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## Brazil's Defense Industry: The Emerging Transformational Role of C5I in Defense Industry's Cluster Formation

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### Abstract

*The creation of defense industrial clusters dedicated to the promotion of regional development would appear to be a contradiction in terms. Defense industries need strong subsidies and state protection. The defense industry conceptual foundation's legacy exists primarily to promote standardized entrepreneur behavior. The ability to see beyond widely accepted defense industries business models and to think outside conventional limits is a trait that is not widely distributed.*

*This hallmark of "permanent" truth is changing in order to handle with innovation in architectures of security and defense decision systems that are a powerful, fast-moving, and complex combination of enhanced C5I system of capabilities. They extend far beyond formal military power: fast adaptable command structures, in-depth control potential, multidimensional intelligence gathering, and a multilayered communication network, powered by an expanded computing network of systems that are capable of amplifying cognition power in the presence of uncertainty.*

*This paper seeks to inspire a whole-of-security approach to fundamental changes in the nature of the scope of challenges to the defense industry cluster formation process. Centered on a database of industrial indigenous capacity of building functional arrays of C5I, the paper considers a range of actual force design alternatives available for Brazil, serving as a venue in which to test the possible developmental effects of policy.*

*Understanding market behavior, motivations of firms, and the role and perspective of policymakers will better enable Brazil to capitalize on its emergence as a regional leader. Not doing so may present significant and long term security issues and, thus, limit Brazil's ability to continue its advancement—political and economic.*

### MOVING FORWARD

Policies are forward thinking. They define outcomes and requirements that can only be ascertained in light of events that have yet to occur. Considerations in this paper permit specific certainties to the prospect that Brazilian Defense initiatives emerging from the National Defense Strategies are disaster-prone, unless a set of policies are implemented.

This paper seeks to inspire a whole-of-security approach to fundamental changes in the nature of the scope of challenges to Brazil's defense industry cluster formation process. Centered on a database

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of industrial indigenous capacity of building functional arrays of C5I, the paper considers a range of actual alternatives available for Brazil, serving as a venue in which to test the possible developmental effects of policy options. The case of Brazil shows that the transformation process is painful and prone to self-doubt.

This analysis explores the intersection of strategy and policy formulation to enable greater real-time interaction between entrepreneurial business and defense strategy to enhance deterrence and war fighting capability. As the emerging regional leading power, Brazil may lose the opportunity to capitalize on the demands for defense capabilities and may forfeit the chance to build sustainable, affordable, and peaceful solutions that are both potentially advantageous to national security and developmental needs if action to achieve proposed goals is not immediately made.

Devoid of the recommendations provided in this paper, Brazil will face inevitable collision of civil society interests, manifested in the industrial base, with military interests coalesced in the repotencialization of the Armed Forces. Paradoxically, without a regulatory executive agency, any compromise among these two actors will be detrimental for transparency and accountability, concurring with government inefficiency, strategic ineffectiveness and corruption.

The research for building the conceptual framework presented in this paper almost exclusively from empirical material in study of aerospace, military, and maritime complexes from the regions of Sao Jose dos Campos, Sao Paulo, and Rio de Janeiro. These regions are connected with reference to potential markets, labor resources, technology access and capital stock, raising no obstacles in the use of a common industrial complex approach.

Conclusions and policy recommendations are primarily oriented to support government policymakers in developing stable and sustained responses to government defense planning and industry strategic planning. Although developed specifically for Brazil's particularities, its concepts have the ambition of providing a general framework with worldwide application.

### ***Operational Definitions***

The relevant literature on Defense Industry and Regional Development offers a wide variety of definitions and methodological approaches for identifying Defense Industry Complex and Clusters.

The relevance of geographic proximity of industries is long supported by economic theory.<sup>2</sup> Weber's 1909 book titled *Theory of the Location of Industries* recognizes spatial location as key variable for economy of scale. Marshall (1890)<sup>3</sup> is cited regarding the correlation between proximity of economic agents and economic productivity. Izard and Willey (1956)<sup>4</sup> coined the expression *Industrial Complex*

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<sup>2</sup> Torre, A. On the role played by temporary geographical proximity in knowledge transmission. UK: Regional Studies, 2008, vol. 42, nr 6, pg:869-889, 2008.

<sup>3</sup> Marshall, A. Principles of Economics. London: Mcmillan, 1890.

<sup>4</sup> Izard W. and Wiley, J. Location and Space-Economy. New York: Technology Press of Massachusetts Institute of Technology, 1956.



based on the inter-industry linkages with geographic proximity. Henderson (1974)<sup>5</sup> also emphasizes the agglomerative effects of positive spillovers between firms in geographic proximity. Spatial economics provides the base for Michael Porter's prominent book "the Competitive Advantages of Nations" (1990), indisputably contributing to the avalanche of (re)definitions of industrial complex and clusters expanding his "Diamond of Advantages" framework for identifying national competitive advantages.

The difference between the interrelated concepts of *cluster* and *industrial complex* is interpreted in Czamansky and Ablas (1979:62) conceptualization: "... cluster is a subset of industries *connected by flows of goods and services stronger than those linking them to the other sectors of the national economy. The concept is thus devoid of any spatial connotation. A complex, on the other hand, has been defined as a group of industries connected by important flows of goods and services, and showing in addition a significant similarity in their locational pattern. Thus, complexes emphasize the spatial aspect of industrial concentration.*" However, vom Hofe and Chen (2006:19)<sup>6</sup> point out that "other scholars have applied cluster-based methods to recommend regional economic development strategies, analyzing industrial clusters as spatial phenomena rather than a sole operating economic grouping of industries."

The field of industrial complexes and clusters has come a long way since Izard conceptualized the industrial district. But the naming and classification of clusters and complex still remains, at least to some extent, without general consensus.

To formulate higher-level propositions on the basis of empirical observations, this paper aims to describe, evaluate (measure), and recommend policy alternatives by offering operational definitions for the terms *defense industrial base*, *defense industrial complex*, and *defense industrial clusters*: *Defense Industrial Base* refers to the national capacity of the industry sector to develop and sustain peace- and war-time defense needs. *Defense Industrial Complex* is reserved for the aggregation of interrelated groups (subsystems) of industrial capabilities within geographic boundaries. The defense complex is part of the Brazilian Defense Industrial Base. *Defense Industrial Cluster* is used to qualify groups of highly interrelated value chains within categories based on technology specificities. An example using these concepts would be the UAV (Unmanned Aerial Vehicles) cluster of Sao Jose dos Campos lodge inside the Defense Aerospace Complex of the Brazilian Industrial Base.

The defense industrial base, with its complex and clusters, is a national resource that makes up a significant portion of the overall deterrent and defense posture. Brazil cannot afford to ignore it or to allow it to deteriorate, nor should Brazil allow it to reemerge with dysfunctional structure, or inadequate correlation with national development. While this subject has undoubtedly been breached, it has mostly been in relation to isolated cases rather than a more widely-considered response to the general paradigmatic shift impulse from Brazil's rising power.

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<sup>5</sup> Henderson, J.V. The Sizes and Types of Cities. American Economic Review, 64, pg:640-56, 1974.

<sup>6</sup> Vom Hofe, R. and Chen, K. Whither or not Industrial Cluster: Conclusions or Confusions? The Industrial Geographer, Volume 4, issue 1, pg: 2-28, 2006.



## DEVELOPMENTAL SETTINGS: CHALLENGES OF THINKING BIG

The first decade of the 21st century demonstrated Brazil's visible and aggressive commitment to progress. This is demonstrated by improved government and economic performance. Brazil's economy is back on top after weathering the global slowdown.

Brazil's goals are sustained by the interdependency assumptions. Robert Art (2003:20)<sup>7</sup> explains this concept *“as the size and importance of the stake that a state has (or believe it has) in economic intercourse with other states – in trading with them and in seeing capital and technology flowing easily among them. The higher the perceived interdependence, the larger a state's presumed stake in the economic well-being of the countries with which it most interacts economically. At high levels of interdependency, all other things being equal, a state will want others to prosper because of the belief that this adds to its own prosperity.”*

According to *The Economist*, in 25 years, the BRIC countries will be even more important to the rest of the growing world. Between 2011 and 2014, Brazil plans to spend almost US\$ 530 billion on infrastructure. In addition, Brazil's oil company Petrobras, indicates investments of around US\$ 108 billion by 2014.<sup>8</sup>

With a GDP of US\$ 2,052 billion, and a large projected growth rate, trend foresight of Brazil's sustained development are based on five linked assumptions: (1) regional political stability and rates of market sharing; (2) global energy demands and Brazil's potential self-sufficiency; (3) fiscal responsibility and inflation target regime; (4) floating exchange rate and stability of protein production (food supply); and (5) critical infrastructure augmentation and sustainment of technology pattern replication.

These assumptions are driving the perception that, in order to meet current and future developmental challenges in the support of a 4.5 percent settled GDP growth and increasing international prominence, Brazil needs a Security and Defense Complex (SDC) that enables it to be tactically flexible, operationally resilient, strategically adaptive, and politically accountable.

Current operations of Brazil's SDC span a broad range of relatively independent government institutions, agencies, industries, research centers, universities, activities and commands. In order to meet and overcome the challenges of national development, the Government embarked on a path to modernize the SDC and to (re)design the force.

As a result, the Ministry of Defense developed a capacity building effort centered in five major programs: (1) area control and power projection (nuclear submarines and a new northern fleet with amphibious capability); (2) air defense and strategic mobility (fighters, missiles, helicopters, transporters and tankers); (3) borders control and geostrategic dominance (advanced light main battle tank, troop transport, unconventional tactical weaponry suite); (4) cybernetics (satellite, global

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<sup>7</sup> Art, Robert J. *A Grand Strategy for America*. Ithaca, US: Cornell University, 2003.

<sup>8</sup> Washington Post, April 18, 2011.



positioning system and Decision and Coordination System (C4I) for monitoring geostrategic regions, and (5) Base Realignment and human augmentation (incorporation of additional 150,000 peacetime billets in the next 10 years and brigade-level restructuring and reallocation).

The economic scale of these programs is attracting interest from foreign governments. Also, global defense contractors are rebuilding business strategies in response to Brazil's estimated total defense transformation expenditures of US\$ 193 billion in the next 25 years. Expal from Spain, for example, projects 20 percent of business revenues from Latin America after 2012. The return on equity and return on total capital for the defense industry is higher than the traditional industry levels.

Perhaps the most significant point about this trend is the fact that the foreign producers are producing the standard components for these defense systems in high volume and, therefore, at a low-cost. Brazil's National Security Strategy injected potential business for foreign countries without correlation to Brazil's defense industries current capacity. The bidders for these production programs are large foreign contractors who have limited research-and-development overhead and are therefore cheaper than Brazilian companies.

The recent Latin American Aerospace and Defense (LAAD) in Rio de Janeiro was a great success of public and number of participants to observe a fiasco in terms of technology & strategy alignment, future systems capabilities and national industry capacity to build defense capacity. The product offered to Brazil is often second class technology, in the threshold of obsolescence, wrapped in a fuzzy terminology of capacity-based planning. Brazil's defense policy makers, more specifically the military, are mesmerized by the possibility of acquiring new equipment, without a consistent force design effort, without a matured strategic concept, and without policy-strategy equilibrium.

Brazil's challenge is to overcome technology challenges, keeping the financial impacts of defense transformation below 6.0 percent of the national budget (currently at 4.4 percent), which is the estimated affordable defense budget cap for a 4.5 percent a year GDP expansion, both politically and economically. In addition to driving improved defense material and arms export, the Defense Transformation Strategy decomposes costs through: (a) extensive practice of offsets, (b) mandatory dual use (civil and military) of defense capacities to incorporate funding sources from other ministries, (c) access national funds for research and innovation through projects guided by technological spin out/in purposes, and (d) joint ventures and defense foreign direct investments.

Another challenge going forward is whether the surge of defense projects will cope with a defense human-centered/labor intensive structure that costs US\$ 11 Billion per year (53 percent of a defense budget of US\$ 20 billion - 2011) inefficiently operating and maintaining a large inventory system which is degrading and quickly becoming obsolete. Moreover, there are major problems reconciling the traditional culture of autonomy of the Armed Forces to overcome barriers and implementing transformative changes. While the Ministry of Defense holds a degree of influence over the planning process, much of the transformation initiatives occur at the Service level, demanding focused investments to achieve institutional maturity and the discipline to stick to the minimally sufficient solution. Without leadership at the highest level, Brazil's transformation effort will not be successful.



As Brazil's security behavior on the international scene is judged by the new National Strategy of Defense, proactive initiative in the national defense industry becomes vital to the establishment of an advanced, endogenous defense industrial base as part of the national critical infrastructure, based on national competence and on the absorption of sensitive technologies.

While advancing the goal of becoming a global player, Brazil's defense aims to engage in shaping the defense industrial base to the requirements from the National Strategy of Defense. Unfortunately, current Brazilian federal legislation, regulations, agencies, procedures, and practices fail to recognize sartorial differences and treat the defense industry and other industries in a uniform fashion.

Expanding democratic oversight and incumbent civilian control over defense also create conflict with existing military culture, processes, and thinking patterns and the difficult and complex incorporation of private enterprises in defense planning. A mutually-acceptable approach has to be measure against regional development, which is another intricate calculation that the military and civilian contractors are not prepared to make.

Confronting asymmetrical priorities without a coherent decision framework drives these collective actors into frustration. Bending rules and regulations for short-term gains undermines the general goal of developing a self-sustainable defense industrial base. The complexity of the challenges facing the defense industrial base increases when policymakers realize that this topic is not neutral, but rather immersed in the wicked domain of Brazil's civil-military relations. This condition increases Brasilia's reluctance in deciding whether the defense industrial base matters at all in its future.

The Ministry of Defense does not respond with enough vigor, strength, and efficacy to address these challenges. For example, the Ministry of Defense's website homepage presents a limited, incomplete, and to some extent meager definition of the defense industry. Furthermore, the Defense Industrial Policy Draft, circulated for critical analysis, is rather timid in scope with generic assertions of truisms and operational objectives that cannot provided a basis for criteria and decision-making regarding the purposes, roles and functions of the defense industrial base. Perhaps this is what can be done at this moment! However, unless policy makers fully understand the complexity, uniqueness and critical importance of the national defense industry in both the integrated strategic and economic perspective, as well as how its unique management requires cluster emergence, life-cycle management, and termination, Brazil will always be inferior to its full potential.

## **INSTEAD OF EVOLVE BY HAPPESTANCE, C5I PROVIDES THE FRAMEWORK FOR DESIGNING MILITARY POWER THROUGH POLICIES**

The regional and global security environment is growing more complex. Brazil faces the challenges of finding an operational solution for anticipated geostrategic threats and determining how forces should be designed to face new and more complicated issues that require the threat or use of force.

Current forces around the world are essentially designed for more conventional and well-defined problems and not for the roles that they are being forced to perform. As the projected tempo of future operations increases due to enhanced strategic mobility, high connectivity, and extreme targeting-



precision, the cross-cutting defense apparatus will enable centralized planning and decentralized execution between distant and loosely bound national industrial capabilities to support dynamically evolving types and categories of combat.

The defense realm has always been victim of a flurry of acronyms, often misused. This is particularly severe with the C2, C4I, and C4ISR concepts, merging technology with decision-making to sustain the commands ability to leverage the operational environment. These concepts have evolved during the last 70 years of practice, dating back to the Battle of Britain in 1940. The C2 (command and control) element is often used alone referring to a system supporting the general direction of operations.<sup>9</sup>

It is increasingly common to incorporate intelligence-gathering capacity into this system tooling a CIS – Command Information System (or also C2IS). The amplified scope of CIS responds to those critical decision steps of information sharing, sense making, and task alignment which increases the speed, accuracy and coordination of multiple and simultaneous tactical, operational and strategic combat decision-making cycles. NATO command structure uses CIS concept widely.

The difference between C2 and C3 is this communication component in the latter. It stresses the increasingly arduous task of disseminating intentions and desired results in an information saturated environment. C4I integrates this with computing capacity to collect, process, archive, and retrieve information under evolving war taxonomies for leveraging speeded planning with incomplete strings of knowledge.

Currently, the level of networks of command, control, communication and intelligence-gathering assets grew with information technology, carrying volumes of more data to feed analysis into the direction and orchestration of a given force structure, with added complexity derived from the proliferation of surveillance and reconnaissance robotic platforms (from unmanned vehicles to “smart” bombs able to dynamically change task packages).

The classical C4ISR acronym has undergone its own transformation into “C5I”, responding to the requirements of expanded boundaries of force design. This provides new pathways for integrating defense requirements with national production capacity to create options and opportunities, and then defining the necessary steps that will bring the effects into being according to policies that best meet security objectives.

C5I is not just the addition of another “C” to the classical C4I, but rather a full-fledge expression of actionable defense strategy delivering superior capacity to decision-makers.

Each C5I express a particular logic articulating system of defense (LAS) that guides the selection of strategic choices of states in response to security threats and its implicit assumptions about the fungibility of force structure with operational strategies into actionable capabilities. The C5I is the LAS translated into comprehensive technology requirements that transform capabilities into power. The concept plays a primary role to influence choices over technology patterns and select mechanisms

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<sup>9</sup> Jamenson, W. F. and Keggler, J. Commanding Information Superiority. Armada, Compendium C4ISR 2010.





through which new competencies can spread requirements throughout the defense system. Hence, it is vital in shaping the way military organizations behave. Moreover, it is fundamental to construct business concepts on development for the industry.

Industries do not easily understand the defense sectors abstract language of capabilities. They need it translated into industrial requirements and standards. The LAS provides a strategic sense to defense capabilities, while also reporting on the financial intensity and organizational capital required for translating technologies into those capabilities.

A case of requirements that redefine LAS is the development of the “Trace Italiene”, the squat and broad-angled bastion fortress in response to increasing cannon quality that gave attacking armies the ability to batter down the tall, thin walls of most fortresses in early modern Europe (Parker 1996, 9-11).<sup>10</sup>

### ***Force Design***

Force design is the unique methodology used to structure complex (wicked) problems, driving the definition of hardware (platforms), software (operational and tactical developments) and peopeware (organizational capital) associated with C4ISR and the financial resources required to produce the system of defense needs to comply security policy requirements.

The LAS emerges from Force Design. Its foundation is capability-based defense planning. Upon this foundation is a set of coherent concepts and a framework that makes them practical in both term and significance. The resulting analytical construct abstracts military capabilities into their component elements, explaining concepts and relationships.

These frameworks and conceptual systems integrate to form hierarchies that articulate processes that provide the means to develop and choose defense alternatives, even when limited information excludes the possibility of assessing all expected outcomes. Framework and conceptual systems' underlying assumption is that defense reform demands emerge as the differential between current defense capabilities and the fluctuating synthesis of defense planning in the light of perceived future conditions.

The final goal of designing the force is to accomplish a system of concept manifested within a framework that is an open-ended measurement tool capable of: (1) assessing the changing relationship between capabilities requirements and defense demands – properly addressing the challenge of defense planning in an era of uncertainty of threats and information technology; and (2) specifying capabilities to be added that might lead to different choices under three concurring perspectives - adaptation, modernization and transformation.

“Spending monies” does not provide defense or security, nor do budget cuts equate to inadequate defense and security. Monies spent for defense and security represent the embodiment and

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<sup>10</sup> Parker, Geoffrey. *The Military Revolution: Military innovation and the rise of the west 1500-1800*. New York: Cambridge University Press, 1996.



empowerment of choices. It is the choices themselves that determine a nation's level of defense and security, which stem from the collective will of the people within the borders of that country. These people have chosen a way of life and, by their voting patterns, give an imprint to their government.

Force Design reform results when sufficient domestic or external change gives cause for a nation's government leadership to revise its assessment. Force Design addresses these same issues of spending and saving. In its most simplistic form, it can take the form of a budget cut by a specified percentage. Alternatively, it can be left to the Armed Services, which too often spend as much time and energy assessing how the other branches are faring as they do buttressing their established positions. Even more, the modern economic and management thought and science can be applied to force design.

The ultimate function of the LAS as the result of force design is deliberating critical decisions that involve complex economic, technological, and capability requirement tradeoffs, cutting through the complexities of scheduling activities while avoiding the quagmire of detail, moving quickly in repositioning production resources either to orchestrate the acquisition or divestiture of function. Production resource allocation is just as important as human resources allocation, exercising interaction among defense industrial possibilities and operational functions. It consists of creating a pattern of decisions that affects the manufacturing of military assets and should be reflective of policy -- with careful attention to the potential interaction and driving forces within the national and international Defense industrial base. If properly allocated, production resources can play a unique role in defining, supporting, and enhancing the success of a defense project, operating in concert with all its functions.

When force design is absent, decisions are based on a set of foundations seen as axiomatic and absolute only because they remain unexamined. As a result, ministries and the political leadership often appear to respond to events as they unfold. When problems arise, the problems become the focus of attention. In such situations, the urgency of decision-making in and of itself pushes aside the seemingly abstract notion of force design.

Lacking an existing force design capability, inappropriate defense decisions taken on a tight timetable generally fail to take into account the various tradeoffs and cannot systematically examine their interaction(s). That is, decisions may tend to result in capabilities later to be found incapable of meeting Defense objectives, i.e., operational failure.

The adoption requirement for a particular LAS influences the length of the asymmetrical advantages those adopters receive, changing the way technology matters for the security environment. This condition creates a context that validates the Brazilian Army endeavor to finance its major C4ISR project with dual use technology applied both to environment surveillance and military vigilance. A project budget in billions of carbon credits is under development—merging energy, environment and defense objectives.

The collective pattern of the decisions taken into force design follows a logic stream regulated by its own results—each one stimulated and derived from the other. As programming is developed to



satisfy capabilities requirements, inconsistencies and a lack of balanced stringency among requirements become apparent.

This knowledge will be manipulated and transformed through the architecture of defense decisions. The requirements for new processes and products change constantly, yet the architecture of defense decisions change only with great deliberation and much effort. It is essential to ensure that the best decision in defense policy formulation be supported by coherent program-evaluation practices.

This installment is even more prominent when making the costs and consequences of defense decisions as explicit as possible by insisting upon the use of the best practices to systematically validate capability requirements (field-test, games and simulations, etc.), ensuring that deficiencies uncovered are corrected with appropriate modifications, and compelling a rationale for defense expenditures fully integrated and balanced with defense programs.

Multiple and simultaneous feed-back between the architecture of Defense decisions show how their processes are not truly neutral in that their substantive content affects the independence of the purposes they serve. As one, they belong to an elaborate complex of related activities that crystallize around a common goal – designing the appropriate composite of military capabilities. Their great need is to make all operational processes work together, expanding and contracting their relationships as needs develop, managing knowledge through process networking on a vast scale in order to influence the powers that control it.

Unless force design is addressed head on, choices offered by ministries to the political leadership are often either “more of the same” (easier and quicker than doing a comprehensive review) or are entirely new approaches that generally hinged imprudently on some form of “technology.”

### **FRAMING THE WICKEDNESS OF THE PROBLEM**

Detailing the mechanisms by which large-scale changes in the defense industrial base occur has both macro and micro level explanations. However, even if the macro level explanation fits within the accepted economic frameworks, changes in the defense industrial base can only be properly explained by its micro foundations. Without a generally agreed upon theory or even a metatheory, structuring the defense industry problem from the dual perspective of security and development relies on strings of empirical patterns with varying degrees of correlation to hypothetical causes.

The need for a clear defense industrial policy aligned with defense strategy has a new urgency caused by Brazil's current position in international politics. Brazil possesses a margin of power over other regional states that need to be equated specifically military power. The choices Brazil makes now will affect not only its future position but also the course of regional integration for some time to come.

Brazil's ability to shape the region is now at its peak, but the future is not likely to be so rosy. Other states are growing restless due to Brazil's predominant position and are likely to challenge it. Thus, the cost of its regional role is likely to rise. The challenge at this critical juncture for Brazil's security is to decide what type of international role it wants defense to play. The prime directives of any defense strategy are, of course, how to protect the homeland and how to implement the role the country



wants to play in international affairs. It is incumbent upon policy formulation to decide about the utility of military power in future security statecraft alternatives.

Policy foresight demands thinking in terms of what did not happen as an important part of identifying planning alternatives that could lead to a stable security condition where individual actors have no incentives to develop actions beyond the scope of authorized strategies. That means that policy formulation has to take into account what those actors would do if the strategy were changed. The underlying assumption of this requirement is that Nash equilibrium would be established between strategy and policy at a given stable security condition.

A stable security condition is a meaningful perception unit varying with the conceptual structure used to frame the policy problem, the inclination of the strategy formulator, and other developmental features of a given situation. Given the existing state of knowledge, it is impossible to identify for all purposes a best set or best hierarchy of sets of developmental features.

Seeking long-term security equilibrium, the Brazilian government defined its National Strategy of Defense with development capabilities springing in three vectors: technology security, focusing on cybernetics to revamp the national capacity to generate and integrate new knowledge into a strategic command and control system; energy and geostrategic security, centered in the nuclear submarine program to generate strategic deterrence; and economic security, prioritizing the reemergence of the domestic defense industry to advance the country's overall defense potential.

Each major component of the defense industry consists of a number of elements which can be combined or aggregated in varying degrees in accordance with different conceptual classifications. The choice of the base aggregate depends on the nature of the problem. In practice the nature of the particular developmental strategy for the defense industrial base tends to determine the major component to be emphasized and the pattern of its disaggregation. Thus, there can be many policies that are equally valid for the development of the Brazilian Defense Industrial Complex.

The analysis assumes a fixed pattern of technology trends and markets for the Brazilian Industrial Complex. However, there is among Brazilian policy makers no generally accepted comprehensive approach of defense industrial complex development and growth finer sufficiently for identifying specific industry categories whose development might be justified.

Each defense industry is established on anticipated pattern of markets and located with a given geographic distribution of productive factors used in the type of industry. Presumably, a specific region would provide geographic advantages for such industries: a larger and diversified labor force; from larger requirements of fuel, power, transport, and various urban and social facilities, from the localization in one district of diverse activities which feed by-products into each other, etc.

It is no longer controversial to say that traditional defense industry concepts are too narrowly founded on airplanes, warships and tanks. That advance does not, however, mean that consensus exists in Brazil on what a more broadly constructed concept should look like. External traditional conflicts influence policymakers and implementers' perspectives on the economic variables disrupting the possibility of consensus equilibrium.



The implication is a lack of consensus on what policy guided mechanisms should be adopted to support industries (tax reductions, incentives, market preferences, privileged access to information, etc.), what industries should receive/or not these benefits, and most important, how to correlate any kind of incentives to regional sustained development that assures the effectiveness of strategy decisions.

The unique characteristic is that in defense work profit is directly related to cost, and in the defense 'make or buy' decision, one is faced with the desirability of maximizing cost. Lacking theoretical and empirical studies, as well as methodological investigations carried out, there is no way to assure Nash policy-strategy equilibrium in the current Brazil's defense market. Fixing this imbalance contributes to realizing national defense objectives and bolsters regional economic development, reducing the strategic dependence on foreign sources of defense material, services and information.

Without corrective steps in the near future, these problems will be both economically inefficient in the production of defense materiel and strategically unresponsive in terms of the production speedup required to meet an emergency.

Absent past comprehensive and stable policies, Brazil's defense inter-industry structures (transformation stages of raw material, power consumption interregional transportation, domestic labor, industrial machinery cross services, and other assets required to produce a unit of output) stemmed by happenstance from changes in consumption patterns incident to income changes. The resulting set of nonlinearities diffused the existing national defense industry cluster incubated during the military governments in the 1970s.

Inferences derived from other countries to address Brazil's policy-strategy imbalance, which address defense industry complex developments can be seriously misleading because consumption patterns, production practices, and income levels can vary widely from those of other countries. It is by no means automatically true that a wise path to defense industrial development is to encourage increased local production of all industries with significant export or import balances.

As current system requirements resulting from the new National Strategy of Defense mounts on the Brazilian Industrial Complex, a stage is actually reached where installed capacity does not become adequate for a free market-oriented operation. It becomes necessary to alter the entire reference standard of business concepts relating the input from the strategy into industrial activity.

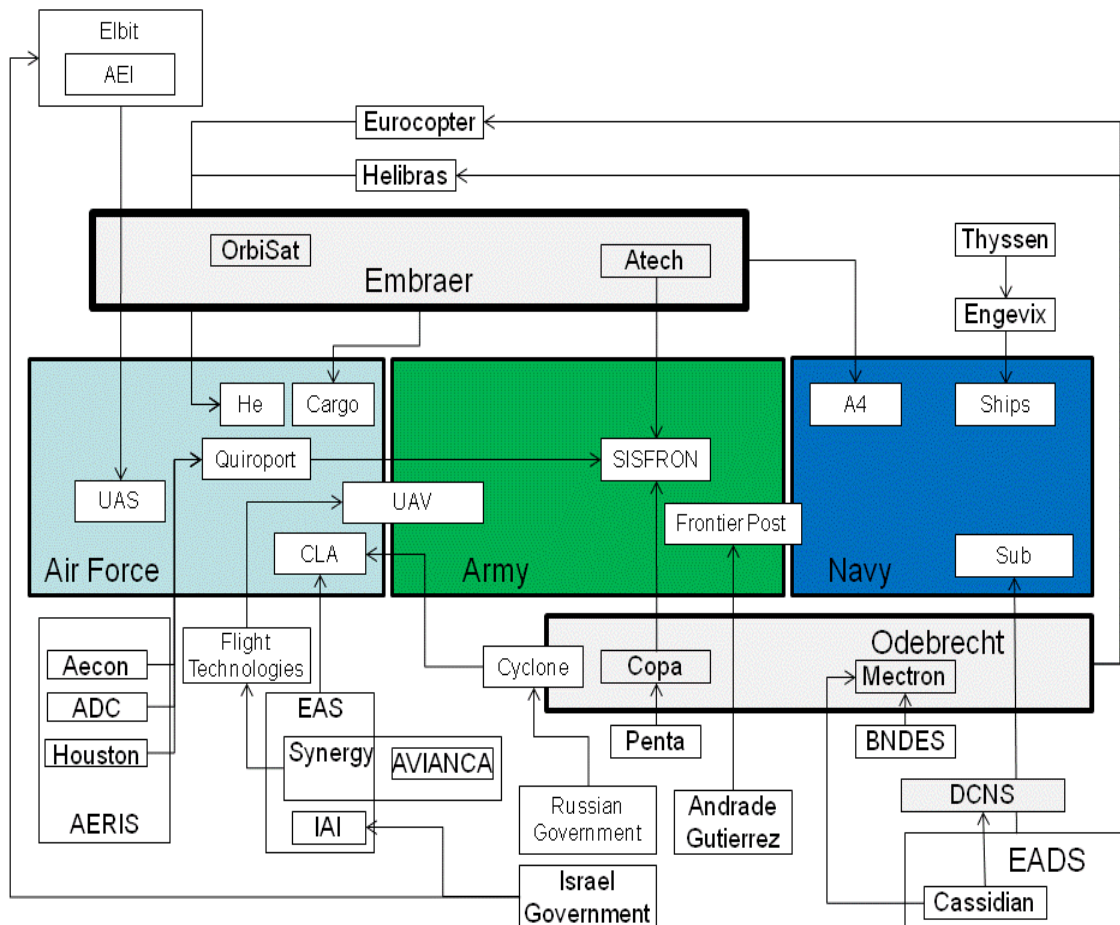
However the strategic problems in the Brazilian Defense Industry are getting far worse because of economic inefficiencies projected from the set of sectorial defense policy arrangements. Brazil's Defense Ministry is inducing the creation of regional defense clusters, each one dedicated for a Service – Army, Navy, and Air Force – with large prime contractors sustaining considerable excess capacity, while creating entry barriers to other prime contractors within the defense market.



## Modeling the Anatomy of Brazil's Defense Inter-industry Relationships

Brazil's strategy for fostering the reemergence of its national defense industry is based on a few major systems (nuclear submarines, fighters, strategic command and control systems, combat fighting and transport vehicles) to support the National Strategy of Defense. The chart below presents the anatomy of Brazil's main defense inter-industry relationships. These are very dynamic relationships that are still in the consolidation process.

The sense of urgency present in this paper highlights the need for government action, before these relationships are consolidated into business contracts and agreements. If Brazil's government does nothing, the state's national interests will be compromised.



Air Force research, development and industrial projects will be centered in Sao Jose dos Campos, a region with a high concentration of air space technology. Embraer Defense, a subsidiary of the gigantic air industry Embraer, will play a primary contractor role. Embraer is partnering with AEI, a subsidiary of Elbit, which is a large defense company from Israel. It has also acquired Atech, the leading Brazilian Company in defense system integrations. The Company is focusing its effort on



sharing a large segment of the C4I systems market, based on airborne strategic sensing capacity, with tactical support from Unmanned Aerial Vehicles (UAV).

It is relevant to note the correlation between these vehicles and the transformation of Brazil's defense operational concept. Pardesi (2005) noted the emergency of this pattern in the US: "*The absorptions of modern information and communication technologies (ICT) has transformed the US military. Unmanned aerial vehicles and unmanned combat aerial vehicles are playing a crucial role in this transformation, as they provide the military with a new platform that exploits the advances in ICTs. At the same time, they are integral to the concept of networkcentric warfare.*"<sup>11</sup>

It is relevant to note that the Embraer has also re-engineered its organization structure and C-level roles and functions, explicitly preparing for a strong vertical integration of its activities in the defense market.

Odebrecht has recently acquired Mectron, the only Brazilian Company with advanced qualification in missile technology, and acquired Copa, a small family company focused on system integration. Atech sold its interests in Copa when it was acquired by Embraer. Odebrecht also plays a key role in the Navy's effort to build nuclear submarines and a new submarine base, with support from EADS and Cassidian through the French DCNS. The Navy nuclear program is a major initiative with many spinouts. Odebrecht and Embraer are disputing access to the CLA (Alcantara Launching Center), a satellite system program; the former through Flightech/EAS, and the latter through Orbistat. Both companies are also engaging the critical infrastructure market within the Defense Industrial Base through Quiropot and other similar programs (airport and fast speed train).

France and Israel play a central role in the Brazilian Defense Base realignment through EADS, EAS and Elbit. It is interesting to note the absence of large US defense companies directly involved in the reemergence of Brazilian Defense Base.

It is crystal-clear that business plans and defense strategic requirements are not mutually supportive. Business plans are maximizing business opportunities, directing a high concentration of power into the hands of two major prime contractors with extensive foreign interests. This is certainly a risky condition.

The structural characteristics on the supply side are not matched by the structure of the demand side. After the giants have achieved a large amount of vertical integration, it will be extremely difficult for the smaller civilian contractors to raise money. Profits will be too low compared to the risks because such vertical integration clearly changes the competitive environment at the subcontractor and supplier levels, although the prime contractor normally claims that his subcontracting divisions still operate autonomously in a competitive market.

Positive feedback plays a central role in shaping the structure of interagency relationships, making prime contractors operate against the smaller firms instead of developing a mutually supporting inter-

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<sup>11</sup> Pardesi, M.S. Unmanned Vehicles/Unmanned Combat Aerial Vehicles: Likely Missions and Challenges for the Policy-Relevant Future. *Air&Space Power Journal*; Fall. pg. 45-54, 2005.



industry framework. This condition is fostered in a very limited market that is constrained by a very large amount of interconnected public regulation. Furthermore, and most important, in Brazil, the public regulator and the public buyer are one and the same.

The modern defense systems that Brazil demands are extremely complex. They require high-technology and capital-intensive specialization that the smaller subcontractors and parts suppliers could not economically sustain without prohibitive government incentives. When this criterion is combined with the concept that competitive advantage grows out of the value a firm is able to create for its stakeholders, the policy decision on having a multilayered defense industrial base becomes their contribution to national security.

Entry of new firms depends not only on the life cycle of technologies but also on the life cycle of the linkages and compatibility across the regional concentration of defense industries able to produce synergy and path dependency. Companies regionally clustered have intimate knowledge of costs formation and are able to establish a positive net result in a cooperation-competition environment that strengthens new behaviors, advances new ideas, and reinforces adoption of improvements.

Horowitz (2010: 31-32) explains that ... *“private business have economic, nondefense incentives to develop the technology, or an essentially military technology, meaning it was invented for military reasons and will arouse little interest from business outside of defense contractors. Underlying commercial technologies will generally require lower net capital investments for a military organization than underlying military technologies, because market competition creates incentives for private firms to pay some of the product costs.”*<sup>12</sup>

However, a firm entering a defense cluster cannot simply duplicate existing technology. It must not only have production capability, but the firm must also have a large research and development establishment. The length of gestation periods for technology intensive defense projects and the nature of military research and development present an entry barrier for conventional industries within the defense market.

Political costs and benefits of the Armed Forces may also influence LAS decisions and therefore policy guidance, which offset the value of the private defense industry through low-cost alternatives or substitutions. But the alternative of bringing a larger share of the work into the Services arsenals and depots in order to keep them occupied is not plausible. Military industrial facilities should not continue in unhealthy financial positions with aging plants in order to counterbalance the negative effects of its current strategy. There has been considerable concern on the part of the Services about the limited investment in shipyards and base modernization and the resulting low productivity—particularly in view of high wages.

The net effect will be furthered concentration of Brazil's defense industries' civilian sector in giant prime contractors that have “locked in” monopoly prices and little or no incentive for cost reductions. Then, when they are in a sole-source position, higher costs for production actually mean more profit.

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<sup>12</sup> Horowitz, M. *The Diffusion of Military Power: Causes and Consequences for International Politics*. Princeton: Princeton University Press, 2010.





A prime contractor can win a development program without significant new investment because his production costs are not part of the development bid.

Prices rise when consolidation eventually reduces the number of suppliers to one. A government commitment to a single supplier shifts the relative bargaining power from government to industry, increasing the country's defense dependency upon this contractor. As the lack of competition increases, large amounts of excess capacity are charged against defense contracts. The cost growth comes primarily from negotiated changes to the contract and through overruns on contracts that have intentionally been underbid.

The perhaps inevitable trend of current policy and strategy mismatch, aggravated by the inadequate injection of politics into defense clustering, will be a few low-performance gigantic vertical clusters, highly dependent on the stability (inertia) of Brazil's defense capabilities necessary for survival. Monopoly and strong state funding dependency are poor prospects for the Brazilian Defense Industry. Brazil is simply wrapping its past failures in defense industries initiatives with the same business model description, only on a larger scale. More complex financial engineering keeps the risk on the government side, increasing dependency on often undependable foreign sources. Monopoly conditions are then justified primarily based on high capital intensity of the manufacturing process.

Defense industrial production occurs after the sale is made, contrasted with civilian acquisition where competition happens during the execution of the program. As a result, the problem is bound to worsen with the current procurement practices of small annual quantities purchase and the high uncertainty of continued project funding that maintain dependence on foreign systems, services, and supplies. That is contrary to the National Strategy of Defense purpose of endorsing the need for a robust national defense industrial base.

The overall picture is not very bright. The dependence issue will be complicated by emphasis on agreements for joint production (targeted to Argentina, China, and France) and offset arrangements (favoring regional economic development). Operations in the defense industry are not a free-market "standard," they are likely to be one because of the dominant role played by the Ministry of Defense.

The risk is increasing the costs of defense in Brazil. Once the product and prime contractors are selected, the long-term production, which may last many years – is then conducted in a sole-source environment, and the contractor essentially assumes a monopoly position. The government becomes dependent upon that producer for military equipment that it badly wants and for which it will usually pay whatever is asked, justifying decisions under the provision of "national security."

This kind of loose interpretation of the terms of the law is already in place in Brazil, with firms exploiting legal loopholes in order to take advantage of fiscal incentives and political benefits through joint ventures, mergers, and acquisition that act contrary to Brazil's national interests. A few of these industries, most qualified as "consultant," have neither defense qualifications nor a product to offer than political relationships of its owners. Moreover, the Ministry of Defense has no legal power to interfere (and has no incentives for interfering); whereas the media, when called upon, was not even able to understand the problem for lack of expertise in such a specialized arena. The immediate



result is the rise of equipment costs significantly above rate attributable to inflation. In the long term, national security is the higher risk.

Apart from this shortcoming, the extreme R&D emphasis on operational performance has rapidly increased the cost of defense equipment. To further complicate the financial equation, costs of complex machinery required for R&D technologies far exceed the depreciation allowances (accumulated expense that writes off the cost of a fixed asset over its expected useful life), industries do not keep a constant modernization level, because of the higher replacement costs.

On the other hand, profit likelihood for small local contractors will be limited to highly specialized companies lodged in the technology chain, with cyclical perilous situations. Management of the procurement process for these small sellers at supply base has a great deal of randomness, with differentiated technology-based products bidding against each other at essentially the price previously established by the defense. This leads to economic inefficiency associated with economies of scale, at increased per-unit costs and small volume, forcing firms to become smaller to compete or forcing exit strategies.

A firm operating in the defense market that wants to develop an exit strategy will complete its “assets list” understanding how governments do business and the established procedures compatible with defense accounting, management, inspection, and reporting. The firm should also list an extensive background, experience, and a robust marketing organization with standards unique to defense, including security clearance. An additional factor unique to defense industries is the excess capacity that must be established and maintained in order to provide “surge” or mobilization capability. All this requires a large overhead capacity, making a company’s prices unattractive in the commercial world. Can’t enter, can’t leave!

The lower tiers of the defense industry could become a problem facing the defense industry. Therefore, the actions to correct these problems must be different. Policy is to start from the current laws and regulations with special considerations for what make the defense market in Brazil similar and different from other countries.

A characteristic not unique to Brazil is that each Armed Force try to maximize the differences between the systems they use from those used in other sister Armed Forces. Alignment of the major prime contractors with specific Service communities will tend to reduce diversification, increasing internal dependency to that particular contractor, escalating the ability of these monopolistic prime contractors to “cross-subsidize” their business in order to get a foothold in any new defense program, rising the horizontal integration, again distorting the market.

Certainly the high complexity of the products being introduced in the newer generations of equipment requires far more specialization and frequently far more capital equipment, both of which tend to limit the number of firms capable of keeping up. Thus, a sub-contractor that makes a large investment during the development phase does not have much assurance of getting the full production contract.

The transfer of military technology to the civilian sector is one of the greatest management challenges. Military standards and specifications are very difficult to convert to the lower-cost



practices of the commercial world. Small Brazilian defense firms do not have experience of managing large, high-technology programs with much more complicated management processes, higher maturity levels requirements, much tighter technology interface tolerances, and more complex designs.

## AGENCY TOOLS FOR DESIGNING AND MANAGING THE DIFFUSION OF PROGRESS

The Ministry of Defense has the power to change this trend, as it is too costly to be ignored. The government cannot [continue to] abdicate its responsibility to assure direct action subcontracts are diffused as widely as possible, and that a broad industrial base is maintained and fostered. The response time is too great to do it later, and the potential cost too high to not do it at all.

Neither of the Ministry's responsibilities can be delegated to civilian organizations, such as the FIESP, who would logically defend corporate interests, fueling decisions for its own interests with neither the competence nor the expertise in defense to develop such sophisticated requirements of Nash equilibrium between policy and strategy.

The decision between making defense assets nationally or buying it from international suppliers is a key element in force design. Readiness plans and programs keyed to realistic threat estimates and scenarios become functions of the rapid development of adequate productive capacity for war-time needs, providing vital materials necessary to support military operations under various assumptions.

Matters are not much better on the management side. The Ministry of Defense does not have a comprehensive Force Design Program, stabilizing assumptions and identifying relationships among core variables that define the systems of defense capabilities. As a consequence, the industrial-base programming for mobilization is locked in a past and obsolete decision framework, with procedures for surging whimsically contemplating "all of those currently in the force structure" under unrealistic assumptions about the defense industrial base and the strategic tempo of future wars.

Modern mobilization is primarily directed to resolve conflict for scarce resources between those systems that could be built in a relatively short time, enforcing the merge of military strategy requirements and policy guidance for the Defense Industrial base in peacetime, and anticipating trends and posture for crisis periods. A future conflict may be far shorter than planning references. Yet the ability to make rapid increases to high production levels is even more critical today because of rates expected in wartime.

Increasing production levels to allow the government sufficient time to develop adequate responses is a crucial element of any defense mobilization doctrine, but Brazil's overall responsibility for industrial preparedness is dispersed around the executive branch. To make things worse, Brazil's mobilization doctrine still reflects the power structure and enforcing authority of past military regimes that shaped military thinking about national crisis management. This is a dangerous anachronism to a fragile democracy that would need to exercise its muscle in a crisis situation.



The near-term projections are based on the assumption that the trends will continue more or less as they have been going. It is necessary to ask questions from the perspective of the overall defense industry, questioning the government controls of entry into and exit from the defense market, and strategies affecting the growth or decline of the firms, as well as imposing its ways of doing business on the firms involved.

All these questions can only be examined at the conceptual level, along with a host of other factors. Appraisal of the several alternatives must cover the recognition by Brazil's policymakers of the significant qualitative differences in structure, conduct, and performance between the defense industrial base and business done with the general industrial capacity. Instead, the government continues to treat this dual economy as though it were uniform, and to apply all of the same rules.

Brazil's National Defense Industry needs a broader, multidisciplinary, interagency perspective to configure a number of possible regional development models considered together and in equilibrium with security and defense strategic objectives, rather than looking at corporative interests, attempting to come up with small actions that could move the defense industry in the direction of limited interests.

The critical step in promoting the Brazilian Defense Industry is to divide the regulator from the buyer, creating a regulatory and oversight agency, thus separating defense industry policy formulation and defense strategy decision making. This assures force structures to take advantage of the likelihood of future technological changes in regional economic development enhanced and sustained by a concentration of competing and cooperating defense industries.

This agency will play an important role in controlling and overseeing all essentially foreign military sales, as they are done through the Brazilian government instead of companies directly. This Defense Industry should be the approver of contractual and financial responsibility. Many foreign governments would prefer this arrangement because it formally commits the government to stand behind and support the sales over the long haul. This action makes Brazil's military products an attractive brand name to overseas buyers and somewhat reduces the risks to Brazilian companies by covering a firm's termination liability costs in the event of an abrupt cancellation.

Instead of generalization of the product description, emphasis should be placed on the capacity to enhance the value chain, promoting innovation in the basic technology or the manufacturing process as the distinguishing characteristics of Brazil's defense product. Still more critical, a culture of dual use shall stem from changes in business concepts patterns to income changes from a broad array of energy and environment security related projects. The stability of input is crucial to remove restraints, which limit resources. A Defense Industrial Agency would be in a unique position to identify cross impacts of projects in other government sectors and defense. As the output of joint activities expands, new combinations of new technical processes may become economically feasible, yielding more valid results.



Individual companies in the defense market, even the large prime contractors, have limited commercial area advertising relative to the civilian market. The major share of the marketing is done through personal contacts.

The Minister of Defense has ruled the defense market as a closed economy. It has to act in this condition and under the related assumptions to protect investments in the national strategy. Only a National Defense Agency has the mechanisms to address interrelated areas of instabilities and uncertainties in the future market, preventing the current status of ignoring the implications of the growing multinational involvements.

A Brazilian Defense Agency could develop a multiyear stable funding program for the efficient use of labor and capacities. Its role should also include the development of cross-referenced standard industrial classification systems with the provision of a variable tax-subsidy pattern that bolsters competitiveness through international cooperation.<sup>13</sup>

The Agency would not deal with solely economic considerations, but it would also coordinate with all Defense and Security agencies and Ministries to provide maximum production efficiency and sufficient surge capability to contribute to the maximum deterrent and battle capability.

A regulatory commission in the Defense Industrial Agency could develop policies to combine some specific defense with civilian businesses in the same firm, making research and development profitable on its own terms, thus easing and speeding up the transfer of technology from military-sponsored research and development to the civilian sector.

Given Brazil's limited background and support for the concept of independent agencies in the Federal Government, three simultaneous actions will be necessary to prevail over resistance to the creation of a National Defense Industrial Agency: a strong leadership to overcome military culture of autonomy; institutional pressure from the Congress supported by analytical evidences extracted through oversight mechanisms at its disposal; and, most important, concerted pressure from the civil society through industry associations. The integrated effort of these actors conveys a whole-of-security approach to incorporate changes in the nature of the scope of the challenge to the defense industry cluster formation process.

## **DEFINING INDUSTRY CLUSTERS AS THE STRATEGY TO ADDRESS THE STRUCTURE OF THE PROBLEM UNDER POLICES DEVELOPED BY THE DEFENSE INDUSTRY AGENCY**

Porter (1999:78)<sup>14</sup> defines clusters as *“geographic concentration of interconnected companies and institutions in a particular field (...) it may include governmental and other institutions – such as universities, standards-setting agencies, think tanks, vocational training providers, and trade associations – that provide specialized training, education, information, research, and technical support.”* He also says that *“Clusters promote both competition and cooperation. Rivals compete*

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<sup>13</sup> McCormack, R.C. Deputy Under Secretary of Defense (Industrial and International Programs). Bolstering Defense Industrial Competitiveness through International Cooperation. US: Defense, pg: 10-13, 1989.

<sup>14</sup> Porter, M. Cluster and the New Economics of Competition. Harvard Business Review (Reprint 98609). November-December – pg:77-90, 1988.



*intensely to win and retain customers. Without vigorous competition, a cluster will fail. Yet there is also cooperation, much of it vertical, involving companies in related industries and local institutions. Competition can coexist with cooperation because they occur on different dimensions and among different players.”*

Many states are promoting regional clusters to foster regional production systems. The literature exhibits a number of methods to identify industrial clusters. Markusen (1996)<sup>15</sup> defines a taxonomy for industry clusters with three types: (1) Marshallian, composed primarily of small-and medium-size locally owned firms; (2) Hub-and-spoke, dominated by one or several firms surrounded by satellite platforms of related input supplies and service providers; and (3) State-anchored, centered in a large public activity (university, military base, etc.) and the supplier and service sectors that develop around through direct impacts and technology related spin-offs.

Brazil is a special case of Porter's definition in category two of Markusen taxonomy. Under this classification, Brazil's Defense Industry's competitive advantage shall emerge in the managing capacity of the entire value system in order to promote sustainable regional development. This will emerge from clustered national defense industries around competing prime contractors focused on technologies instead of products and supporting defense capacity, thus building efforts based on a force design endeavor developed independently, but in cooperation with, market capabilities.

Adoption of industry clusters as development strategy posits variations in the technological and organizational capital and financial requirements for force design governs the way individual firms make decisions and system-level distribution of responses, as well as the subsequent implications for deterrence. Financial requirements refer to the level of resources required to implement the LAS. The higher the cost per unit of C5ISR hardware associated with the LAS and the more underlying technologies are exclusively military oriented, the higher the level of financial intensity required adopting the innovation.<sup>16</sup>

Defense clusters become policy responses by the Agency to create regional production systems within which existing firms become more productive and new defense start-ups are encouraged. Policy and strategy equilibrium is sustained by a highly specialized concentration of technologies and skill in a sophisticated inter-industry network, generating a variety of inter-firm spillover factors, such as information sharing in market intelligence, new production techniques, and labor quality that propels a regional economy.

The correlation among military clusters, regional development and national security is presented in the 2010 report Regional Economic Strategy: Military Cluster by the Prosperity Partnership,<sup>17</sup> which

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<sup>15</sup> Markusen, A. Stick Places in Slippery Space: A Typology of Industrial Districts”. Economic Geography, 3, pg: 293-313, 1996.

<sup>16</sup> Kuah, A. T.H. Cluster Theory and Practice: Advantages for the Small Business Locating in a Vibrant Cluster. Uk: Journal of Research in Marketing and Entrepreneurship, Vol. Four, Issue 3, 2002.

<sup>17</sup> Puget Sound Regional Council. Prosperity Partnership. Regional Economic Strategy: Military Cluster, Puget: February, pg:206-28, 2010.



analyzed the strengths, challenges, and opportunities, developing major initiatives and strategies to facilitate economic growth in the industry. The conclusions can be extrapolated to Brazil's case as:

- 1) Military contracts play a significant role in the regional development. When defining the military cluster as the combined impact of the military installations, as well as the network of contractors and subcontractors that support the military and work on defense contracts, the significance of that role increases.
- 2) The regional base and defense contractors (complex) also have significant workforce impact by attracting skilled employees to the region and providing specialized training opportunities that can later be applied in industries not necessarily related to the military.
- 3) The cluster must provide mission support for the military, including any activity that makes it easier for the military to achieve strategic national defense objectives and for individuals to play their expected roles.
- 4) Community relations are a distinguished characteristic of the military cluster not found in other economic clusters. Strengthening the relationship between the defense industries and their host communities affects local policy decisions that impact location and investments decisions.

Recognizing these characteristics of clusters, the Ministry of Defense initiative of defining a list of "privileged" firms that are part of the National Defense Industrial Base is conceptually and empirically bluntly wrong. It frustrates the emergence of potential defense industries.

Brazilian defense clusters may propagate across national borders, although most would be contained within political boundaries. Since clustering algorithms depend on detailed published data, the operational actions of the agency contribute to transparency and accountability. Relying solely on established industries is a wrong-headed strategy. In fact, that justifies the need for an independent and autonomous National Defense Industry Agency capable of making policies that qualify emerging or potential industries.

## PRESCRIPTIONS

The arguments offered in this paper lead to three major prescriptions. First, the wholesale dismantlement of the defense industrial base must be terminated. Brazil should create a regulatory, independent, Defense Industry Agency. Brazil must not allow its defense industry to degrade, and it cannot shrink from developing a robust military power to support national security interests' through deterrence, competence or active defense. Second, the federal government should not retreat into a neutral posture by abandoning the ability of the defense industry to induce and sustain regional development, and the unbridled unilateralism of the Defense Ministry to shape the defense market must be terminated. Third, the Defense Ministry must develop a Force Design Initiative, providing C5ISR elements that integrate force structure, regulating factors and strategy in a comprehensive force posture, with the proper balance between national defense industry supply and acquisition from



foreign sources. In sum, if Brazil allows its defense industry to degrade significantly, if it does not strike the right balance in policies, sooner or later that will redound to Brazil's detriment.

