2003-8*.

[303] SIPAM, *Nota Técnica No. 04/2006*.

A break down of some of the differences between the two projects may explain factors that created controversy and stirred different concerns among the political leadership, military, and industrial sector in the SIVAM project which never touched the AL-X program. One factor was the cost of the projects. SIVAM cost US$ 1.395 billion at the time of its bidding, but actual costs far exceeded that figure, especially when considering cost overruns with aircraft, civil works, and penalties for breaking financing rules. The AL-X program was budgeted at US$ 420 million in production costs.

A second factor was the number of firms involved. SIVAM included several Brazilian defense or technology firms, a major U.S. defense contractor, a Swedish defense contractor, a German defense contractor – all in substantial roles – and dozens of U.S. subcontractors. The AL-X program featured Embraer, two foreign defense contractors from Germany and Israel, and one other Brazilian company acquired by the Israeli firm.

A third factor was the scope and origin of the technology required to complete the projects. With SIVAM, Brazilian planners and engineers were attempting something that had never been done inside Brazilian territory or elsewhere, essentially starting from scratch with foreign hardware. The closest thing that Brazilian planners could compare the undertaking to was the DACTA systems, which used similar technologies. The rest had to be imported or developed. The AL-X prototype aircraft, in contrast, was developed by Embraer from an existing airframe, the T-27 Tucano trainer, which used a great number of the same parts as the 600-plus Tucanos that had been delivered world-wide and which had established supply chains and logistic support.

Finally, a fourth factor was the export plans for the projects. SIVAM being a unique, sophisticated, and complex system was not well suited for export, although several of its critical technologies were, and have been helping selected neighboring countries. The AL-X aircraft can trace its roots to a prototype developed to compete for the U.S. trainer aircraft market during the JPATS competition. The plane was simple enough and applicable to so many countries' needs

that an export market was essentially waiting for it as a niche product that few other countries could match.

These differences may help explain why so many political forces were attracted to the SIVAM project and why the AL-X program seemed to slip by with less grief. The demand factors (threats and organizational pressures/ambitions) that these two projects responded to were of a different magnitude. The political, military, and industrial actors involved acted differently. While threats to the Amazon basin may have been a more decisive factor for the political and military leadership in forming their decisions about the SIVAM project and AL-X program, for the military the organizational ambitions were perhaps just as important. For industrial actors left out of SIVAM, or for die hard nationalist supporters in the defense industry's lobby who were concerned with technological autonomy, the government's choice to import foreign hardware was seen as a threat to their existence.

At the most extreme, critics such as SBPC member Rogério Cezar de Cerqueira Leite wanted 100 percent national content in the SIVAM project and claimed that fully Brazilian consortiums were dismissed from the competition after the first evaluation without explanation. He also claimed that the technological concept of the project featured technology nearing obsolescence, and lobbied the congress to rescind the SIVAM contract using his organization's alternative technological proposal.[304] Even deeply nationalistic military personnel like former CTA director Sérgio Xavier Ferolla admitted, however, that the days of import substitution had passed and to trying and produce all components for defense goods was not a viable strategy for the SIVAM project. He stated, "No country exists in the world that is self-sufficient. The country that has a certain capacity for power has leverage in bargaining, but it cannot produce

[304] Rogério Cerqueira Leite, "O Sivam: uma oportunidade perdida," *Estudos Avançados* 16, no. 46 (2002), 123.

everything. Then, this problem of doing it all in Brazil can carry, and did carry, some firms to a difficult situation, because there was no market viability."[305]

As pointed out in Chapter 2 by Renato Dagnino, the "innovation policy" that the military developed in executing its technological projects during the 1970s and 1980s has been the key legacy that has persisted in the Brazilian industrial sector. In both the SIVAM and the AL-X projects this approach was employed by government and its industry allies by sending engineers and technicians overseas for training alongside firms contracted to execute significant portions of the projects. Executing this mechanism is most relevant where software engineering, industrial techniques and know-how, and certain systems integration activities are involved, because they feature more of a learning process that is embedded in human capital, rather than physical capital such as facilities, machine tools, and computer design equipment. The former becomes more deeply embedded in a workforce, but it may not have an immediate payoff and requires financial capital to execute. The latter provides the tools needed to produce technology, but does not provide a skilled work force to execute the tasks.

The military services' proclivity during the 1990s to import military materiel, after the domestic defense industry faltered, spurred a policy using offsets as the key tool to make the best of a situation where buying domestically was usually not feasible. The Air Force, in particular, formalized its offsets policy early, and employed it in the SIVAM and AL-X programs as the best way to get concessions for Brazilian defense industry from foreign suppliers by using the service's purchasing power in situations where Brazil could not wait for national technological solutions. The Air Force sees the benefits of this policy in the balanced commercial equilibrium it promotes, the new export markets it promotes through counter-trade mechanisms, the potential

[305] Câmara dos Deputados, *Projeto SIVAM: Audiências Públicas 1995 Volume I*, 181.

increased external capital investments in Brazilian firms with added jobs and improved knowledge, and the incremental technological preparation inside the industrial park.[306]

Some defense industry spokesmen, such as AIAB's Walter Bartels, believe that using offset clauses can be useful in limited circumstances, but counterproductive on many more occasions. He has argued in the congress, in seminars, and in publications that the Air Force's use of offsets is an admission that the service must shop outside of Brazil. He maintains that by buying technology from foreign suppliers the government invests in other nation's technological R&D capabilities rather than Brazil's. Bartels believes that Brazil's industry can only really benefit from offsets if it participates in the development of a product, in part because transfers from foreign suppliers usually feature only tangible (products) or depreciated technology, rather than new, sensitive, or intangible (accumulated knowledge) technology. By going to foreign suppliers the military may find financing to make up for government budget shortfalls, but local industry loses the technological expertise and potential export market it could benefit from by developing and producing the product locally.[307]

The Role of Structures in the SIVAM and AL-X Cases

The factors highlighted in defense industrial activities spelled out thus far in Chapters 4, 5, 6, and 7 are sufficient to populate Conca's framework to examine the role of domestic and international structures in Brazilian defense industry. They also illuminate much about Brazil's current effort to achieve elusive technological autonomy. Table 7-4 provides a recap of the key actors involved in both technological projects.

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[306] Comando da Aeronáutica, "SDDP/COPAC: O Adensamento da Cadeia Produtiva da Indústria Aeronáutica." Briefing presented at BNDES for the Seminar on Thickening of the Aeronautics Industry Productive Chain, Rio de Janeiro, 16 April 2004, URL: <http://www.bndes.gov.br/conhecimento/seminario/aer_offset.pdf>, Accessed on 23 March 2006.

[307] AIAB, "Cenário Atual e Perspectivas da Indústria Aeronáutica Brasileira – Associação das Indústrias Aeroespaciais do Brasil, Walter Bartels," 42; Câmara dos Deputados, *Commissão da Ciência e Tecnologia, Comunicação e Informática - Audiência Pública para discutir a proposta de aquisição dos caças supersônicos em substituição aos atuais Mirage, que deverão ser desativado*.

	Domestic Firms	Domestic R&D Allies	International Partners	Financing/Capital Allies
AL-X	Embraer Aeroeletrônica (Aeromot)	CTA ITA FINEP	Elbit El-Op Rohde & Schwarz	1. Export Development Canadá (EDC) 2. Deutsche Bank AG-London Branch & Export Credits Guarantee Department (ECGD) 3. Deutsche Bank AG 4. Banco BNP Paribas S/A e Bank Leumile-Israel B.M.
SIVAM	ATECH Embraer Infranav Schahin IBM do Brasil Tectelcom	CTA ITA PUC BNDES	Raytheon Ericsson Rohde & Schwarz	1. Banco do Brasil S.A. Grand Cayman Branch & Export-Import Bank of the United States 2. Banco do Brasil S.A. Grand Cayman Branch e Eximbank 3. Banco do Brasil S.A. Grand Cayman Branch & AB Svensk Exportkredit – (SEK) 4. Raytheon Credit Facility – (RCF) 5. Vendor Credit Facility – (VENDOR)

Table 7-4: Defense Industry Technological Project Participants and Allies.

Source: Author's Analysis.

With these relationships in mind, using elements of Conca's framework to focus details of the collective case study, some comparisons between the two cases allow for measurement of Brazil's relative independence and ability to improve its level of technological autonomy. The success of the Brazilian defense sector in dealing with international structures that dictated

defense sector interaction with external actors is summarized for the two cases in Table 7-5. In terms of Brazil's ability to gain access to the technology to develop both projects, there were few problems, so a capacity rating of "high" is granted in both cases. Global suppliers threw up essentially no barriers to Brazil's requested technologies and were eager to bid for both the SIVAM and AL-X program requirements.

A second measure dealing with capacity to develop systems or military technology without outside help is rated "low" for both cases, in part because Embraer eschews vertical production practices in favor of sharing risk with global partners. This is clear from the manner in which both the Super Tucano aircraft and the EMB-145 aircraft are assembled. While the Super Tucano case is somewhat less extreme, without vital inputs from foreign suppliers like Pratt & Whitney, Martin Baker, and Elbit, there would be no AL-X. The case is even more extreme for the EMB-145, particularly its military aircraft variants which need sensors exported from abroad. The rest of SIVAM's key technologies may eventually be substituted for with nationally produced items – a point which will be explored in the next section – but the project never would have existed without vital international technological inputs.

In terms of freedom to export technologies developed through both projects, both cases showed clear success in harnessing the technologies developed during the 1995-2006 time period and exporting products to international customers. What differed was the level of interference from external actors. The AL-X case is rated at "medium" because the U.S. government was able to essentially veto Embraer sales of the Super Tucano to Venezuela and temporarily impede sales to Colombia. Exports of military aircraft designed for SIVAM encountered no similar barriers. ATECH services that are based off of expertise developed during SIVAM installation have also encountered no barriers from external actors. This includes helping Venezuela develop a territorial surveillance system similar to SIVAM. For these reasons the capacity for freedom to export for the SIVAM case is rated as "high"

International Structure Impact	AL-X	SIVAM
Extent to which the Brazilian defense sector institutions can gain access to technology from external source for production needs	High	High
Extent to which Brazilian industries can independently produce weapons systems or other military technology without inputs from outside sources	Low	Low
Extent to which Brazilian industries can export defense materials to external markets or create spin-offs for internal and external markets, without outside interference from other nations or corporations	Medium	High

Table 7-5: Impact of International Structures on AL-X and SIVAM.

Source: Author's Analysis.

Table 7-6 summarizes and compares the key roles, procedures, and rules that were critical in influencing actors' decisions and their ability to adapt to changing circumstances during the course of the SIVAM project and AL-X program development and implementation. Conca's 1997 study examined largely the failure of public and private defense industry firms to adapt to changing circumstances associated with global market changes. From the summary in Table 7-6, it appears that many of the harsh lessons from the failures of Brazilian defense industry were taken into consideration in the implementation of the AL-X program and SIVAM project.

For instance, the roles, rules, and procedures applied to both cases allowed for some flexibility in meeting actors' institutional objectives while remaining realistic about resources available to meet those objectives. While DMA 400-6 allowed the Air Force to write operational requirements that favored Embraer over competitors, the offsets policy ensured that industry would be compensated for those portions of the project coming from foreign suppliers that

Embraer could not produce. In the case of SIVAM, decision makers realized early that national industry could not meet the government's needs, but the existing law allowed flexibility to waive selected rules for cases of national security. While the vast bulk of equipment came from the exterior, offset provisions allowed the government to extract compensation that greatly benefited the technological capabilities of a number of defense industry firms.

A number of relationships with international and domestic structures, some preexisting and some developed over the course of project implementation, either helped or hindered the status of industrial actors in the AL-X and SIVAM projects. In both cases, financial capital was available to key defense industry participants from state-controlled (FINEP and BNDES) and international sources (financing from banks or export guarantee institutions). Some of the preexisting relationships were established supply chains and partnerships (Embraer) while others were temporary marriages of convenience that served a purpose, disappeared, and then re-emerged (ESCA-Raytheon).

Most institutions demonstrated the ability to adapt to changing circumstances. In some cases inability to adapt led to bankruptcy, such as in the case of ESCA and Tectelcom in the SIVAM project, but even in this case the Air Force was able to adjust and find solutions to the problem, with the creation of ATECH and that firm's ability to absorb Tectelcom's function and learn from it. In both the SIVAM and AL-X cases, the successful application of an offsets strategy allowed the defense industry's project participants to gain expertise not previously available in Brazil, and was enough of a success that the newly created Defense Ministry adopted Air Force offset mechanisms as a sector-wide policy.

Domestic Institutional Focus	AL-X	SIVAM
Institutional core of roles, rules, and procedures applied	1996 PDN set overall policy stressing technological goals Air Force directive DMA 400-6 defined guidance for defining requirements Offsets policy provided specific mechanisms	1996 PDN set overall policy stressing technological goals Law 8.666 partially defined bidding process, but were partially waived Offsets policy provided specific mechanisms
Existing defense sector relationship with international and domestic structures	Air Force had well-established external procurement habits Preexisting Embraer relationship with Canadian, British, and U.S. component suppliers FINEP support as financier for R&D International financing available for foreign supplied goods	Raytheon/Lider/ESCA Letter of Intent & long ESCA relationship with Thomson-CSF for CINDACTAs Embraer risk partners (Enaer, Gamesa, C&D Interiors, Sonaca) for EMB-145 development BNDES support as financier for aircraft development International financing available for foreign supplied goods
Did key institutions in the defense sector adapt to structural change?	Yes: Air Force developed offsets policy within to deal with globalization Yes: Embraer privatized in order to survive and thrive Yes: Combination of CTA, FINEP assistance enabled Embraer to meet Air Force needs Yes: Aeroeletrônica secured investment from Elbit to assume critical subcontractor and logistic support role	Yes: Air Force developed offsets policy within to deal with globalization Yes: Defense Ministry adopted similar offsets policy Yes: Air Force creation of ATECH after ESCA's removal from SIVAM No: ESCA and Tectelcom went bankrupt under pressure to deliver

Table 7-6: Domestic Institution Adaptation to International Structures.

Source: Author's Analysis.

How Technology Spin-Off Projects May Benefit the Defense Sector

The directives in the National Defense Policy, National Policy for Defense Industry, Policy of Science and Technology of the Armed Forces, and others have been closely examined

during the course of this study. The policies have guided the services and the defense industry to establish a modified set of expectations regarding the extent to which they are supposed to help each other in order to develop and produce defense items and materials that the military can use to conduct military operations and fulfill their missions. The defense industry's firms also need to find other outlets besides the military for their products, whether adapting military or dual-use technology for the civilian market or exporting defense items overseas. The previous chapters addressed some products directly related to the SIVAM project and AL-X program that have been successfully exported, such as EMB-145 surveillance and maritime patrol aircraft, surveillance technology derived from SIVAM to set up similar capabilities in neighboring countries, and Super Tucano deliveries to several countries as well. In terms of innovation these exports demonstrate the ability to apply newly developed capacities, but they do not really demonstrate the ability to take technology in a different direction.

If technological autonomy implies the ability to innovate as well as to produce systems without foreign help, what have Brazilian defense firms done that demonstrates both the means to meet the military's near-term needs as well as produce something that might anticipate future needs? In the event that industry is projecting to meet future needs of the services, are they are they partnering with each other and correctly positioned to field new systems? Evidence exists that the answers these questions are both "yes" and "no." While some thought has apparently been given to anticipating eventual replacement of many of SIVAM's subsystems, industry partnering could be much stronger and supported more comprehensively by the military. Below are some example projects that provide insight into these questions.

ATECH has taken advantage of its systems integration expertise gained during the SIVAM project to put together a new, low-cost aerial monitoring system, named "Aquila," using a combination of national and international suppliers. The new system, which was developed with 50 percent financial support from FINEP, utilizes a two-seat motor-glider platform manufactured by Aeromot, equipped with a CASI-1500 hyper-spectral sensor that features 288

spectral channels and is manufactured by Canadian firm ITRES Research Limited. The system also features a real-time data-link capability that can be remotely controlled by radio frequency from up to 150 kilometers away. The "Aquila" system was developed in conjunction with the Brazilian Naval Research Institute to serve the local market for a high resolution hyper-spectral imagery system that can be purchased at a low cost by institutions for surveillance, reconnaissance, and environmental monitoring missions.[308]

A second technology that was developed by Campinas-based firm OrbiSat, with support from the São Paulo State Foundation for the Support of Research (FAPESP), is an Interferometric Synthetic Aperture Radar (InSAR) named OrbiSAR-1. The sensor, which uses the X- and P-bands simultaneously, comes with its own processing software designed by OrbiSat and has been used in airborne platforms, such as a Cessna 207A or other aircraft, for cartographic, digital elevation modeling, and terrain mapping purposes in Venezuela. The system can create images with a resolution of 25 centimeters. The OrbiSAR-1 system was marketed at the LAAD 2007 show in Rio de Janeiro as a low cost system ideal for military, intelligence, counter-drug, and border surveillance missions.[309]

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[308] ATECH, "Negócios/Produtos: Aquila," n.d., URL: <http://www.atech.br/_new/site/negocios/produtos.php>, Accessed on 18 June 2007; ITRES, "Press Release: ITRES Delivers CASI-1500 w Remote Operation Capability to Atech (Brazil)," 16 November 2006, URL: <http://www.itres.com/modules/news/newsitem.php?ItemId=25>, Accessed on 18 June 2007; Instituto Brasileiro de Informação em Ciência e Tecnologia, "Informações Sobre o Projeto/Fundo: Encomenda FINEP/CT-AERO No. 0105073300 – Sistema de Monitoriamento Aereo de Baixo Cuto," n.d, URL: <http://prossiga.ibitc.br>, Accessed on 18 June 2007; Luciano Mousinho Rodrigues and others, "Sistema de imageamento hiperspectral de alta resolução embarcado em plataforma aérea de baixo custo," Paper presented to the Anais XIII Brazilian Symposium of Remote Sensing, Florianópolis, Brazil, 21-26 April 2007, INPE, 7079-7085, URL: <http://marte.dpi.inpe.br/col/dpi.inpe.br/sbsr@80/2006/11.14.22.45/doc/7079-7085.pdf>, Accessed on 27 June 2007.

[309] Markus Rombach, "The Newest Multipolarizate Dual Band Sensor OrbiSAR-1 InSAR," Paper Presented to the XXI Brazilian Congress of Cartography, URL < http://www.cartografia.org.br/xxi_cbc/202-SR23.pdf>, Accessed on 27 June 2007; Defesanet, "Sensoriamento: Uma Ferramenta para Ações de Inteligência Militar," URL: <http://www.defesanet.com.br/laad07/3_orbisat_1.htm>, Accessed on 12 April 2007; Defesanet, "Orbisat Apresenta Radar com Tecnologia Única para Apoiar a defesa na Vigilância de froteiras e no combate ao Narcotráfico," 12 April 2007, n.d, URL: <http://www.defesanet.com.br/laad07/3_orbisat.htm>, Accessed on 12 April 2007; ORBISAT, "Tecnologia: InSAR – Radar Interferométrico de Abertura Sintética," n.d., URL: <http://www.orbisat.br/sensoriamento_remoto/tecnologia.html>, Accessed on 6 June 2007; ORBISAT, "Projetos: Conheça Nossos Projetos," n.d., URL: <http://www.orbisat.br/

OrbiSat also recently received the technology from a prototype of a low-altitude, three dimensional, targeting radar – known as the SABER M-60 – developed by the Brazilian Army's Technological Center. The radar was designed to work with Anti-Air Artillery systems and the Man-Portable Surface-to-Air Defense Systems (MANPADS) that the Army uses. The system can reportedly track 40 targets at once, uses open source code software, and is designed to be linked into the Army's tactical communications system using the M3TR radios the Army purchased from Rohde & Schwarz, among other communications systems. FINEP provided R$ 13.5 million in seed money for the Army to develop the prototype during a first phase in 2006, with R$ 9.3 million in assistance scheduled for two additional phases in 2007 and 2008. OrbiSat's role is to develop the SABER M-60 for production, and the firm has reportedly received financing from BNDES for this activity.[310]

Based on the data-link expertise it gained in working with Rohde & Schwarz on secure communications in the SIVAM project, Embraer was awarded a contract to develop the LINK-BR2 tactical data-link for the Air Force in December 2006. LINK-BR2 will feature a Time Division Multiple Access (TDMA) network that allows 32 aircraft to interact on the network at one time, in addition to the more limited point-to-point communications capabilities used in the LINK-BR1 system developed for SIVAM, which allows R-99 aircraft to communicate with 27

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sensoriamento_remoto/projetos.html>, Accessed on 6 June 2007; Tânia Marques, "Vôos da Inovaçã," in *Novos Caminhos em Pesqusa Empresarial: Resultados do Programa Inovação Tecnológica em Pequenas Empresas* (São Paulo: FAPESP, 2004), URL: <http://www.fapesp.br/publicacoes/novos_caminhos.pdf>, Accessed on 6 June 2007; INFOREL, "OrbiSat Tem Radar para Vigilância de Fronteiras," 14 April 2007, URL: <http://www.inforel.org>, Accessed on 6 June 2007.

[310] Exército Brasileiro, "Centro Tecnológico do Exército - Projeto Brasil 38º Fórum de Debates," Briefing presented at the 38th Debate Forum on "Military Industrial Policy: Foundations for a New Strategy," São Paulo, 23 November 2006, URL: <http://www.projetobr.com.br>, Accessed on 28 November 2006; Exército Brasileiro, "A 1ª Bda AAAe e o Projeto M01.00 – Sensor Radar de Defesa Antiaérea de Baixa Altura," n.d., URL: <http://www.1bdaaaae.eb.mil/Artigo%20Bda%20AAAe.htm>, Accessed on 19 June 2007; Ricardo Bonalume Neto, "Militares se adaptama à penúria, mas têm projetos bilionários," Folha de São Paulo, 29 April 2007, NOTIMP, No 119, URL: <www.fab.mil.br>, Accessed on 29 April 2007; INFOREL, "OrbiSat Tem Radar para Vigilância de Fronteiras."

remote ground stations (DLRS) in the Amazon basin. The key challenge is to develop a unified package of applications to manage the data-links.[311]

Earlier in this chapter S-band and X-band Doppler weather radars produced jointly by Omnisys and ATMOS were introduced as the legacy of Tectelcom's failed attempt to supply meteorological radars for the SIVAM project. Omnisys has recently developed the capability to produce L-band, long range radars through a major investment by French company Thales (51 percent). As part of the deal Omnisys will build on its current activities of simply upgrading the French LP-23M surveillance radars installed in Brazil during the 1980s as part of SISCEAB, and will actually begin building new radars based on Thales' LP-23M design for the local market and for export. The key difference is that the LP-23M radars that Omnisys will build will use a solid-state semiconductor technology for pulse modulation instead of magnetron valve technology, as used in the French radar's original design to emit electromagnetic signals. FINEP decided in 2006 to support Omnisys' efforts to build the radars with the solid state technology with R$ 2.9 million in venture capital.[312]

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[311] Alexandre Lessa, "O Sistema de Comunicações por Enlaces Digitais da Aeronáutica (SISCENDA): Aspectos Relacionados com o seu Desenvolvimento."; Sistema de Armas, "SISCENDA."; Valdenice Pimenta de Araújo, "Em tempo real," *Aerovisão* 207, Ano XXXI, July-September 2003, 40-41; Mario A. de Freitas, "Sistema de Comunicações Seguras (SECOS) da Rohde & Schwarz - Características Gerais e Implementação no Data Link do COMAER."; Kevin T. Fitzgibbon, "O Sistema de Enlace de Dados Táticas em Redes," Briefing presented at the V Symposium on Electronic Warfare, 2 September 2003. URL: <http://www.cta.br/sige/dia2desetembro%5CV_SIGE_Embraer_DataLink_Final.pdf>, Accessed on 26 September 2006; Embraer, "News Release: Embraer and the Brazilian Government Sign Communication Software Contract," 22 December 2006, URL: <http://www.embraer.com.br/institucional /download/2_157-Prd-VPD-Link_BR2-I-06.pdf>, Accessed on 27 June 2007.

[312] Francisco Góes, "Thales quer fazer do Brasil plataforma para exporter radar," *Valor Econômico*, 12 March 2007, NOTIMP No. 71, URL: <http://www.fab.mil.br>, Accessed on 12 March 2007; Mônica Teixeira, "Contrato com governo, subvenção da Finep e competência nascida de apoio da Fapesp fazem Omnisys exportadora de radars de rota," *Inovação UNICAMP*, 26 March 2007, URL: <http://www.inovacao.unicamp.br/report/noticias/index.php?cod=52>, Accessed on 18 June 2007; Mônica Teixeira, "Desenvolvimento de radar meteorológico financiado pelo Pipe deu credibilidade à Omnisys, comprada em 2006 pela Thales," *Inovação UNICAMP*, 2 May 2006, URL:<http://www.inovacao.unicamp .br/report/news-pipeomnisys.shtml>, Accessed on 28 June 2007; FINEP, "Chamada Pública MCT/Finep/ Subvenção Econômica À Inovação - 01/2006 Projetos Aprovados - Temas Gerais," n.d., URL: <http://www.finep.gov.br/fundos_setoriais/subvencao_economica/resultados/Resultado_final_subven%C3 %A7%C3%A3o_01_2006.pdf>, Accessed on 28 June 2007; Omnisys, "Modulador de Pulso a Estado Sólido – SST-2M," n.d., URL: <http://www.omnisys.com.br/pdf/MODULADOR%20DE%20PULSO %20A%20ESTADO%20SÓLIDO%20–%20SST-2M.pdf>, Accessed 19 June 2007.

Each of the technologies identified above could serve Air Force, Army, or Navy needs in coming years, some could be applied to law enforcement or regulatory agency missions, or alternatively, they could be harnessed for export to other countries that seek sophisticated capabilities at lower costs. For example, the Air Force has only 3 R-99B remote sensing aircraft with SAR on-board. The cost of operating this aircraft, according to Air Force sources, is roughly US$ 4,000/flight hour.[313] SIPAM user agencies, including each military service, also have to compete for operating time for the various missions and sensor capabilities of this aircraft. Purchase of a cheaper airframe equipped with the OrbiSAR-1 system, whether the Air Force or some other entity operated the system, could free up the R-99B to perform more missions where using the SAR sensor was not critical, but using SIGINT sensors or FLIR imaging systems was.

As a nationally developed sensor, the OrbiSAR-1 also could potentially serve as a replacement for the Canadian SAR system on board the EMB-145 airframe, making the content of the plane more "Brazilian" and providing more flexibility for export without the end-user restrictions that can hamstring sales in some circumstances. While this might seem like a logical development for a defense ministry that stresses increased independence from foreign suppliers, neither Embraer nor the Brazilian government has moved in this direction. A June 2006 briefing presented to the India-Brazil-South Africa forum dealing with issues of South-South economic cooperation concluded that while OrbiSat wants to sell its InSAR sensor on-board an Embraer airframe, funding constraints, a lack of interest on Embraer's part, and other more pressing government priorities have prevented Brazil from developing a prototype.[314]

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[313] SIPAM, *SAR do R-99B*, Briefing (Nilo Andrade - Comando da Aeronáutica), n.d., URL: <http://www.sipam.gov.br/intranet/paginasipam/portal/downloads/SARR99B.zip>, Accessed 24 March 2007.

[314] Mario Marconini, "IBSA and the Aerospace Industry in Brazil," Briefing presented to the conference on South-South Economic Cooperation: Exploring IBSA (India-Brazil-South Africa) Initiative, 28 June 2006, Johannesburg, URL: <http://www.cuts-citee.org/documents/Marconini-IBSA-Johannesburg

ATECH has also fielded a system that could have great practical use for the Armed Forces, intelligence organizations, and law enforcement. The Aquila's hyper-spectral imaging system would seem to offer a cheaper alternative to the single R-95 aircraft fitted with a hyper-spectral scanner, which has proven to be somewhat unreliable. The configuration of the original airframe for the Air Force's hyper-spectral imager (Cessna C-98) ended up rendering the system useless because of the harmful impact of engine exhaust on the sensor. Breakdowns in the hardware and software were fixed by the vendor, but the vendor convinced the Air Force to retrofit a different airframe (the R-95) for the sensor. This process delayed initial operational capability until 2006, even though delivery of the system occurred in 2002, because a different set of crew members had to be trained to operate the sensor and only one plane was retrofitted to accept the hyper-spectral sensor on board. In this system's case operational inefficiencies have built a great deal of lag time between when a mission is requested and when the imagery data is actually processed.[315] The Aquila system, however, features a real-time data-link capability that the R-95 does not currently have.

The Air Force has already used Omnisys' services to upgrade its existing LP-23M radars, and it seems feasible that the service would acquire new radars from Omnisys if an operational need existed. The Air Force has already acquired a meteorological radar unit produced by the ATECH-Omnisys partnership for installation in São Luis, Maranhão.[316] This supply relationship will likely continue. Similarly, the Air Force is depending on Embraer's newly developed data-link expertise to serve as the basis for the service's tactical secure communications link for air-to-air and air-to-ground situations. This capability could eventually extend to the other services, but

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.ppt>, Accessed on 7 June 2007.

[315] Força Aérea Brasileira, *Utilização e Emprego do HSS*, Briefing Presented to the SIPAM 1st Meeting of Remote Sensing Activity, n.d., URL: <http://www.sipam.gov.br/intranet/paginasipam/portal/downloads/gav_planejamentoexecucaodmissao_ten_norman.pdf>, Accessed on 23 March 2007; SIPAM, *Nota Técnica No. 04/2006*; ARGON ST, "Press Releases: Sensytech, Inc. receives $2.5 Million contract for HyperSpectral Imaging System."

[316] Yuri Vasconcelos, "Weather Radar: São Paulo Company Develops and is Going to Manufacture Novel Meteorological Equipment in Brazil."

certainly will be a key feature in the Air Force's C³I capabilities for years to come. The extent to which Embraer has designs to commercialize this capability has not been revealed.

A final technology that could eventually fill military orders is the SABER M-60 radar system, being produced by OrbiSat. The Army developed the technology and essentially turned it over for production to a promising private sector partner (OrbiSat) which knew radar systems. Given the system's reported capabilities, including the ability to network with the Army's tactical communications system and interface with different arms systems, this radar system may have export potential. The key for this possibility will likely be Army testing and proving activities for the SABER M-60 once initial 5 production prototypes are complete.

Summary of Findings

Chapter 7 sought to answer two key questions presented in Chapter 1. The first question asked how defense industry influences the defense policy process and key policy actors in Brazil. The second question was concerned with what national and international resources are available to Brazil's defense industry to develop military technology.

This chapter found that the defense industry influences the defense policy process and its key decision makers through recurrent interaction with them in a variety of forums and through several defense sector lobbying organizations. Regular interaction with the government's decision makers affords industry the ability to participate in shaping defense policy and address some of its specific concerns by shaping policy documents that guide the defense sector in procurement practices and S&T development. This dynamic was clearest with the 2005 PNID.

Another finding is that the SIVAM and AL-X cases showed that once the government has contracted Brazilian firms for specific projects, the leverage of these firms can increase as the government becomes more dependent on them for a project's success. The dynamic was evident in negotiations with Embraer, ATECH, and Schahin, all of which were able to improve contracts beyond their original conditions, get contracts extended, or land contracts that cost more than the

government originally envisioned. Embraer's influence during the earliest days of the AL-X definition process managed to convince the highest level of the Aeronautics Ministry to assist the firm by devising an operational requirement to support prototype development of Embraer's light attack aircraft. Domestic industry actors also learned, however, there are distinct limits to their influence, as the removal of ESCA and Tectelcom from SIVAM demonstrated.

Industrial actors play a role in innovation, but they rarely have led the way due to their inability to invest significant venture capital in projects. The government usually plays the key role in financing innovation, and in many cases the services research centers turn over projects they developed independently or in conjunction with industrial actors to the private sector to develop. This chapter showed this phenomena occurring with the SABER M-60 radar system. The meteorological radars produced first by Tectelcom, and now by ATMOS and Omnisys were also developed first by CTA in the 1970s and 1980s, as mentioned in Chapter 5.

With regards to the national and international resources available to defense industry to develop military technology, this chapter found that during the period that the SIVAM project and the AL-X program were contracted, the military could not rely on the national budget for paying the cost of these programs. Consequently the military had to secure foreign financing to initiate these projects. With respect to the SIVAM case, a key result of this financial weakness was the need to import the vast bulk of the hardware and contract a number of services from foreign suppliers, thus diminishing the level of national input to the system. The one noteworthy exception was Embraer's ability to secure money from BNDES to help finance the development of the EMB-145 regional jet, which served as the platform for the R-99A and R-99B aircraft.

The AL-X project demonstrates that defense industry fared somewhat better because financing for prototype development was available from FINEP, and Embraer was is a position to absorb the rest of the development costs. When the time came to produce the aircraft, however, securing sufficient financing took nearly two years and the majority of it had to come from external sources.

This chapter also found that defense firms in Brazil have suffered from an inability to secure domestic financing for research and development. Their lobbying efforts to convince the government to provide additional resources may have worked in establishing additional resources from BNDES and FINEP. This is suggested by the number of new spin-off projects featuring ISR technologies and improved support for export promotion and the upward trajectory of FINEP funding. The perception among defense industry actors, however, is that the state is still not doing all that it could to help and the government's inability to provide the military with a dedicated investment budget over a sustained period has seriously weakened industry.

In terms of answering the second hypothesis and the associated key questions, this Chapter has found that industry and its lobby clearly can influence defense policy and the defense leaders who define policy, but the extent of that influence is limited and episodic.

CHAPTER 8

CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Initial Research Question

The study began with a question: What relationship exists between Brazil's defense policy and its defense industry's activities? The study progressed by examining past approaches to studying defense policy and defense industrialization in Brazil and mining this research for relevant past observations, analytic approaches, and conceptual tools to help answer the research question. A methodology was presented which featured examining the specific content of a group of key Brazilian defense policy documents that were in effect during a 12 year time frame, as well as two cases of major Brazilian military technological procurement activity that were executed during the same time frame. Four empirical chapters examined the specifics of: 1) Brazilian defense policy, military planning practices, and the guidance used for military procurement and interaction with the defense industrial sector; 2) national technology procurement and development activity during implementation of the SIVAM project; 3) Air Force technology and procurement activity during the AL-X program; and 4) the defense industry's lobbying activities, state assistance it receives, and how industry wields influence with the defense leadership in Brazil.

This study put forth two hypotheses. The first argued that Brazil's defense policy compels the Armed Forces to seek war materiel solutions from national industry in order to stimulate autonomous development of military technology, before the military services can turn to external sources. A second hypothesis contended that Brazil's defense industrial sector

influences the shape and content of the nation's defense policy through its interaction with the defense and political leadership.

Five key questions were put forward to break up the hypotheses into more manageable units for examination. The first three key questions were linked to the first hypothesis. The last two key questions were linked more to the second hypothesis. While not mutually exclusive, Chapters 4-6 were designed more towards examining the claim of the first hypothesis. Chapter 7 was directed more towards the second hypothesis.

Evaluation of Hypotheses in Light of Findings

At the end of Chapters 4-7 this study presented a summary of findings for each chapter. Table 8-1 summarizes the collective findings and matches them up against the two hypotheses introduced in Chapter 1. The table shows whether the finding supports or refutes the hypothesis, is inconclusive, or does not apply.

FINDINGS (Chapter 4, Chapter 5, Chapter 6, Chapter 7)	**Hypothesis 1:** Brazil's defense policy compels the Armed Forces to seek war materiel solutions from national industry in order to stimulate autonomous development of military technology, before the military services can turn to external sources.	**Hypothesis 2:** Brazil's defense industrial sector influences the shape and content of the nation's defense policy through its interaction with the defense and political leadership
"Paucity of defense policy guidance" critiques are outdated and Brazil's development of a defense ministry has helped address a number of concerns.	Supports	N/A
Technological cases, while having origins preceding the PDNs, are consistent with overarching defense policy and strategy and are not as parochial as other analysts might argue.	N/A	N/A
Tools from Ch. 2 can be applied to examining Brazil's defense policies and identifying mechanisms used by the state to lessen its dependence, but analyzing the technological cases with the provisions and mechanisms defined in the government's own policies may be a better approach.	N/A	N/A
Selected defense policies and norms used by the military as guidance for procurement and R&D activities reveal a clear concern with avoiding dependence through the application of strategies to increase self-sufficiency and increase national control over spare parts and technical support activity.	Supports	N/A

Selected defense policies and norms used by the military in their procurement and R&D activities show a preference for seeking technology transfer through technical assistance, local component manufacture, and agreements to install new productive capacities in the country.	Supports	N/A
The military's preferred strategies to reduce dependence and to assure technology transfer are clearly defined in the Brazilian Air Force's offsets policy and directive.	Supports	N/A
Military decision makers involved in the SIVAM project's execution were sensitive to the national policies, directives, and guidance that governed the era during which the project was implemented.	Supports	N/A
Managers of the SIVAM project made adjustments, to the extent possible, to guarantee as much technology transfer as possible to the defense industrial base.	Supports	N/A
1993 evaluation and decision by the CDN to go with a foreign supplier to provide SIVAM's hardware limited the extent to which national industry could play a part in the project and contribute to increasing Brazil's technological autonomy.	Refutes	Inconclusive
Not being able to depend on the national treasury to fund long-term, complex projects of this nature is a severe constraint to establishing true autonomy.	Refutes	N/A
One could view the Air Force's offset procedures as an effective means of securing technology transfer, but one that does so at the cost of having to import foreign technology.	Inconclusive	Inconclusive
Government decision makers evaluated national industry's capabilities to produce SIVAM, as well as their own ability to fund its construction over the long-term, and found industry's capabilities and the government's own capacity severely wanting in both circumstances.	Refutes	Refutes
A clear correlation can be drawn between what the Air Force hoped to achieve with the AL-X program and what defense policy directives from the 1996 PDN specify.	Supports	N/A
Air Force's AL-X program achieved service's aims of developing an aircraft with a high level of technological content, that met the operational criteria related to mission needs, and which featured a central role for domestic defense industry.	Supports	Supports
AL-X program did show itself to be dependent on some external technology, although the Air Force took aggressive measures to mitigate that dependence through offset mechanisms.	Supports	Inconclusive
Supply options that Air Force decision makers and the defense leadership considered were superficial, because the circumstances seem to have been fixed to favor Embraer and a national solution all along.	Supports	Supports
The rules and mechanisms derived from the defense policy that helped national defense industry's ability to secure military orders and pursue R&D opportunities for AL-X project are evident in the heavy application of offset mechanisms for the portions of the aircraft that Embraer could not deliver on.	Supports	Supports
The foreign components in the AL-X and its other aircraft allow Embraer to share risk with foreign partners, but because some of the technology is subject to end-use restrictions, other nations may be able to control the company's commercial pursuits when they deem it in their interest.	Inconclusive	N/A

Defense industry influences the defense policy process and its key decision makers through recurrent interaction with them in a variety of forums and through several defense sector lobbying organizations.	Supports	Supports
Regular interaction with the government's decision makers affords industry the ability to participate in shaping defense policy and address some of its specific concerns by shaping policy documents that guide the defense sector in procurement practices and S&T development.	Supports	Supports
The SIVAM and AL-X cases showed that once the government has contracted Brazilian defense firms for specific projects, the leverage of these firms can increase as the government becomes more dependent on them for a project's success.	Supports	Supports
Domestic industry actors also learned, however, there are distinct limits to their influence, as the removal of ESCA and Tectelcom from SIVAM demonstrated.	N/A	Refutes
During the period that the SIVAM project and the AL-X program were contracted, the military could not rely on the national budget for paying the cost of these programs and consequently had to secure foreign financing to initiate these projects.	Refutes	Inconclusive
The result of this financial weakness was the need to import the vast bulk of the hardware and contract a number of services from foreign suppliers, thus diminishing the level of national input to the system.	Refutes	Refutes
Defense firms in Brazil have suffered from inability to secure domestic financing for research and development.	N/A	Refutes
A number of recent spin-off products from ISR technologies and successes in exporting shows lobbying efforts to convince the government to provide additional resources may have worked in establishing financing from BNDES and FINEP.	N/A	Supports
Totals:	Supports = 12 Refutes = 5 Inconclusive = 2 N/A = 5	Supports = 7 Refutes = 4 Inconclusive = 4 N/A = 11

Table 8-1: Summary of Findings about Hypotheses.

Source: Author's Analysis.

From the Table 8-1 above, it appears that the findings are more supportive of the first hypothesis than the second one. Many of the findings, while relevant for other issues raised in this study like themes in the literature review, are not directly relevant to supporting or refuting the hypotheses. Some of the findings above also did not allow for a conclusion to be reached with respect to the hypotheses. Hypothesis two suffered more from this issue. An explanation for non-applicable information is tied to the key questions addressed in the chapters. Chapters 4-

6 were designed mainly to address key questions 1-3 from Chapter 1, which were tied to the first hypothesis. Chapter 7 was designed mainly to answer key questions 4 and 5 from Chapter 1, which were tied to the second hypothesis. While there was some overlap in content, the high number of "non-applicable" findings for hypothesis two in Chapters 4-6 is attributable to the key questions these chapters were aimed at addressing.

In order to evaluate whether the totals above for each hypothesis are accurate indicators of the hypotheses' accuracy, closely examining findings that refute the hypotheses is important. In light of the findings above, the basis for refutation of the first hypothesis would be tied to the following factors:

- In the SIVAM case domestic industry's weaknesses, in terms of adequate technological capabilities, prompt execution, and capital shortcomings, convinced the government to seek a predominantly foreign technological solution to address a threat.
- In both the SIVAM and AL-X cases the military's inability to spend national budget resources for R&D and production of specific systems compelled the Air Force to spend money borrowed from external sources tied to purchasing foreign technological systems.
- Embraer's strategy as a private company using global supply chains and partnership for building its military systems (AL-X and EMB-145SA/RS aircraft) helps avoid elevated risk but undermines truly national solutions.
- Inability to spend the nation's own money was a severe limiting factor for national autonomy and independence of action in developing military technology.

The basis for refutation of the second hypothesis when considering these findings would be tied to the following factors:

- Private defense industry in Brazil is categorically weak, and only Embraer has significant individual political clout among the industry's private sector firms.

- Inability to independently fund R&D and production of military technology, and the government's tepid willingness to help, perpetuates defense firm inability to convince the military and key decision makers of their ability to deliver orders.
- The military's and government's decision makers are willing to let capable national firms fail if they break rules or if they are incapable of filling an order independently.

With these bases for questioning the strength of the two hypotheses, is this a strong enough justification to discard them wholeheartedly? The number of supporting findings for both hypotheses, but particularly the first hypothesis, is compelling enough to look at what elements can be salvaged. Hypothesis one's key weakness seems to hinge on two issues. The first is how defense policy can mandate any level of national technological content for military procurement when the services cannot spend national resources for their procurement needs. The second is that when both the military and the nation's most successful private defense firms look externally for technology to efficiently fill equipment orders, there is a problem with the model – it is too permissive.

The strong points of the first hypothesis are that defense policies and norms exist in Brazil, and they do guide military action and practices there. In both cases the military did evaluate local industry's capabilities to satisfy their needs. In the SIVAM case, the military and government went with a partial solution that featured predominantly foreign technology, but left space for national industry to supply the needs they deemed most critical, such as software, systems integration, and data-link technology. Air Force offset practices at that time were applied to extract concessions from the principal foreign suppliers to benefit the national defense industry's development, most notably with Embraer and ATECH Foundation. This was consistent with the 1996 PDN's directive to seek research, technological development, and production capacity to minimize the country's dependence on foreign sources; it just did not do so immediately, because there was an apprenticeship of sorts involved.

In the AL-X case, the Air Force essentially designed a program that was a vehicle for Embraer to become proficient in modern military avionics integration, and the service applied offset mechanisms to guarantee that the foreign companies involved would invest in Brazilian industrial capabilities, as both Elbit and Rohde & Schwarz did. Like the SIVAM case, the military's actions in the AL-X case were consistent with existing defense policy, and featured an apprentice role for defense firms, but in this case the technology and control of the project's development was more firmly in Brazilian industry's grasp than in the SIVAM project's case.

The second hypothesis's key weakness centered on national industry's inability to sway policy makers through lobbying efforts to recognize their value, to craft policy that served their needs, and deliver resources. The weakness in the hypothesis is more episodic than fundamental. Clear instances where the defense industrial sector influenced and shaped policy through its interaction with the defense and political leadership in Brazil exist. The 2005 National Policy for Defense Industry is a compelling case in how the defense industrial lobby can wield its weight and shape a document that regulates military interaction with the sector. So modification of this hypothesis to make it less categorical, would likely improve its validity.

Conclusions about Research Question

So what is the relationship between Brazil's defense policy and its defense industry's activities? A simple answer is that the former tries to help the latter when time and money are not an issue in military procurement needs. When immediate technological solutions are necessary, however, regardless of industry pressure on the government, the military's need to acquire equipment rapidly to address a perceived threat will trump defense policy's stated goal to develop technology with increasing autonomy. This was clearly demonstrated in the SIVAM case where an external solution was favored, although defense policies in place worked to mitigate complete dependence. Where needs are not so immediate, as in the case of the AL-X, defense policy worked to benefit national industry more fully, clearly favoring Embraer from project conception

through the development stage and into production. The one weak spot came down to national spending power, which was remedied with foreign loans, and which is a separate area of policy not under the control of defense decision makers.

Implications for Theory

In Chapter 2 this study reviewed a number of arguments made by a selection of authors on Brazil's defense policy, its defense industry, and technological autonomy. As a manner of closing the loop about what this thesis offered in light of previous arguments, Table 8-2 provides a summary of insights gleaned from this study in response to others' arguments.

Author	Argument (s)	Thesis Insight
Antônio Carlos Pereira	- Political class and broader society is not interested in defense issues, so defense industry has no place.	- Political class is participating in debate, society has been included in the process, and industry is beginning to get a voice.
Thomaz Guedes da Costa	- Brazil lacks a codified joint military doctrine. - Availability of budget resources rather than war planning determines pace of large technology projects. - Brazilian political culture does not embrace the concept of defense policy. - Society needs to resolve how much of a national defense industry it wants and how much it is willing to spend to sustain it.	- Brazil has had a Doctrine of Military Defense since 2001. - Budget resources are still a constraint but war plans and their ties to technological projects and capabilities have advanced. - Brazilian political culture is getting used to having a defense policy after 11 years of having one. - Societal debate about how much to support a national defense industry is ongoing.
Clóvis Brigagão and Domício Proença Jr.	- Service autonomy still determines their defense activities, rather than the 1996 PDN and new defense ministry. - No integrated perspective for defense management exists and services' planning hypotheses are still separate.	- The services are still somewhat independent, but they now exercise together frequently and the use the PDN as a regular part of their planning cycle. - Building a joint perspective is an ongoing task, and the increasing publication of joint doctrine in a number of areas is evidence of this.
Mário César Flores	- Lack of clearly defined threat hypotheses obligates services to fulfill state directed tasks, even if scarce funding lowers military readiness. - Brazil needs to consider following concepts for warfare: precision weapons; use of intelligence from sensor-based systems; high R&D	- State directed tasks are unavoidable, but definition of "threat hypotheses" has become clearer with a systematized military planning cycle. - The SIVAM project addressed the development and conceptual employment of intelligence from active and passive sensors. - The AL-X features precision weapons

	expenditures and rapid weapon system obsolescence; compressed and blurred joint battle space.	capability in its weapons system. - Brazil's defense firms perceive high R&D costs and seek financing allies.
Clóvis Brigagão, Raul de Gouvea Neto, and Peter Lock	- Alliance between state, private, and multinational capital is the basis for Brazil's arms industry.	- This alliance is still prevalent, but not to the extent previous noted; Embraer is a good example.
Alexandre Barros, Clóvis Brigagão, and Ethan Kapstein	- Export of arms to other nations is an important part of Brazilian foreign policy and independent status in global affairs.	- This is still true and the defense ministry is a key actor in making arms exports happen, especially with neighboring countries.
Clóvis Brigagão, Raul de Gouvea Neto, Peter Lock, and Ethan Kapstein	- Need for more sophisticated weapons systems technology is a key obstacle for export-oriented Brazilian defense firms.	- This is still true as the government's turning to foreign suppliers in the SIVAM project showed, but Embraer has adapted.
Amit Gupta	- Three sets of actors (political, military, and industrial) have differing motives and unequal bargaining capabilities which are shaped by supply and demand factors.	- This study supports this view and demonstrated as much in Chapter 7.
Ken Conca	- Domestic structures define who controls defense industrial policy and international structures govern industry access to technology, capital, and markets.	- This study agrees with this characterization and used elements of this framework in Chapter 7.
Rexford Hudson	- Aircraft industry's incremental path towards increasing independence was pursued through joint ventures, licensing agreements, import substitution, foreign investment in Brazil's capabilities, with obligatory technology transfer required in these mechanisms. - Regardless of improved percentage of national content in products, dependence on multinational technology persisted.	- Leading aeronautics firm Embraer still depends on foreign capital in its products but has assumed the highest "value added" portion of the process in a "globalized" economy. - Gaining technology transfer through offsets accords is still prevalent, although joint ventures and licensing agreements are not as common as they once were. - Firms are still dependent on foreign capital.
Renato Dagnino	- Military maintained a robust R&D effort for weapons technology in order to bolster autonomy. - Key achievement of military approach was an innovation policy concerned with developing human resources that can integrate components and systems in new ways. - Military R&D rarely benefited the civilian sector and sucked up all of the R&D funding available.	- Military R&D is not as robust as in the past, and this has harmed technological autonomy. - Emphasis on dual-use technologies, particularly in the SIVAM project has generated some spin-off products designed for civilian market. - The innovation policy has been incorporated into the practices of many firms, with ATECH and Embraer as key examples.
Gamaliel Perucci	- Military R&D had little benefit for the civilian sector and few technology spin-offs resulted from follow-on military production efforts. - As state-funded capital dried up for defense firms, foreign capital was the	- Military R&D is not as strong as in the past, but emphasis on dual-use technology has allowed spin-offs to be produced by ATECH, as indicated in Chapter 7.

	only option available to keep producing, and dependence increased.	
Emanuel Adler	- Seven modes of technology transfer are useful for examining how Brazilian firms gain access to technology and capital investments.	- As indicated in the findings for Chapter 4, while these modes of technology transfer can be helpful, the Air Force's offsets policy was a more useful tool.
Christian Catrina	- Recipient dependence is based on threat perception, self-sufficiency, ability to start or expand production, diversification, availability of alternative suppliers, domestic availability of spare parts, and self-sufficiency in maintenance and training.	- The concept of recipient dependence was useful for examining the Brazilian government's defense policy documents, and several of the strategies to combat recipient dependence were mention in these documents' content.

Table 8-2: Relevance of Thesis Data to Theoretical Arguments.

Sources: Chapter 2 and Author's Analysis.

Implications for Policy

Chapter 1 introduced some of the underlying factors that shape Brazilian perceptions and interaction with developed nations, particularly as they pertain to access to advanced technology and developed world interest in the Amazon basin. Amazon basin threat perceptions were examined a bit closer in Chapter 7 in the discussion of varying views held by political leaders, military personnel, and industry. Chapter 4 built on the sketches of Brazilian threat perception by introducing how policy has evolved to meet the twin concerns of protecting the Amazon region from external and transnational threats and establishing a means to secure technology from the developed world for defense purposes. Chapters 5 and 6 addressed the links between the two technological programs – designed with Brazil's Amazon region sovereignty in the in mind – and Brazil's regional foreign policy goals, highlighting how Brazilian export and integration activities can increase military interoperability with neighbors and exercise influence.

Brazilian activities to nudge its neighbors towards contributing to Brazilian policy goals and associated solutions to problems that plague the members of the Amazon Cooperation Treaty (TCA) are clearly tied to state marketing efforts of Brazilian technology produced by Embraer

and ATECH Foundation, among others. In order to offer something practical to policy makers, certain rough scenarios can be drawn from the data presented in this study looking forward in the near-mid term, assuming that Brazilian current day technological prowess advances and export goals remain the same.

Figure 8-1 paints these rough scenarios based on current Brazilian technological interests and pursuits as presented in Chapters 1, 5, 6, and 7. Events mentioned in the scenarios tied to each country in Figure 8-1 are a starting point, with a basis in actual fact. The technologies on the Higher-Lower axis become increasingly sophisticated in their application for intelligence activity at the high end, and could significantly improve a nation's intelligence capabilities if successfully applied. Brazil has demonstrated some level of competency in either research or development of these technologies, they are on the Defense Ministry's list of critical technologies, and Brazil has demonstrated an interest in exporting them. The Hostile-Friendly axis is based on the contemporary behavior of selected South American nations that belong to the TCA and who have been courted by Brazil for export of SIVAM and AL-X related technologies. The hostile side of the axis features nations with whom the U.S. government has suffered increasingly strained relations, inconsistent cooperation, and bouts of severe distrust. The friendly side of the axis features nations with whom the U.S. government currently exercises strong relations, with deep cooperation, and few concerns.

Brazil's foreign policy mechanisms in these scenarios are execution technical assistance, training, and product export activities built around what the SIVAM and AL-X technologies have to offer neighboring TCA member nations. The foreign policy objective is to exercise influence in an unimpeded manner. In some instances, Brazilian goals may support or contradict U.S. interests with regard to each of these nations.

Export of Mini-SIVAM to Peru. Brazil maintains a bilateral accord with the Peruvian government to provide technical assistance to Peru and help the nation establish a center in Pucallpa for the exchange of real-time radar data for airspace control cooperation. Peru aspires to

gain progressive logistical and technological means to conduct territorial and electromagnetic spectrum surveillance, topographical surveys, and environmental and meteorological surveillance. To this end Brazil would assist Peru through training of personnel, software development, joint studies, and other mechanisms to eventually establish an Amazon surveillance center in Peruvian territory.[317] Export of EMB-145SA or EMB-145RS aircraft is a possibility.

Export of Intelligence Tools to Venezuela. Brazil is helping Venezuela develop a system that has capabilities similar to SIVAM, called SIPORAV.[318] ATECH Foundation is a key firm involved in this activity, has systems integration expertise, and ATECH's president claims that the technologies that provide the same capabilities that SIVAM provides to Brazil are readily available on the international market.[319] As mentioned in Chapter 7, ATECH has demonstrated its ability to develop a low cost hyper-spectral imaging system. Brazilian firm OrbiSat has an airborne InSAR sensor for sale and has already assisted Venezuela in cartographic activities, terrain mapping, and digital elevation modeling of Venezuelan territory with this sensor, as indicated in Chapter 7. With sensors supplied by ATECH and OrbiSat, and the imagery and MASINT processing techniques developed from research that ATECH has funded at the CTA, Venezuela could conceivably improve its technical intelligence collection and data fusion capabilities at a reasonable cost if Brazil decided to assist with these capbilities.

Export of Super Tucano Aircraft to Bolivia. As indicated in Chapter 6, Brazil has an active interest in selling Super Tucano aircraft to Bolivia. Bolivia is reportedly interested in

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[317] Presidência da República, *Decreto Nº 5.752, de 12 de Abril de 2006 - Promulga o Memorando de Entendimento entre os Governos da República Federativa do Brasil e da República do Peru sobre Cooperação em Matéria de Proteção e Vigilância da Amazônia, celebrado em Lima, em 25 de agosto de 2003*.

[318] Julio Ottoboni, "SIPAM sera modelo para integração," *Gazeta Mercantil*, 5 June 2006, A4.

[319] Julio Ottoboni, "Atech pode reproduzir tecnologia na região," *Gazeta Mercantil*, 5 June 2006, A4.

acquiring 12-20 units for a price ranging between US$ 60-100 million.[320] While it is unclear how a Bolivian variant of the Super Tucano would be equipped, it could conceivably include armor shielding developed by the CTA for the aircraft, a data-link capability that Embraer has seemingly mastered, electronic avionics supplied by Aeroeletrônica, and a weapons system including air-to-air heat seeking missiles and software developed by Embraer.

Export of AL-X Variant to Colombia. Brazil's Embraer is well under way in building and delivering 25 Super Tucano aircraft and associated simulators to the Colombian Air Force for US$ 235 million, stemming from a December 2005 contract, as mentioned in Chapter 6. The Brazilian and Colombian governments also maintain a bilateral agreement between their respective defense ministries that serves as the basis for sharing of operational and intelligence information between their militaries. The agreement also specifies scientific and technological R&D for defense industries, training and preparation of human resources, and logistic support.[321] Brazil could certainly export many of the sensor-based technologies already referred to above, but assuming a greater bilateral cooperation on the counter-drug front, provision of a data-link for the Super Tucanos being delivered that is interoperable with Brazilian R-99A aircraft could allow for a more effective bilateral effort in air interdiction.

[320] "Indústria Aeronáutica: Bolívia estuda compra de lote de Super-Tucano," *Vale Paraibano*, 9 May 2007, NOTIMP No. 129, URL: <http://www.fab.mil.br>, Accessed on 9 May 2007.

[321] Ministério de Relações Exteriors, *Memorando de Entendimento entre o Ministério da Defesa aa República Federativa do Brasil e o Ministério da Defesa da República da Colômbia Sobre Cooperação em Relação a Matérias de Defesa*, 20 June 2003, URL: <http://www2.mre.gov.br/dai/b_colo_95_5103 .htm>, Accesed on 21 April 2007.

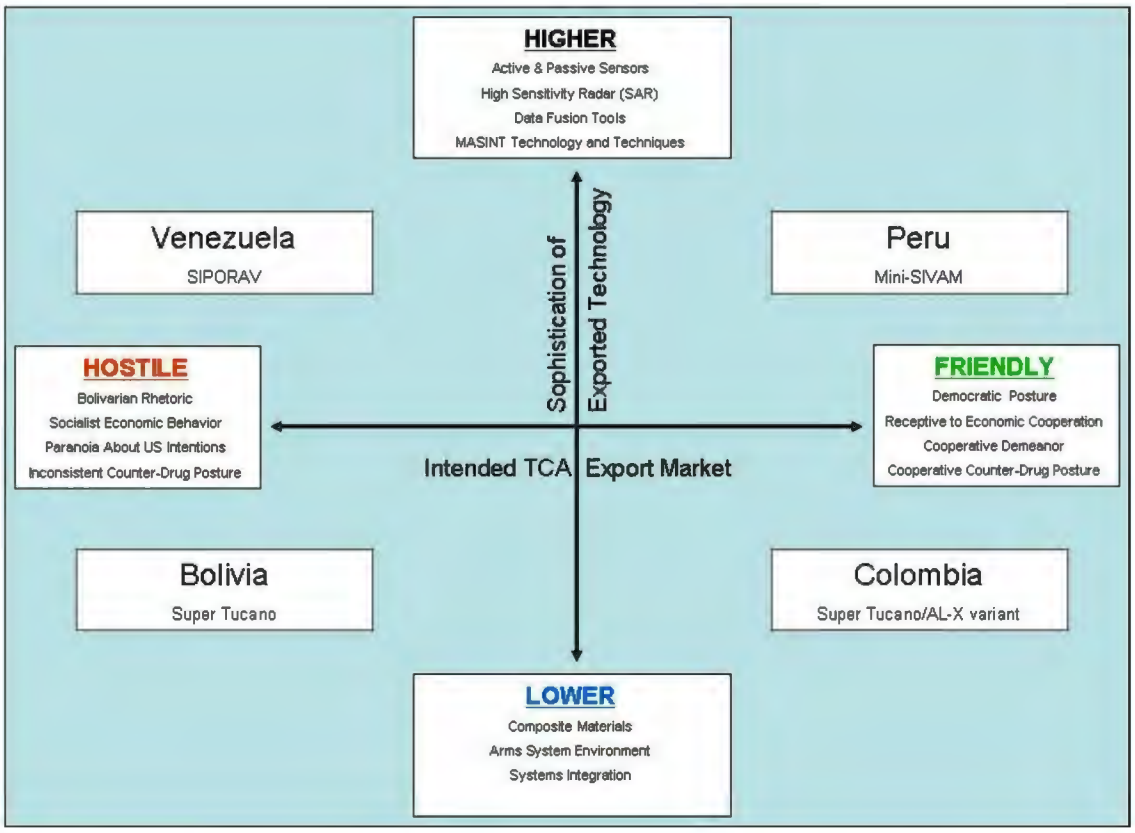

Figure 8-1: Potential Scenarios for Brazil Export of SIVAM and AL-X Technologies

Source: Author's Analysis

In all of these scenarios, Brazilian leaders would work towards Brazilian goals, whether motivated by a security objective, such as counter-drug cooperation, or a more economic objective, such as establishing a market for Brazilian goods and follow-on logistic support activities. In both of these objectives, the goal is regional participation in something defined by Brazilian decision makers or industry – whether it is different levels of integration with SIPAM, tackling the counter-drug mission using Brazilian tools and information, or outfitting regional militaries and police forces with intelligence and military systems designed in Brazil.

As South America's "key state," Brazil wants to define its role in global and regional politics. Defense industrial development and sales of defense materiel to regional countries are two manners of becoming more influential. Brazilian interests to serve as a supplier to countries

it views as natural markets – such as Peru, Colombia, Venezuela, and Bolivia – is a natural and logical extension of a strategy that Brazilian statesmen have been planning for years. To date, this strategy has not included reckless actions, although some ambitions have apparently run afoul of U.S. interests. Discussing the right balance with Brazil is an area where U.S. policy could work to ensure that Brazil, as the continent's "key state," technology developer, and primary weapons exporter does not embrace past practices from the 1980s, when little discrimination existed for prospective weapons systems clients.

Recommendations for Future Research

One of the temptations about studying the impact of defense policy on technological development, technology transfer, defense industrial production, and government weapons systems procurement efforts is that there are many cases to draw from in a country of Brazil's size. During the course of the study, this author realized that there were many individual cases of technological development in Brazil that could be examined, but not with sufficient depth to include in a master's thesis with the design adopted here. Since the author's intent was to show the relationship between Brazilian defense policy and defense industrialization, an in-depth and comprehensive examination of the technologies involved was not attempted.

A few technological cases stand out which future MSSI candidates might consider studying because of their importance in providing Brazil a military advantage over other regional forces, because of the sensitive technologies involved, or for the independence of action they could afford the Brazilian military. This author was tempted to examine some of these cases, but realized that none of the development efforts were far enough along yet to assemble a case study from open sources.

A first area of technology is military communications systems in Brazil. This would include not only the Military Communications System by Satellite (SISCOMIS), but also Brazil's aspirations to build a Brazilian Geostationary Satellite (SGB) for secure military communications

and air traffic control navigation. While SISCOMIS has existed for years, the government's planning since the Ministry of Defense was created has given a new impulse to regain state control over vital military communications channels from satellites that were privatized during the 1990s and are now leased by the government. Examination of the seriousness with which Brazil involves its engineers and technicians in communications satellite construction would provide insight to whether Brazil merely wants to own its communications channels or to also dominate the communication satellite building process.

A second area that could orient a future study would be the Brazilian Navy's on going effort to master all phases of technology necessary to build a nuclear submarine. This author originally compiled sources to present Brazil's nuclear propulsion and submarine construction activities as a third technological case in this study, but for several reasons discarded the case at an advanced stage of manuscript preparation. While the nuclear submarine program has languished for years, President Lula's 11 June 2007 announcement of the programs importance may indicate a renewed willingness to move the program forward with additional resources. The Navy's 2006 announcement to build more submarines of German IKL-214 design could be examined in conjunction with Brazil's long-held goal to build its own national submarine.

A final area worthy of study is Brazil's efforts to modernize and acquire advanced fighter aircraft. The modernization of the A-1/AM-X/ and F-5BR aircraft with mid-life upgrades is still proceeding. Shortly after President Lula took office, he suspended a nearly completed selection process for Brazil's F-X program for a year. He allowed the competition to resume in 2004 only to cancel it in 2005. As part of a broader plan to reequip the military announced by the government during June 2007, the F-X project was re-launched with an emphasis on the purchase of the newest technology on the market, and a declared willingness to spend over US$ 1 billion for fighter aircraft. The F-X program, in particular, is important for infusion of new technology into Brazil's aerospace sector, and employment of the offset mechanisms identified in this study in an F-X transaction bears close scrutiny.

Another approach MSSI students might take is exploring Brazilian R&D efforts in several of the critical technologies referenced in Chapter 1 that this thesis did not discuss. During the course of researching the cases in this study, this author identified a number of Brazilian efforts in S&T undertakings that demonstrate a firm grasp of the technologies concentrated on but a still unclear view on how they would be applied to Brazil's defense sector and which firms could benefit from producing them for either civilian or military purposes. This is an area that could be explored further.

APPENDIX A: LIST OF ACRONYMS AND ABBREVIATIONS

ABIMDE	Brazilian Association of Defense Material Industries
AIAB	Brazilian Association of Aerospace Industries
AL-X	Air Force Light Attack Aircraft Program
AM-X	Air Force Tactical Fighter Aircraft Program
ASMACS	Air Space Management and Control System
ATAERO	Additional Airport Tariff
ATECH	Fundação Aplicações de Tecnologias Críticas
BBC	British Broadcasting Corporation
BID	Defense Industrial Base
BNDES	National Bank for Economic and Social Development
C2	Command and Control
C^2	Command and Control
C^3I	Command, Control, Communications, Computers and Intelligence
C^4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CABW	Brazilian Air Commission in Washington
CBERS	China-Brazil Earth Resources Satellite
CCG	General Coordination Center
CCIP	Continuously Computed Impact Point
CCRP	Continuously Computed Release Point
CCSIVAM	Coordinating Committee for the Amazon Surveillance System
CDN	National Defense Council
CEBRI	Brazilian Center of Foreign Relations
CENSIPAM	Management and Operations Center of the Amazon Protection System
CIA	Central Intelligence Agency
CIGE	Army Integrated Electronic Warfare Center
CINDACTA	Integrated Center for Air Defense and Air Traffic Control
CISCEA	Commission for the Implantation of the Brazilian Airspace Control System
CNI	National Confederation of Industry
COMDEFESA	Committee for the Productive Chain of Defense Industry
COMFIREM	Commission for Oversight and Receipt of Materiel and Services
COMINT	Communications Intelligence
CONOPS	Concept of Operations
COTER	Army Ground Operations Command
CPI	Commission of Parliamentary Inquiry
CTA	Aerospace Technological Center and General-Command of Aerospace Technology
CTO	Technical Operations Center
DACTA	Air Defense and Air Traffic Control
DEPED	Air Force Department of Research and Development
DIAP	Parliamentary Advisory Body of the Inter-Union Department
DLRS	Data-Link Remote Station
DMD	Doctrine of Military Defense
DoD	U.S. Department of Defense
EDC	Export Development Canada

ELINT	Electronic Intelligence
ELN	Colombian National Liberation Army
EMFA	Armed Forces General Staff
EMGEPRON	Management Company for Naval Projects
EMiD	Military Strategy of Defense
ERS	European Remote Sensing Satellite
ESCA	Engineering of Systems of Control and Automation
Eximbank	U.S. Export-Import Bank
FAPESP	São Paulo State Foundation for the Support of Research
FARC	Revolutionary Armed Forces of Colombia
FIESP	São Paulo State Federation of Industries
FINEP	Studies and Projects Financing Agency (Ministry of Science and Technology)
FLIR	Forward Looking Infrared
F-X	Air Force Advanced Fighter Aircraft Program
GOES	Geostationary Operational Environmental Satellites
GPS	Global Positioning System
HF	High Frequency
HOTAS	Hand on Throttle and Stick
HUD	Head Up Display
IAE	Institute of Aeronautics and Space
IFI	Institute for Industrial Promotion and Coordination
IMBEL	Brazilian War Materiel Industry
IMINT	Imagery intelligence
INFRAERO	Brazilian Airport Infrastructure Company
INPE	National Space Research Institute
INS	Inertial Navigation System
InSAR	Interferometric Synthetic Aperture Radar
ISR	Intelligence, Surveillance and Reconnaissance
ITA	Aeronautics Technological Institute
JPATS	Joint Primary Aircraft Training System
LAAD	Latin America Aerospace and Defense
LANDSAT	Land Remote Sensing Satellite
MANPADS	Man-Portable Surface-to-Air Defense Systems
MASINT	Measurement and Signatures Intelligence
MERCOSUR	Common Market of the South
MSSI	Master of Science in Strategic Intelligence
NGO	Non-Governmental Organization
NuCRIS	Regional Signals Intelligence Center Nucleus
NVG	Night Vision Goggles
PDN	National Defense Policy
PFCEAB	Program for the Strengthening of the Brazilian Airspace Control System
PMD	Military Policy of Defense
PNID	National Policy for Defense Industry
PROEX	Export Promotion Program
PUC	Pontifical Catholic University
R&D	Research and Development
RDSS	Radio Determination Satellite Service
S&T	Science and Technology
SAE	Secretariat for Strategic Affairs
SAR	Synthetic Aperture Radar

SBPC	Brazilian Society for Progress in Science
SC2FTer	Ground Forces Command and Control System
SCC	Coordination Sub-Center
SCO	Operations Sub-Center
SECOS	Secure Communications System
SEGE	Strategic Electronic Warfare System
SGB	Brazilian Geostationary Satellite
SIGINT	Signals Intelligence
SIMAGEx	Army Imagery System
SIMDE	Syndicate for Industries of Defense Materials
SIPAM	Amazon Protection System
SIPORAV	System for the Protection of the Orinoco and Venezuelan Amazon
SISCEAB	Brazilian Airspace Control System
SISCENDA	System for Communications and Data-Link
SISCOMIS	Military System for Communications by Satellite
SISTAC	Tactical Communications System
SISTED	Tactical Data-Link System
SIVAM	Amazon Surveillance System
SMC2	Military Command and Control System
SOUTHCOM	United States Southern Command
SPOT	Satellite for Earth Observation (Satellite Pour l'Observation de la Terre)
TAN	Air Navigation and Communications Assistance Tariff
TAT	Communications, Radio, and Visual Services Assistance Tariff for Public Airfields
TCA	Amazon Cooperation Treaty
TCU	National Accounting Tribunal
TDMA	Time Division Multiple Access
UHF	Ultra High Frequency
UN	United Nations
UNICAMP	São Paulo State University at Campinas
VHF	Very High Frequency

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