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The three levels of Technological Dominance: hardware, software and cognition in global south defense architectures

Isabela Wagnerovna Rocha-Dashicheva[I]

[I]University of Brasília, Brasília, DF, Brazil

Abstract

This article develops a critical literature review on technological dominance in defense, structured around three levels: hardware, software, and cognition. It advances a synthetic framework that harmonizes Classical Elite Theory and Marxist political economy through Hardt and Negri's concept of Empire (2001), treating technological power not as a neutral outcome of innovation or efficiency, but as a historically situated mode of domination. Methodologically, the article mobilizes Hardt and Negri's formulation of Empire alongside Rael's (2022) eleven dimensions of power (scope, domain, weight, costs, means, mode of application, incidence, agency versus structure, degree of dominance, geographic reach, and degree of transience) to examine how material capabilities (hardware), digital infrastructures and code (software), and cognitive structures (narratives, symbolic authority, and expert knowledge) are integrated into a stacked architecture of imperial dominance - compromising Global South defense architectures. This framework allows technological dependence to be analyzed as a systemic configuration rather than as a series of isolated technical gaps as, by organizing the literature through these three levels, the article offers an analytical framework to assess strategic autonomy beyond armaments or industrial capacity alone, arguing that without confronting imperial-mediated cognitive alignment, software dependency and the development of foreign tech infrastructure solutions in national soil, defense modernization efforts undermine, rather than reinforce, Global South Defense Architectures.

Keywords: Defense governance; Strategic autonomy; Technological capabilities; Security architectures; Decolonial security studies

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INTRODUCTION

A Brazilian general decides to, for whatever reason, move the nation's forces to reinforce a sensitive stretch of the Amazonian border. The command is immediate, operational, and unmistakably sovereign. And yet, the satellite imagery guiding the deployment is processed through foreign-owned constellations, the geolocation data relies on positioning systems governed by external standards, the secure communications linking units in the field run on encrypted software licensed under foreign law, and the logistics software optimizing fuel, supplies, and troop movement was designed to comply with doctrines and threat models defined elsewhere: even the risk assessments shaping the general's judgment draw on analytical frameworks absorbed through foreign training and standardized operational manuals. The boots move on Brazilian soil, but the decision itself travels through cables, code, and cognitive frames that Brazil does not control. The order might be Sovereign, and yet, his command unfolds through layers that are not.

The problem illustrated above is that even if states acquire advanced defense platforms[I] necessary for modernization, the trade-off is the relinquishment of true autonomy. Defense Architectures (or "technological solutions") adopted by the Global South from the West import far more than hardware. The solutions also import standards, dependencies, doctrines, and assumptions about how security should be organized, perceived, and exercised.

What appears, at first glance, as a discrete operational upgrade (a weapons system, a surveillance platform, a command-and-control interface) arrives already embedded in foreign supply chains, proprietary software ecosystems, licensing regimes, compliance standards, and training pipelines. These upgrades, of course, have their uses actively delimited, defining in advance what actions are possible,

[I] In 2025, Brazil's Institutional Security Office (GSI), the federal agency responsible for national security and information governance, moved toward formalizing a technical cooperation agreement with Amazon Web Services (AWS), the global cloud division of Amazon to bolster "maturity in security of information and cybersecurity", including joint workshops and capacity-building activities, under a *portaria* delegating signing authority to the Secretary of Cyber and Information Security. This negotiation occurred alongside the publication of Instrução Normativa GSI nº 8/2025, which for the first time authorized the use of cloud environments for the treatment of classified information, provided they are hosted in Brazil and under qualified governance structures. These developments could expose sensitive government data to foreign cloud infrastructures and the legal jurisdictions that govern them, raising concerns about digital sovereignty and cross-border access under laws such as the U.S. CLOUD Act.

permissible, and interoperable, as well as when and with whom they may be undertaken. And so, as each new acquisition may expand nominal capability, they also also tighten structural constraints.

As defense architectures become more deeply integrated into external technological stacks, autonomy becomes progressively more costly: financially, operationally, and doctrinally. Sovereignty persists as a legal claim, while its practical exercise is steadily thinned out, with decision-making processes passing through infrastructures, code, and epistemic frameworks that lie beyond national control. It is this widening gap between capability and control, between possession and governance, that this article sets out to theorize and make analytically visible.

At the **Hardware** level, dominance is fixed materially. Weapons platforms, satellites, sensors, energy inputs, and logistics infrastructure impose high costs, long life cycles, and limited substitutability, locking defense capabilities into externally governed supply chains. At the **Software** level, dominance is mediated infrastructurally. Interoperability requirements, proprietary code, update cycles, compliance standards, and data governance frameworks quietly govern how hardware can be used, who it can communicate with, and which operational choices remain viable. Finally, at the **Cognitive** level, dominance becomes durable. Doctrines, expert knowledge, training regimes, and strategic imaginaries shape what decision-makers perceive as rational, modern, or responsible, aligning judgment in advance with external priorities.

And so, technological modernization becomes a mechanism of governance without annexation. Sovereignty does not disappear, but is instead hollowed out and re-scripted, exercised within an architecture designed elsewhere. And the logic presented here is recursive: hardware dependence generates software lock-in; software lock-in produces cognitive alignment; and cognitive alignment, in turn, normalizes further rounds of hardware and software dependence

By theorizing technological dominance as this three-layered system, this study offers a framework for understanding why defense modernization in the Global South so often deepens dependence while speaking the language of autonomy, and why reclaiming strategic sovereignty today requires confronting not only what states buy, but how their technologies think, connect, and govern on their behalf. This article mobilizes Classical Elite Theory to explain how such arrangements are organized and stabilized by coordinated minorities, Marxist political economy to situate them within dynamics of monopoly, accumulation, and imperial integration, and Rael's (2022) multidimensional framework to trace how power is distributed, converted, and stabilized across hardware, software, and cognition. Together, these lenses allow defense modernization to be read not as a structured configuration of power in which acquisition, governance, and strategic imagination are progressively aligned under external architectures.

Attempting to harmonize Classical Elite Theory with Marxist political economy through Hardt and Negri's concept of Empire (2001), and reviewing current literature on technological dominance, the following section introduces Rael's (2022) eleven dimensions of power as the methodological instrument through which technological dominance can be examined in concrete terms after going through current literature on the issue. The third section operationalizes this framework by mapping technological dominance as a stacked system coordinated across material capabilities (hardware), digital infrastructures and code (software), and the cognitive layer of narrative framing, symbolic authority, and mediated social understanding. Here, we provide the analytical structure through which Rael's dimensions specify how power is distributed, stabilized, and normalized within imperial and pro-American defense arrangements. The final section consolidates the article's theoretical contribution by formally defining the three levels of technological dominance and demonstrating how their interaction reshapes the meaning of strategic autonomy in defense governance, arguing that defense modernization efforts that neglect the cognitive layer alongside software dependency and foreign technological implantation tend to reproduce imperial alignment, undermining rather than strengthening Global South defense architectures.

LITERATURE REVIEW: EMPIRE, POWER AND ELITES

This section is divided into two subsections. It first harmonizes the canonical dispute between Classical Elite Theory and Marxist political economy by reading them together through Hardt and Negri's (2001) concept of Empire, treating their rivalry not as an obstacle but as an analytical resource for grasping contemporary, technologically mediated domination. It then moves from theoretical articulation to methodological specification by introducing Rael's eleven dimensions of power as the toolset through which this article can disaggregate power without dissolving its systemic coherence, allowing hardware, software, and cognition to be examined as a stacked configuration of dominance rather than as separate technical domains.

The main objective here is to refuse the comfort of theoretical purity or ideology in favor of analytical traction. By forcing the Marxist and the Elite Theory into conversation under the conditions of Empire (Hardt, Negri, 2001), and by operationalizing their points of convergence through Rael's (2022) multidimensional framework, the section lays the groundwork for an analysis that is less interested in adjudicating intellectual lineage than in exposing how power (and in turn Defense Architectures) is actually organized, stabilized, and reproduced today: quietly, infrastructurally, and with remarkable efficiency.

The Empire and the Elites from then to now: harmonizing the rivals towards a radical-pragmatic perspective

The realist tradition of Elite Theory holds that power in all complex societies is necessarily concentrated in the hands of a minority, regardless of formal regime type. Michel's (2001) notion of an Iron Law of Oligarchy, for one, argues that all complex organizations - regardless of supposedly democratic ideals - tend to develop oligarchic leadership, as structural necessities (such as delegation, specialization, and leadership skills) concentrate power among a few, creating a self-perpetuating elite. In other words, an organized minority would inevitably govern a disorganized majority, irrespective of ideological claims or constitutional form as powers persists because elites coordinate, institutionalize authority, and reproduce themselves through a secondary stratum of administrators, experts, and intermediaries who stabilize rule over time (Mosca, 1989).

Elite domination can also be understood simultaneously as a recurrent feature of social order and a historically produced structure of reproduction. This is because elite rule appears as a cyclical and transhistorical phenomenon driven by unequal distributions of aptitude and disposition expressed through the distinction between coercive and persuasive elite types and the circulation of ruling minorities over time (Pareto, 1935), with its persistence institutionally engineered through the stabilization of domination by accumulation, conversion and transmutation of economic, cultural, and social capital, mediated by education, the state, and symbolic authority (Bourdieu, 1984).

From an economic perspective, Marxist theory could potentially complement this sociological account by locating elite power within the material dynamics of capital accumulation. As Capitalism tends towards the concentration and centralization of capital, competitive pressures eliminate smaller actors and consolidate ownership and control over the means of production in progressively fewer hands (Marx, 2023), elite domination is exercised also through the coordination, stabilization and reproduction of power through the command of monopolized productive infrastructures. In this sense, Monopoly emerges not as one of its immanent tendencies, instead, as the material basis upon which oligarchic organization and elite cohesion are sustained in contemporary society.

This tendency acquires a geopolitical form in Lenin's (2012) theory of imperialism: Imperialism would be the political expression of monopoly and finance capital at the international level, marked by the export of capital, the dominance of monopolistic firms, and the hierarchical integration of peripheral economies into global circuits of accumulation. Here, elite power is no longer confined to national political classes, but is projected outward through transnational corporate, financial, and technological structures that subordinate dependent states.

Of course, these traditions have not developed in harmony. Classical Elite Theory has often been criticized by the marxists for abstracting power from its material foundations, treating elite domination as a sociological constant rather than as a historically specific outcome of capitalist relations, risking the flattening class antagonism by presenting elites as interchangeable minorities and obscuring the structural primacy of capital and the exploitative relations that bind ruling classes to modes of production. And then - Elite theorists view the Marxists as overly economistic, arguing that it reduces political power to ownership while underestimating the autonomous role of organization, leadership, and institutional control in achieving and maintaining power.

This all to say that where Marxist theory situates domination in the ownership and control of productive forces and in the imperatives of accumulation, Elite Theory emphasizes the organizational capacity of minorities to coordinate, govern, and stabilize rule even across divergent economic systems. For example, Pareto's (1935) circulation of elites, for instance, implies continuity of minority rule regardless of shifts in property relations, while Lenin's (2012) Imperialism holds that monopoly restructures both domestic elites and international hierarchies. Then, Bourdieu's (1984) analysis complicates both traditions by showing that economic capital alone is insufficient to explain elite persistence, yet it remains convertible into symbolic and institutional power through state and educational mechanisms. Yet, though these perspectives stem from different traditions - they all address the same issue.

This article draws on these traditions precisely because none of them, in isolation, seems to be sufficient to account for the contemporary configuration of technological power. Elite theory explains how domination is organized, stabilized, and reproduced through minority coordination while the theory explains why this coordination coheres around monopoly, accumulation, and structural dependency - and Bourdieu clarifies how material power is converted into symbolic authority and institutional legitimacy. Marxist theory, in turn, specifies the structural conditions under which such coordination is realized, locating elite power within the dynamics of capital concentration, monopoly formation, and imperial integration through today's corporatism, as understood by Hard and Negri (2001) under what they call the Ether[II].

It is from this articulation that the three levels of Technological Dominance (Hardware, Software, and Cognition) are derived, as an attempt to harmonize the Elite Theory and Marxist theory - though I am certain to invoke both their ires[III] in the process, which is all good if it means this article will be all the more read and its core message of the risks Global South Nation Defense Architectures now face[IV]. Scandalization and ire are, after all, known and overused instruments of dissemination of messages in digitally networked environments, as explored in some of my previous published works (Rocha, 2024, Rocha and Dashichev, 2025).

Hardware refers to the control of material and industrial capacities such as physical infrastructure and production chains, where monopoly capital and elite coordination manifest through ownership, supply dependence, and technological lock-in. **Software** designates the layer of digital systems, code, standards, and protocols that mediate the operation of hardware, structure interoperability, and embed asymmetrical dependencies within ostensibly neutral technical architectures. **Cognition**, in turn, captures the symbolic and epistemic dimension of power: the production of doctrines, narratives, expert knowledge, and strategic imaginaries through which technological dependence is normalized, justified, and internalized as modernization or efficiency.

II Hardt and Negri use the notion of Ether (also referred to as the imperial milieu) to describe the diffuse, omnipresent environment through which power under Empire operates. Rather than a formal institution or a centralized authority, the ether denotes the informational, normative, and infrastructural atmosphere that conditions action in advance composed of legal norms, technical standards, communication networks, expert discourses, and cultural expectations. It functions as a medium of governance in which domination is exercised indirectly, by shaping what appears possible, legitimate, and inevitable before political decisions are even posed. In this sense, the ether is the connective tissue of Empire: the space in which monopoly capital, elite coordination, and biopolitical regulation circulate continuously, allowing power to be exercised without territorial conquest or explicit command (Hardt and Negri, 2001).

III The tension between Marxist political economy and Classical Elite Theory is a well-established point of contention in the literature (Codatto, Perissinotto, 2009a, 2009b, Barrow, 2002). Marxist scholars have long criticized elite theory for detaching domination from its material foundations, arguing that by treating elite rule as a sociological constant it obscures the historically specific role of class relations, exploitation, and accumulation in the production of power. From this perspective, elite theory risks naturalizing domination and underplaying the structural primacy of capital. Conversely, elite theorists (most explicitly Pareto) rejected Marxism as reductionist, contending that political power cannot be deduced from ownership alone and that organization, leadership, and psychological dispositions explain elite persistence even when property relations change. Later comparative work in political sociology has reinforced this divide by presenting Marxist class analysis and elite theory as competing models with different assumptions about historical change, elite renewal, and the autonomy of political institutions. **The approach adopted in this article does not attempt to dissolve this disagreement, but to treat these traditions as analytically distinct registers whose combined use becomes necessary for explaining contemporary forms of technologically mediated domination under conditions of monopoly, imperial integration, and elite coordination**.

IV The decision to articulate rather than polarize theoretical traditions reflects a broader concern in contemporary debates on digital and technological sovereignty. When the question of sovereignty is framed as a binary choice between technological "openness" and "autarky," cooperation and resistance, innovation and dependency (often mapped simplistically onto political "right" and "left" positions) it becomes politically sterile and analytically impoverished. Such polarization tends to fragment critique along ideological lines, weakening the capacity of Global South states to diagnose how dependence is reproduced through infrastructures, standards, and cognition rather than through overt domination. This radical-pragmatic approach seeks instead to preserve analytical tension while refusing sectarian closure: it draws on Marxist political economy to identify structural dynamics of monopoly and imperial integration, and on Elite Theory to specify the organizational mechanisms through which these dynamics are stabilized and managed. By refusing to treat these traditions as mutually exclusive, the article aims to keep the debate on technological sovereignty focused on conditions of autonomy rather than ideological allegiance, thereby expanding the analytical and political space available for Global South defense and development strategies.

Within the Marxist tradition, Empire (Hardt and Negri, 2001) provides the structural synthesis that allows, in the scope of this particular research, these strands to be read together without collapsing their differences. Empire names the historical form assumed by domination once monopoly capital, elite coordination, and symbolic power cease to be primarily mediated through sovereign nation-states and are instead reorganized through deterritorialized, networked, and normative structures of governance. Rather than a single imperial center, Empire operates through a dispersed architecture in which corporate, military, financial, technological, and epistemic elites converge around shared standards, rules, and regimes of legitimacy.

In these terms, the organized minority identified by Mosca no longer governs solely through national political classes, but through transnational coalitions embedded in global supply chains, defense markets, digital infrastructures, and regulatory frameworks. Michels' Iron Law persists under Empire, but its locus shifts upward: oligarchic closure characterizes not only parties and states, but also supranational institutions, security alliances, platform ecosystems, and standard-setting bodies that are structurally insulated from democratic contestation - what I have called the Meta-Trumpismo[V] in the scope of today's political environment, in previous work (Rocha and Dashichev, 2025). Pareto's circulation of elites likewise remains operative, though increasingly confined to intra-elite rotation within imperial circuits rather than genuine renewal from below. Finally, Bourdieu's mechanisms of reproduction acquire a global scale, as symbolic authority, expertise, and legitimacy are produced through international institutions, epistemic communities, and professional norms that naturalize imperial hierarchies as technical necessity.

Empire, as formulated by Hardt and Negri (2001), names the historical configuration in which sovereignty is no longer anchored primarily in territorial conquest or inter-imperial rivalry, but reorganized as a deterritorialized and continuous

[V] Meta-Trumpismo refers to a transpersonal and transnational mode of political operation in which the core techniques associated with Trumpism such as radical personalism, affect-driven antagonism, institutional bypassing, and direct mediation between leadership, platforms, and audiences are and rearticulated within corporate-state alliances, digital infrastructures, and security-economic networks in the mark of Trump's second term. In this sense, Meta-Trumpismo designates not an ideological movement, but a structural configuration through which oligarchic power is reproduced above the nation-state, operating through platform governance, defense markets, regulatory insulation, and cognitive influence rather than through formal democratic institutions. More at https://diplomatique.org.br/meta-trumpismo-e-meta-politica/ and https://diplomatique.org.br/para-alem-das-tarifas-a-disputa-esta-na-cognicao/.

system of rule. Empire does not negate Lenin's theory of imperialism, but represents its historical development under conditions in which inter-imperial rivalry has been partially displaced and partially absorbed into a higher level of coordination among dominant capitals and states through corporate power. This is the condition under which elite coordination and monopoly capital converge beyond national borders, producing a form of domination that operates through networks, norms, and infrastructures rather than through direct colonial administration. Imperial power, in this sense, is exercised less through episodic coercion and more through permanent regulation, standardization, and the management of social, economic, and political life at a global scale.

Within this configuration, technological dominance becomes central because Empire governs through infrastructural and biopolitical means, and the control over hardware, software, and cognition constitutes the primary mechanism through which power is stabilized without the need for formal annexation. States may retain a semblance of juridical sovereignty, flags, and institutions, yet remain structurally subordinated through dependence on foreign technological systems, standards, and knowledge regimes that delimit the horizon of action. Domination is thus embedded in supply chains, code, interoperability requirements, expert doctrines, and strategic imaginaries that shape what is possible, legitimate, and thinkable. Thus, where Lenin understood imperialism as the competitive expansion of monopoly and finance capital across national empires - marked by rivalry, territorial division, and periodic war - Hardt and Negri identify a phase in which the logic of monopoly persists, even if its political form is transformed. Competition among imperial powers does not disappear, of course, but it is now mediated through shared regimes of governance, legal norms, technological standards, and institutional frameworks that manage conflict without dismantling the underlying hierarchy.

Current literature seems to fail to integrate the Marxist paradigm of monopolization and imperialism with elite theory and the understanding of a stacked architecture of rule. And, where attempts exist, they often remain trapped in partial diagnoses that isolate platforms, data, or ideology as if they were separate worlds - which is all good considering the phenomena of platform-mediated social life and the debate surrounding it is quite new. One branch of the debate foregrounds the novelty of Big Tech's power by arguing that platform monopolies have displaced market competition with rent-like extraction, marking a qualitative shift in accumulation and governance (Varoufakis, 2024). Another branch resists this claim, insisting that monopoly, rent, state capture, and coercion are not external to capitalism but among its ordinary instruments, and that naming the present "techno-feudal" risks misreading capitalism's own elasticity (Morozov, 2022).

What this disagreement reveals is a problem of integration: the same empirical objects (platforms, standards, cloud infrastructures, financial backing, security partnerships) are being theorized through incompatible lenses which speak both about the organizational mechanics of elite reproduction and the geopolitical grammar of imperial constraint at the same time, without being brought into a single analytical frame capable of holding both dimensions together. As a result, organizational dynamics might be analyzed in isolation from imperial structures, while geopolitical constraint is discussed without sufficient attention to the elite circuits that operationalize and stabilize it, leaving the systemic character of technological dominance analytically under-specified.

A second limitation appears in how the digital is often treated as an economic sector rather than as an infrastructure of sovereignty. Srnicek's account of Platform Capitalism insists on reading platforms as economic actors within a capitalist mode of production, shaped by competition and profit imperatives, which is indispensable for avoiding mystification and for keeping political economy in view (Srnicek, 2017). Yet political economy alone struggles to specify how platform infrastructures become governing mechanisms, as in, how they reorganize authority, discipline states, and shape defense modernization by hardening dependence into standards and, most importantly, operational routines. Durand moves closer to this junction by framing the digital economy through monopoly, rent, and infrastructural capture, describing a logic in which Silicon Valley's dominance functions as control over essential systems rather than simple market success (2024). Still, even here, the bridge to elite theory is often implied rather than built: who coordinates, who arbitrates, who stabilizes, and through which intermediary strata these arrangements become durable.

A third strand pushes directly into the cognitive register, showing how dominance is secured by asymmetries of knowledge and by the extraction of human experience as a strategic resource. Couldry and Mejias conceptualize Data Colonialism as a process of appropriation that redesigns ways of knowing, producing, and participating politically, giving language to the colonizing function of digital capture beyond mere market exchange (Couldry and Mejias, 2019). Zuboff, in turn, theorizes Surveillance Capitalism as an unprecedented form of power rooted in behavioral extraction, prediction, and control, pointing toward a regime of governance that works through instrumentation rather than overt coercion (Zuboff, 2019). These accounts illuminate cognition as a site of domination, but they often leave under-theorized the elite circuits (organizationally, institutionally, and geopolitically) through which such cognitive control is normalized, exported, and folded into state capacity, including defense architectures.

It is precisely at this seam that Empire (Hardt and Negri, 2001) becomes methodologically useful, not only for what it explains, but for the remarkable foresight with which it does so. Written at the very beginning of the twenty-first century, prior to the consolidation of Big Tech, platform monopolies, global cloud infrastructures, and the full maturation of digital governance, the work identifies a form of sovereignty that operates through dispersed networks, norms, and infrastructures, rather than through classical territorial command alone - to the detriment, as observed in the scope of this research, to the Sovereignty of the Global South. Empire names a regime in which power is exercised continuously and immanently, through regulation, standards, and circulation, anticipating with striking precision the contemporary convergence of monopoly capital, elite coordination, and symbolic authority across borders as a single, systemic mode of rule.

Hardt and Negri's conceptual vocabulary is especially prescient. Their account of deterritorialized sovereignty captures a world in which authority no longer emanates from a single imperial center or territory, but is distributed across corporate actors, international institutions, military alliances, legal regimes, and epistemic authorities. The emphasis on biopower foregrounds the governance of life itself such as communication, knowledge, security, and affect well before platforms, data extraction, and algorithmic mediation became central to political power. Their notion of immaterial labor anticipates economies structured around code, information, and cognitive production, while the idea of an imperial milieu or ether, conceptualized as a pervasive informational and normative environment that conditions action in advance, closely mirrors contemporary forms of software dependency and cognitive alignment. Finally, Empire's focus on smooth space and managed circulation foreshadows a world governed less by conquest than by interoperability, compliance, and infrastructural integration.

That these elements were articulated in 2001, before the rise of social media platforms, cloud monopolies, global digital standards, and platform-mediated warfare and governance, is, if anything, remarkable! Empire provides a foundational framework for understanding how elite power, monopoly capital, and technological infrastructures now converge to produce domination without annexation, making it uniquely suited to grounding the analysis of technological dominance across hardware, software, and cognition. And when articulated with Mosca's organized minority, Michels' oligarchic closure, Pareto's constrained circulation, Bourdieu's reproduction through institutions and symbolic power, and Lenin's internationalization of monopoly and finance capital, Empire clarifies why technological dominance at the center of geopolitical power today: hardware supply chains, software standards, and cognitive alignment operate as the practical channels through which imperial governance is exercised without annexation, and through which Global South defense modernization can be guided into dependence while still speaking the language of sovereignty.

Finally, it is important to mention that Silveira's (2025) conception of sovereignty arrives at closely aligned conclusions through a distinct argumentative route grounded in critical political economy of technology and Latin American debates on digital dependence. Rather than beginning from Elite Theory or from Empire as a macro-structure of global governance, Silveira approaches sovereignty from the standpoint of technological dependency and infrastructural asymmetry, arguing that contemporary power is exercised through control over digital architectures that mediate state capacity, social organization, and knowledge production in the Global South.

Where sovereignty cannot be reduced to formal jurisdiction or legal authority, we understand that sovereignty is in fact the collective capacity of a people to design, govern, and transform technological systems according to their own social, political, and cultural priorities. This definition directly challenges modernization narratives that equate technological adoption with progress, showing instead that the outsourcing of data storage, cloud services, artificial intelligence, and digital platforms to foreign providers systematically erodes autonomy while preserving the appearance of sovereign choice. In this sense, Silveira's work converges with the argument advanced here: **dependence is reproduced not *despite* technological modernization, but *through* it**. Drawing on the idea that technologies embody specific social values and power relations, he argues for plural technological pathways as a condition for sovereignty, rejecting the universalization of Euro-Atlantic and corporate technological models. Technodiversity thus functions as a counter-project to imperial technological homogenization, emphasizing public infrastructures, open technologies, and collective control over data as prerequisites for autonomy in the Global South.

And in this sense, Silveira's (2025) analysis is particularly attentive to the position of the Global South by demonstrating how states peripheral to the centers of technological production are incorporated into global digital systems under conditions of structural lock-in, where interoperability standards, proprietary software, and extraterritorial legal regimes constrain policy space and strategic decision-making.

Sovereignty is hollowed out not by direct coercion, but by infrastructural dependence that redefines what states can realistically govern, secure, or develop. This mirrors the imperial logic identified in the present article, in which domination operates without annexation and through continuous regulation rather than episodic force.

With these conceptualizations out of the way, let us explore how to operationalize the exercise of such power, stabilized, and transformed across contexts. To move from theory to analytical application, it becomes necessary to disaggregate power into its constitutive dimensions without losing sight of its systemic coherence. It is precisely at this juncture that Rael's (2022) multidimensional framework of power offers the methodological bridge required to translate Empire and elite theory into an empirically tractable model, one capable of specifying where, how, through which means, and with what degree of dominance technological power is exercised. The following section therefore introduces Rael's eleven dimensions of power as the analytical instrument through which the three levels of Technological Dominance - Hardware, Software, and Cognition - are examined in a structured and comparative manner.

The eleven dimensions of power as a methodological toolset

Rael's (2022) contribution departs from the premise that power cannot be reduced to a single resource, arena, or causal mechanism. His framework explicitly builds on David Baldwin's (2013 *apud* Rael, 2022) five dimensions of power (scope, domain, weight, costs, and means) as its analytical foundation, treating them as the minimal conditions for any rigorous assessment of power relations. To these core dimensions, Rael adds six further dimensions derived from the broader literature in political theory and international relations, drawing on authors such as Dahl, Bachrach and Baratz, Lukes, Strange, and Barnett and Duvall. The result is a multidimensional, relational, and convertible conception of power, in which outcomes are not determined by isolated variables, but by the configuration and interaction of multiple dimensions operating simultaneously.

The first dimension is (1) **Scope**, which refers to the substantive issue-area in which power is exercised. Building on Robert Dahl's relational conception of power, Rael emphasizes that power is always exercised over something: finance, security, technology, development, norms, or knowledge. No actor possesses power in the abstract; influence is always bounded by the thematic field in question. This allows analysts to distinguish, for instance, between financial power, technological power, and cognitive power, even when exercised by the same actor.

Closely related is the dimension of (2) **Domain**, which concerns the set of actors affected by a given exercise of power. Inspired by Susan Strange's distinction between relational and structural power, Rael treats domain as the reach or audience of power: whether it targets a single state, a coalition, a region, or a global system. Power with a narrow domain differs qualitatively from power that reshapes the behavior of entire classes of actors.

The third dimension, (3) **Weight**, captures the effectiveness of power, namely, the probability that one actor can induce another to act differently than it otherwise would. This dimension draws directly from Dahl's classic formulation and serves as a corrective to purely capability-based approaches. Possessing resources does not guarantee power unless those resources reliably translate into behavioral outcomes.

Rael the fourth dimension as (4) **Costs**, a dimension rooted in rationalist and institutionalist traditions. Power is asymmetrical not only when one actor can impose outcomes, but when the costs of resistance are unevenly distributed. Power is stronger when it is inexpensive to exercise and prohibitively costly to contest, a condition frequently produced through technological dependence and infrastructural lock-in.

The fifth dimension concerns the (5) **Means of Exercise**, encompassing the resources mobilized to influence outcomes. Here Rael adopts an expansive view, incorporating military, economic, institutional, technological, and symbolic means. Influenced by Barnett and Duvall's typology, he stresses that institutions, rules, and technologies are not neutral instruments, but autonomous vectors of power in their own right.

Distinct from means is the (6) **Method of Application**, which refers to how power is exercised. Drawing on debates surrounding hard power, soft power, and smart power, Rael distinguishes between coercion, inducement, attraction, and hybrid strategies. This dimension foregrounds strategy and sequencing rather than resource possession alone.

The following dimension of (7) **Incidence** specifies whether power operates directly or indirectly. Influenced by Lukes' third dimension of power, Rael highlights that some of the most consequential forms of power never appear as explicit commands or conflicts. Indirect power operates through rules, standards, infrastructures, and temporal delay, shaping outcomes by structuring the field of possible action in advance.

Rael then addresses the classic tension between (8) **Agency *versus* Structure**. Drawing on Giddens and structural power debates in international political economy, he argues that power may be exercised intentionally by actors or embedded impersonally in systems that constrain behavior regardless of intent. Structural power, in this sense, governs by shaping incentives, identities, and horizons of action.

The ninth dimension, (9) **Degree of Dominance**, concerns the quality of the power relation itself. Influenced by feminist and critical traditions, Rael differentiates between "power over," "power with," and "power to," allowing domination, coordination, and capacity-building to be analytically distinguished rather than conflated.

Rael also introduces a (10) **Geographic or Spatial Dimension**, acknowledging that power varies according to the space in which it is exercised. Drawing on geopolitical and strategic studies, this dimension encompasses land, sea, air, space, and implicitly but crucially, digital and cyber domains. Spatial architecture conditions how power travels, who controls access, and where resistance is possible.

Finally, Rael emphasizes the (11) **Degree of Transition**, or the temporal stability of power relations. Influenced by power transition theory, this dimension captures whether power configurations are consolidating, eroding, or being contested. It allows analysts to distinguish between stable dominance and moments of structural flux.

Underlying all eleven dimensions is the assumption that Rael makes explicit: **power is fungible**. Economic power can be converted into institutional authority, technological control into symbolic legitimacy, financial leverage into geopolitical influence. This insight aligns his framework with Bourdieu's theory of capital conversion and makes it particularly suitable for analyzing technological dominance as a stacked system rather than a single-variable phenomenon.

The fungibility of power is especially consequential for Elite Theory because it addresses one of its long-standing analytical limits: the tendency to describe elite dominance as organizationally stable without fully specifying the mechanisms through which elites adapt to structural change. If power is fungible, elite persistence cannot be explained solely by position, circulation, or closure; it must also be explained by elites' capacity to translate advantages accumulated in one domain into leverage in others. Rael's framework makes this process explicit, showing how elites do not merely occupy institutions, but actively recompose their dominance by converting economic resources into regulatory authority, technological control into epistemic legitimacy, and infrastructural power into geopolitical influence.

This also resolves a classic tension between sociological permanence and historical transformation. Rather than treating elite rule as either transhistorical (Pareto, 1935) *or* institutionally reproduced (Mosca, 1989, Michels, 2001), fungibility allows elite dominance to be understood as adaptive and recombinatory. Elites endure not because they remain identical over time, but because they continuously realign their power across domains as the locus of control shift. In the contemporary context, where technological infrastructures mediate economic production, security governance, and social cognition, this capacity for conversion becomes decisive.

This also facilitates the harmonization with Marxist theory. By foregrounding conversion rather than static ownership, fungibility bridges the gap between class-based accounts of domination and elite-centered analyses of organization and control. Marxist theory identifies the structural tendency toward concentration, monopoly, and imperial expansion, but some marxists might treat the translation of economic power into political, institutional, and cognitive authority as derivative or secondary. Rael's framework clarifies this translation as an active process: monopoly capital does not automatically govern, but becomes dominant through its conversion into rules, standards, infrastructures, and expert regimes that stabilize accumulation beyond the market.

In this sense, fungibility specifies how monopoly capital becomes imperial power. Economic concentration is converted into technological dependence; technological dependence into institutional lock-in; institutional lock-in into cognitive alignment; and cognitive alignment into the normalization of hierarchy as necessity. This process is coordinated, managed, and reproduced by elites operating across domains, precisely as Elite Theory predicts. Rael thus supplies the missing link between Lenin's account of Imperialism as the internationalization of monopoly capital and Hardt and Negri's description of Empire as a deterritorialized system of governance: fungibility explains the mechanisms through which capital, elites, and infrastructures are synchronized into a continuous architecture of domination.

For the purposes of this article, Rael's insight is decisive. It allows technological dominance to be analyzed not as an external shock to elite rule, nor as a novel domain detached from political economy, but as a privileged site of power conversion under contemporary imperial conditions. Hardware, Software, and Cognition are thus reservoirs of convertible power through which elites adapt to shifting geopolitical, economic, and security environments while preserving structural asymmetry. In operationalizing Rael's dimensions, the following section therefore treats technological dominance as a dynamic process of elite recomposition, one that sustains Empire not through annexation or overt coercion, but through the continuous conversion of power across digitally mediated domains.

THE SYSTEM OF DOMINANCE: CABLES, CODES AND COGNITIVE CONTROL

The Empire, as conceptualized by Hardt and Negri (2001) emerges from a rearrangement of Imperial power which involves the resolution, suspension, or containment of inter-imperial rivalry as the violent clashes between imperial powers that Lenin (2012) saw as intrinsic to monopoly capitalism give way to a system in which leading states and corporate actors recognize a mutual interest in stabilizing accumulation through corporately coordinated rule. Direct military conflict remains possible, of course, but it is not yet the primary mechanism of expansion[VI], so dominance is secured in the Global South nations through regulation, integration, and infrastructural control.

From the perspective of Elite Theory, this transformation does not diminish the role of ruling minorities, but reconfigures the arenas in which they operate. The organized minorities identified by Mosca (1989) and Michels (2001) migrate upward, embedding themselves within transnational institutions, corporate networks, security alliances, and standard-setting bodies that coordinate accumulation and governance beyond the nation-state. Pareto's (1935) circulation of elites continues under these conditions, but increasingly as rotation within an integrated imperial stratum rather than as renewal driven by mass incorporation.

In this way, Empire can be read as the political form assumed by imperialism as it attains global integration, making permanent rivalry among great powers dysfunctional to the accumulation itself. And, it is under these conditions that elite coordination and monopoly capital converge beyond national borders, producing a form of domination that operates through networks, norms, and infrastructures rather than through **direct** colonial administration. Imperial power, in this sense, is exercised less through episodic coercion and more through permanent regulation, standardization, and the management of social, economic, and political life at a global scale.

[VI] Under contemporary imperial conditions, direct inter-imperial war seems to be displaced by proxy wars, hybrid conflicts, and managed escalation, in which violence is outsourced, geographically displaced, or mediated through client states and non-state actors. Such conflicts allow rivalry to persist without disrupting the overarching coordination of monopoly capital and elite interests that stabilize accumulation at the systemic level.

From the standpoint of the Global South, this transformation acquires concrete and asymmetric effects. As Silveira (2025) argues, sovereignty under contemporary technological conditions is not defined by formal jurisdiction or diplomatic recognition, but by the capacity to govern technological infrastructures, data flows, and knowledge systems that increasingly mediate state action and social life. Therefore, Global South states are integrated into imperial systems of rule not through annexation or direct coercion, but through dependency on external technological stacks (cloud infrastructures, proprietary software, data centers, standards, and algorithmic systems) over which they exercise very little control. And so, this form of subordination preserves the language and symbols of sovereignty while hollowing out its material and cognitive substance, particularly in strategic domains such as defense, security, and public administration.

In this context, defense modernization in the Global South often unfolds within parameters defined *elsewhere*. The acquisition of advanced hardware, the adoption of foreign software ecosystems, and the internalization of external doctrines and expert frameworks are presented as technical necessities or markers of progress, while they deepen structural dependence instead of enhancing strategic autonomy.

The logic of this mapping rests on the recognition that technological dominance operates through a stacked configuration of power in which different layers activate distinct dimensions of control while remaining mutually reinforcing. At the **hardware level**, power is materially fixed: the adoption of weapons systems, physical infrastructure, semiconductors, or industrial platforms concentrates costs, weight, and geographic reach, rendering dependence tangible, capital-intensive, and slow to reverse. This is where monopoly capital anchors domination in durable form, transforming strategic choice into long-term constraint.

Software, by contrast, functions as the infrastructural mediator of power. Through interoperability requirements, standards, updates, compliance regimes, and proprietary ecosystems, software activates dimensions such as incidence, domain, agency versus structure, and mode of application, allowing power to be exercised indirectly and continuously, without overt command. This is the preferred layer of Empire: governance through protocols rather than orders.

Cognition completes the stack by legitimizing and reproducing domination over time. Through doctrines, expert knowledge, professional norms, and strategic imaginaries, the cognitive layer consolidates degree of dominance, scope, and transience, defining what is thinkable, legitimate, and "realistic" for decision-makers.

Crucially, what Rael conceptualizes as fungibility connects these layers into a single system: **hardware dependence generates software lock-in; software lock-in produces cognitive alignment; and cognitive alignment, in turn, normalizes further rounds of hardware and software dependence**. The system is therefore not linear but recursive and cumulative.

Methodologically, this mapping demonstrates that technological dominance is not a mere capability gap, but a configuration of power managed through elite coordination across layers. It clarifies how Empire governs less through force than through the structuring of costs, standards, and cognition, and why defense modernization efforts in the Global South often fail: by strengthening one layer while deepening dependence in the others, modernization reproduces imperial power rather than dismantling it.

This framework allows us to demonstrate that contemporary defense modernization efforts in the Global South frequently undermine, rather than reinforce, national defense architectures: hardware acquisition increases dependency costs, software adoption produces institutional and operational lock-in, and cognitive alignment narrows strategic imagination and doctrinal autonomy. Through Rael's dimensions, technological dominance is mapped as a structured configuration of power that stabilizes Empire while constraining the strategic autonomy of so-called peripheral states.

Before turning to the empirical and analytical unpacking of technological dominance, **Table 1** bridges the function between theory and application by translating Rael's eleven dimensions of power into a layered analytical matrix, explicitly mapping how each dimension operates across Hardware, Software, and Cognition. The subsections that follow therefore do not merely describe three technical domains; they unpack a single system of dominance from its material fixation (Hardware), through its infrastructural mediation (Software), to its cognitive naturalization (Cognition), demonstrating how power circulates, stabilizes, and reproduces itself under imperial conditions.

Table 1 – The Dimensions of Power and their Layers

Dimension of Power	Layer	Operationalization in practice
Scope	Hardware, Software and Cognition	Defines which issue-area is governed: defense procurement (hardware), cybersecurity and/or interoperability (software), doctrine and strategy (cognition).
Domain	Software and Cognition	Determines who is affected: ministries, armed forces, allies, suppliers, epistemic communities; often expanded via platforms and standards.
Weight	Hardware and Software	Probability of compliance rises when systems are mission-critical: weapons systems, operating systems, cloud services.
Costs	Hardware and Software	Exit costs from platforms, spare parts, licenses, updates, training. Resistance becomes prohibitively expensive.
Means	Hardware, Software and Cognition	Material assets (hardware), code and protocols (software), expertise and legitimacy (cognition).
Mode of Application	Software and Cognition	Power exercised through inducement, standardization, "best practices", and expert consensus rather than coercion.
Incidence	Software	Indirect power via infrastructures, standards, and protocols that shape action without explicit commands.
Agency *versus* Structure	Software and Cognition	Power embedded in systems (clouds, standards, doctrines) rather than deliberate acts - rule without ruler.
Degree of Dominance	Cognition	From "power over" (doctrinal dependence) to "power with" (alliances) to "power to" (conditional autonomy).
Geographic Reach	Hardware and Software	Physical location of data centers, supply chains, satellite coverage, cloud jurisdictions.
Degree of Transience	Hardware, Software and Cognition	Hardware lock-in is long-term, software dependence medium-term, cognition often the most durable.

Source: Author (2026)

Hardware

Within the proposed framework, hardware constitutes the material foundation of technological dominance and the point at which power becomes **physically** embedded in defense architectures. Hardware refers not simply to weapons platforms, but to the broader industrial and infrastructural base that sustains them: production chains, specialized components, maintenance ecosystems, energy inputs, logistics networks, and the physical location of critical assets. At this level, power operates through material fixation: once adopted, hardware systems impose durable constraints on strategic choice due to their capital intensity, long life cycles, and technical specificity.

Hardware primarily activates **Costs**, **Weight**, and **Geographic Reach**. The acquisition of advanced defense systems entails high sunk costs and long-term contractual obligations that make exit prohibitively expensive as maintenance, spare parts, upgrades, and training are often controlled by the original supplier, transforming procurement into sustained dependence. As a result, the probability of compliance increases through structural necessity: alternatives become economically or operationally unviable. Geographic reach further reinforces this asymmetry, as supply chains, data centers, satellite coverage, and production facilities are spatially concentrated in a small number of states and corporations, placing peripheral actors at a structural disadvantage.

Hardware dominance is also where monopoly capital most visibly anchors itself. High barriers to entry such as capital requirements, technological complexity, and regulatory certification limit production to a narrow set of firms embedded in core economies. This concentration allows elites to stabilize power materially, ensuring that even formally sovereign states remain dependent on external industrial ecosystems for core defense functions. Importantly, this dependence is rarely framed as political subordination, instead, it is presented instead as technical necessity, interoperability, or modernization.

Hardware dominance is also the site where monopoly capital most clearly materializes. Marx's analysis of the concentration and centralization of capital (2023) already explained why defense-industrial production tends toward oligopoly: escalating capital requirements, technological complexity, and the scale of fixed investments progressively eliminate smaller producers, leaving control over the means of production in the hands of a few firms; this dynamic is further intensified by the control over geographically specific strategic resources such as Rare Earth elements (lithium, niobium, and other critical minerals) whose extraction requires capital-intensive mining operations, environmentally destructive processes, and long-term regulatory capture that only large conglomerates can sustain. Lenin's (2012) account of imperialism extends this logic outward, showing how monopoly capital acquires a geopolitical function by reorganizing production, supply, and dependency across borders; in contemporary conditions, this includes not only industrial manufacturing but also energy matrices (oil, gas, nuclear fuel, and renewable infrastructure) and space-based assets such as satellites, launch vehicles, and orbital services.

In the defense sector, this translates into industrial ecosystems concentrated in core economies, whose products and standards structure the strategic possibilities of peripheral states; even when peripheral countries possess strategic assets, their integration into global supply chains often occurs under asymmetrical terms that externalize value and internalize dependency.

Elite Theory clarifies how this material concentration is organized and stabilized. The barriers that restrict entry into defense production also restrict participation in decision-making, reinforcing the dominance of organized minorities capable of coordinating capital, expertise, and state authority. As Mosca (1989) would anticipate, control persists not merely because of ownership, but because elites occupy strategically positioned nodes across industry, government, and regulatory bodies. This is evident in sectors such as mining concessions, energy licensing, satellite procurement, and space governance, where technical expertise and regulatory complexity concentrate authority in a narrow transnational stratum. As Michels' (2001) logic of oligarchic closure unfolds, these arrangements reproduce themselves over time, with technical specialization and bureaucratic complexity insulating defense-industrial governance from democratic contestation; the governance of launch infrastructure and orbital access exemplifies this closure. Brazil's strategic launch sites, for example, such as Alcântara and the Barreira do Inferno[VII], also highlight how even territorial advantages can be subsumed into imperial technological regimes when control over launch services, payload integration, and satellite systems remains externalized.

Pareto's (1935) circulation of elites remains operative at this level, though in a constrained form: rotation occurs within a closed transnational stratum of industrial, military, and political elites rather than through substantive renewal from below. Bourdieu's (1984) contribution helps explain why this domination is rarely perceived as such. Economic capital concentrated in defense hardware is converted into symbolic authority (expertise, credibility, and legitimacy) through state institutions, professional military doctrines, and technical certification processes; the mastery of complex domains such as rare-earth processing, nuclear energy, satellite command, and space launch operations becomes a marker of "seriousness" and "modernity" in defense planning.

As a result, material dependence is reframed as modernization, interoperability, or efficiency, while the geopolitical costs of resource extraction, energy dependence, and space infrastructure asymmetries are rendered invisible, masking relations of subordination behind the language of technical rationality.

For Global South defense architectures, hardware dependence often marks the initial point of integration into imperial systems of rule. While acquisition may increase short-term capabilities, it simultaneously narrows long-term autonomy by locking armed forces into externally governed technological trajectories. Hardware

[VII] Alcântara and the Barreira do Inferno occupy a uniquely strategic position in the global space and defense architecture due to their geographic, energetic, and technological advantages. Alcântara, located just over two degrees south of the Equator, allows launches to exploit the Earth's rotational velocity, reducing fuel consumption by up to 30% compared to higher-latitude sites and significantly lowering launch costs while increasing payload capacity. This makes it one of the most efficient launch sites in the world for equatorial and geostationary orbits, which are critical for military communications, surveillance, navigation, and meteorological satellites. The Barreira do Inferno Launch Center, in turn, has long functioned as Brazil's primary hub for suborbital launches, tracking, and atmospheric and missile research, anchoring national capabilities in telemetry, guidance, and aerospace experimentation.

thus establishes the material preconditions for dominance: it fixes power spatially and temporally, setting the stage for software-mediated control and cognitive alignment to follow.

Software

If hardware fixes power materially, software mediates power infrastructurally. Software refers here to the broader ecosystem of operating systems, digital platforms, cloud services, command-and-control software, cybersecurity architectures, data standards, interoperability protocols, and licensing regimes that govern how hardware functions and how institutions operate. At this level, power becomes less visible and more continuous, exercised not through ownership of objects but through control over rules, interfaces, and operational logics.

Through Rael's dimensions, software primarily activates **Incidence**, **Agency *versus* Structure**, **Domain**, and **Mode of Application**. Power at this layer is predominantly indirect: it does not require explicit commands or coercive acts, but works by shaping the field of possible action in advance. Interoperability requirements, update cycles, proprietary formats, and compliance standards define what systems can communicate, which upgrades are permissible, and which operational practices are considered viable. Each term here names a distinct mechanism through which software converts technical design into governance, quietly fixing power relations without issuing orders.

Interoperability requirements refer to the technical conditions that determine whether systems are allowed to communicate with one another. In defense and security environments, this usually means that platforms, databases, sensors, or command-and-control systems must conform to specific protocols, interfaces, or data models to speak to allied or vendor-approved systems. What appears as coordination or compatibility is in practice a filter: systems that do not comply are rendered unusable, excluded, or operationally inferior. Interoperability thus governs inclusion and exclusion in advance, deciding who can participate in a security ecosystem and on what terms.

Update cycles describe the rhythm through which software is maintained, patched, upgraded, or deprecated, and these cycles are typically controlled by the vendor, not the user. In defense contexts, updates may be mandatory for security certification, functionality, or continued support. This creates temporal dependence: operational continuity becomes contingent on accepting external timelines, technical priorities, and design choices. States may formally own the hardware, yet their systems remain functionally governed by external decisions embedded in update schedules.

Proprietary formats are closed technical standards for data storage, communication, or system configuration that are owned and controlled by a firm or consortium. When information, logs, or operational data are produced in proprietary formats, switching providers becomes costly or infeasible without loss of functionality or institutional memory. Proprietary formats therefore produce lock-in by design: even when alternatives exist in principle, migration becomes economically, technically, and organizationally prohibitive.

Compliance standards refer to formalized technical, legal, and procedural requirements that systems must meet in order to be certified, funded, insured, or deemed "secure". These may include cybersecurity frameworks, data protection regimes, operational doctrines, or alliance-based standards. While often framed as neutral best practices, compliance standards embed specific threat models, legal assumptions, and strategic priorities. Adhering to them reshapes institutions internally, aligning workflows, doctrines, and risk perceptions with the standards' originating centers.

As a result, governance is embedded in infrastructure itself, producing outcomes without the need for constant intervention. Taken together, these mechanisms explain why power at the software layer is indirect and structural. No command is issued, no sovereignty is formally violated, yet the space of possible action is pre-structured. Decisions are made upstream, in code, standards committees, licensing terms, and update policies, and downstream actors merely operate within the confines already set, making Software function, in truth, as governance by ruling not the instruction, but the very architecture.

Software dominance also radically expands the **Domain** of power. Whereas hardware dependence may be confined to specific platforms or units, software ecosystems permeate entire institutions like ministries of defense, intelligence agencies, logistics systems, and even civilian administrative structures. Once embedded, these systems reorganize workflows, reporting chains, and decision-making processes, extending control across organizational boundaries. In this sense, software functions as a multiplier of elite coordination, allowing relatively small groups of corporate and institutional actors to influence large and complex bureaucracies.

And so, from the standpoint of **Agency *versus* Structure** as well as **Mode of Application**, software exemplifies structural power in its purest form. Control is exercised not necessarily by identifiable decision-makers, but by systems that encode assumptions, priorities, and constraints into their design. Legal regimes governing intellectual property, data sovereignty, and extraterritorial access such as licensing agreements and cloud jurisdiction laws, further entrench this structural asymmetry. What appears as technical dependence is, in practice, a durable redistribution of authority away from national institutions and toward transnational corporate and regulatory elites.

For Global South defense architectures, software dependence often represents the critical hinge between material acquisition and cognitive alignment. While hardware locks in physical dependence, software governs daily operations, doctrine implementation, and strategic planning tools, defense modernization programs that adopt foreign software stacks frequently inherit not only technical solutions but also embedded assumptions about threat perception, operational *tempo*, and acceptable forms of coordination. Software thus prepares the ground for cognitive dominance, translating infrastructural dependence into normalized ways of thinking, planning, and deciding.

In this sense, Software is the preferred layer of Empire. It allows domination to be exercised without annexation, coercion, or overt political pressure, operating instead through standards, protocols, and “best practices” that appear neutral, technical, and unavoidable. By mediating between hardware and cognition, software transforms technological modernization into a mechanism of continuous governance, reinforcing imperial power while preserving the appearance of sovereign choice. Articulated through the lenses of Elite Theory, software dominance reveals how contemporary ruling minorities exercise power by coordinating control over infrastructures rather than over populations directly.

The organized minorities identified by Mosca (1989) and Michels (2001) operate through transnational coalitions of corporate executives, defense contractors, standards bodies, cybersecurity firms, and regulatory agencies that define the technical environments within which states must function. These coalitions exert power not by issuing commands, but by shaping interoperability requirements, determining which systems are allowed to communicate, under what protocols, and within which alliance or vendor-approved ecosystems. Software ecosystems thus become privileged sites of elite coordination, where decisions made by relatively small groups acquire systemic effects across entire defense and security institutions.

From this perspective, Michels' Iron Law of Oligarchy manifests not only within organizations, but within technical systems themselves. Software architectures centralize decision-making through proprietary formats, update authorities, and certification thresholds that restrict meaningful participation to credentialed insiders, concentrating expertise and insulating key choices from democratic oversight under the guise of technical complexity. Pareto's (1935) circulation of elites continues at this level as well, but as rotation within closed epistemic and professional communities (systems architects, cybersecurity experts, platform engineers) whose authority is anchored in control over standards, formats, and compliance regimes rather than political mandate. Bourdieu's (1984) logic of capital conversion further explains how technical control is translated into symbolic legitimacy: mastery over software infrastructures, compliance frameworks, and interoperability doctrines becomes a marker of professionalism, modernity, and strategic credibility.

The Marxist perspective is also, here, not to be ignored, especially within the scope of international security and defense architecture arrangements, as the global organization of monopoly and finance capital (Lenin, 2012) explains why software dominance assumes such strategic importance under contemporary conditions. Just as industrial monopolies structured earlier phases of imperial expansion, digital and software monopolies now organize control over the operational core of defense systems through proprietary platforms, closed standards, and vendor-controlled update cycles. Communications, intelligence, logistics, and command-and-control increasingly depend on software ecosystems whose production is concentrated in a small number of firms embedded in core economies, reflecting the same logic of monopoly Lenin identified, albeit translated into informational and infrastructural terms.

In this context, software functions as a mechanism for the export of capital and control without territorial occupation. Interoperability requirements condition inclusion, update cycles impose external temporal discipline, proprietary formats generate lock-in, and compliance standards embed foreign legal, doctrinal, and operational assumptions into domestic institutions. Licensing regimes, proprietary standards, data governance rules, and continuous update cycles bind peripheral states to the technological and regulatory ecosystems of dominant powers, reproducing dependency through everyday operational practices, as is the case of Brazil[VIII] (Silva et al., 2025a). What appears as technical cooperation or interoperability is, in fact, the internationalization of monopoly control through infrastructure itself, governing how security is produced, maintained, and imagined.

This all is to say that software dominance represents the contemporary form of imperial integration. It fuses elite coordination, monopoly capital, and technological

[VIII] The dynamics described here are empirically documented in “*Contratos, Códigos e Controle: A Influência das Big Techs no Estado Brasileiro*”, a large-scale study of public procurement in information and communication technologies conducted between 2014 and 2025. Based on systematic analysis of PNCP, ComprasNet/Contratos.gov.br, Painel de Preços (Serviços e Materiais), and standardized TIC catalogs, the study demonstrates how Brazilian public institutions across federal, state, and municipal levels have become structurally dependent on proprietary software, cloud services, and cybersecurity solutions supplied by a small group of foreign corporations. The findings show that licensing regimes, recurring contracts, interoperability requirements, and opaque intermediary arrangements convert software adoption into long-term institutional lock-in, reallocating operational control, data jurisdiction, and strategic discretion away from the State and toward transnational corporate ecosystems. What is framed administratively as efficiency, modernization, or digital transformation is shown to function, in practice, as a mechanism of infrastructural subordination and fiscal transfer, with direct implications for sovereignty, defense capacity, and policy autonomy (Silva et al, 2025b) infrastructure into a single mode of governance, ensuring that defense modernization in the Global South proceeds along paths compatible with imperial accumulation and strategic interests. By embedding dependency in code, standards, update authorities, and compliance regimes, software completes the transition from overt imperial rivalry to managed hierarchy, confirming Lenin's (2012) diagnosis while demonstrating its transformation under the conditions of Empire.

Cognition

If hardware anchors domination materially and software stabilizes it infrastructurally, cognition is the layer through which domination becomes durable, legitimate, and self-reproducing. Cognition concerns the production of meaning, expertise, doctrine, and strategic imagination. It defines what is perceived as rational, modern, responsible, or inevitable within defense and security policy. At this level, power no longer operates primarily through coercion or technical constraint, but through the governance of perception, belief, and interpretive frames.

Contemporary Cognitive Warfare is not an external disruption of liberal orders, nor a novelty imported from non-Western actors, but the institutional maturation of a long-standing Western strategic tradition rooted in Psychological Operations and hegemonic governance (Rocha and Dashichev, 2025). From Linebarger's mid-twentieth-century codification of PsyOps to their algorithmic reconfiguration under Big Tech infrastructures, cognition emerges as a permanent battlespace in which state power, corporate platforms, and elite alignment converge to shape attention, emotion, and belief on a planetary scale.

Within the framework of Elite Theory, cognition is the domain where oligarchic closure is most effectively insulated from contestation. Michels' (2001) Iron Law operates here not through formal organizational hierarchy, but through epistemic monopolization: access to authoritative knowledge, strategic vocabularies, and legitimate problem definitions is concentrated within credentialed communities of experts, military intellectuals, think tanks, and platform-aligned professionals. Pareto's (1935) circulation of elites persists, yet increasingly as rotation within closed epistemic strata, where renewal is confined to actors already socialized into dominant doctrinal and cognitive frameworks. Finally, Bourdieu's (1984) logic of symbolic power is decisive at this level: control over the categories of perception and evaluation allows elites to convert material and infrastructural dominance into legitimacy, professionalism, and moral authority.

Empire, as conceptualized by Hardt and Negri (2001), provides the structural condition under which cognitive domination becomes systemic rather than episodic. Under Empire, sovereignty is exercised through biopolitical means: the management of life, communication, affect, and knowledge rather than through territorial occupation. Cognitive alignment thus functions as a mechanism of governance without annexation. Through doctrines of interoperability, narratives of modernization, and moralized discourses of "rules-based order", Global South actors are induced to internalize imperial priorities as technical common sense rather than external imposition.

This cognitive layer is materially supported by digital infrastructures controlled by a small number of Western corporate-state nexuses through contemporary Meta-Trumpismo: the fusion of state strategic objectives with Big Tech's algorithmic architectures (Rocha and Dashichev, 2025). Algorithms, moderation systems, and data-driven amplification mechanisms do not merely transmit discourse, but structure pseudo-environments in which certain narratives become omnipresent, emotionally saturated, and, most importantly, resistant to challenge. In such environments, dissenting strategic imaginaries are not suppressed by force, but rendered invisible, irrational, or irresponsible.

For the Global South, the consequences are profound. Cognitive dependence narrows the horizon of strategic possibility, shaping defense modernization as a process of alignment rather than autonomous capacity-building. Foreign doctrines, threat perceptions, and operational concepts are adopted not because they are universally optimal, but because they are embedded within the dominant epistemic infrastructure of Empire. As a result, sovereignty is preserved formally while being eroded substantively: states retain institutions and symbols, yet their strategic imagination is disciplined by external cognitive regimes.

In this sense, cognition is the layer where technological dominance completes its cycle. **Hardware dependence imposes costs, software dependence locks in procedures, and cognitive alignment ensures consent**. The dominance of Empire is thus secured not only through monopolized infrastructure or elite coordination, but through the internalization of imperial rationalities as neutral expertise.

CONCLUSION: THE THREE LEVELS OF TECHNOLOGICAL DOMINANCE

In this article I propose a framework to analyze technological dominance in defense as a stacked architecture of power operating across Hardware, Software, and Cognition. It harmonizes Classical Elite Theory and Marxist political economy through Hardt and Negri's concept of Empire (2001), arguing that contemporary sovereignty is increasingly governed through deterritorialized infrastructures, norms, and elite coordination rather than territorial annexation. After reviewing both canonical and contemporary debates, from monopolization and imperial integration (Marx, 2023, Lenin, 2012) to platform power and data colonialism (Srnicek, 2016, Varoufakis, 2024, Morozov, 2022, Zuboff, 2019, Couldry and Mejias, 2019), I introduced Rael's eleven dimensions of power as the methodological instrument that disaggregates power without fragmenting it.

My central claim is that technological dominance is not a neutral capability gap but a convertible configuration of power. Hardware fixes dependence materially through costs and supply chains, software mediates governance through standards, interoperability, and structural constraint, and cognition secures durability by shaping doctrine, legitimacy, and strategic imagination. Together, these three levels describe technological dominance not as a linear hierarchy, but as a stacked and recursive system in which material fixation, infrastructural mediation, and symbolic legitimation reinforce one another under contemporary imperial conditions.

In formal terms, the three levels of Technological Dominance can be defined as distinct yet fungible and interdependent modalities of power.

Hardware dominance refers to control over the material and industrial conditions of capability reproduction, encompassing weapons platforms, production chains, maintenance ecosystems, energy and logistics inputs, and the spatial concentration of critical infrastructure. At this level, power is fixed materially through high costs, long life cycles, and limited substitutability, transforming procurement into durable dependence.

Software dominance designates control over the operational and institutional mediation of technology, including code, standards, interoperability protocols, licensing regimes, cloud infrastructures, and data governance frameworks that govern how hardware functions and how organizations operate. Here, power is exercised indirectly and continuously by structuring procedures, permissions, and constraints rather than issuing commands.

Cognitive dominance, finally, concerns control over meaning, legitimacy, and strategic imagination: the production of doctrines, expert knowledge, professional norms, and threat perceptions that define what is rational, modern, and feasible in defense governance. This level secures the durability of domination by internalizing dependence as common sense and transforming constraint into consent.

My main theoretical contribution is the formal definition of these three levels, as well as the demonstration that western-centric defense modernization efforts in the Global South undermine, rather than reinforce strategic autonomy because modernization conducted inside imperial infrastructures translates adoption into lock-in, and lock-in into alignment, while sovereignty remains largely symbolic. In this sense, Silveira (2025) situates this argument firmly within the lived political economy of the Global South, demonstrating how Empire materializes in everyday administrative, scientific, and security practices. His work strengthens the claim that without confronting technological dependence as a question of sovereignty, and without addressing its cognitive and infrastructural dimensions, efforts at development and defense modernization reproduce the very hierarchies they seek to overcome.

Methodologically, the framework's payoff is precision. Rael's (2022) dimensions allow technological dominance to be specified as a configuration of costs, incidence, structural constraint, and durability distributed across layers, rather than treated as a single capability gap. Under conditions of Empire, power becomes most effective when it is inexpensive to exercise yet prohibitively costly to contest: hardware produces sunk costs and long cycles, software embeds dependence in standards, licensing, and interoperability, cognition converts these constraints into legitimacy by defining what is "professional," "modern", and "realistic". The result is a predictable conversion sequence: **procurement into lock-in, lock-in into doctrinal alignment through which modernization can expand nominal capability while narrowing strategic choice**. This is why the problem is not modernization *per se*, but modernization conducted inside imperial infrastructures that pre-structure the horizon of autonomy.

This framework also allows Global South policymakers and military authorities to audit their own Defense Systems beyond surface indicators of capability or modernization. An audit grounded in the three levels of technological dominance asks not whether new assets have been acquired, but where control resides after acquisition. In example:

If hardware procurement increases reliance on external maintenance, upgrades, spare parts, or supply chains, material dependence is intensified rather than reduced;

If software ecosystems are adopted without sovereignty over standards, source code, data jurisdiction, or update cycles, interoperability ceases to be cooperation and becomes structural submission;

If doctrine, training, and strategic education are outsourced to external institutions or standardized through foreign epistemic regimes, cognition is aligned in advance, narrowing strategic imagination before decisions are even made.

Such an audit would reveal if modernization succeeds or fails not at the moment of purchase, but in the distribution of authority across hardware, software, and cognition, and in whether technological integration expands or constrains the capacity for autonomous decision-making.

From this perspective, non-imperial defense modernization cannot be defined by technological sophistication alone, but by the conditions under which autonomy is preserved across hardware, software, and cognition.

At the material (Hardware) level, this implies procurement strategies designed for substitutability rather than exclusivity: diversified suppliers, domestic repair and retrofit capacity, strategic stockpiles, and lifecycle control that prevents capability from becoming irreversible dependence. At the infrastructural (Software) level, autonomy requires sovereignty over software environments through public or nationally governed cloud infrastructure, open and contestable standards, escrow or source-code access, and cybersecurity baselines defined internally rather than imported as compliance packages. At the Cognitive level, non-imperial modernization depends on doctrinal pluralism: locally rooted war colleges, autonomous epistemic communities, and strategic cultures that are not benchmarked against Euro-Atlantic models as the default horizon of rationality. These are not policy prescriptions, but conditions of autonomy. Without them, modernization functions as integration into imperial systems of rule; with them, technological development becomes a means of expanding, rather than contracting, sovereign capacity.

What follows from this framework is a proper research agenda. If technological dominance operates as a stacked and convertible system of power, then it demands methods capable of tracing conversion, lock-in, and alignment across layers rather than isolating artifacts or sectors.

Future work should therefore proceed comparatively, examining how different Global South states (such as Brazil, India, South Africa, and Indonesia) experience distinct trajectories of hardware acquisition, software integration, and cognitive alignment under similar imperial constraints. Process-tracing can reconstruct how procurement decisions cascade into software dependence and, ultimately, doctrinal adoption, while network analysis can map the elite circuits linking standards bodies, defense contractors, training institutions, and epistemic communities. Empirically, this requires developing indicators for each layer (exit costs, licensing and update dependence, data jurisdiction, doctrinal citation networks, training flows) to render dominance measurable rather than impressionistic. Finally, particular analytical attention should be paid to moments of rupture (sanctions, wars, supply shocks, or technological bans) when imperial smoothness breaks down and alternative pathways briefly become visible. These moments would expose the architecture of dependence with rare clarity, making them decisive sites for both analysis and contestation.

Technological dominance, as argued here, is the contemporary grammar of power itself. Hardware binds states materially, software governs them infrastructurally, and cognition disciplines them in advance until dependence is no longer experienced as domination, but as realism. Empire endures not because sovereignty has vanished, but because it has been hollowed out and re-scripted through standards, expertise, and elite coordination that operate beyond state reach.

For the Global South, the central question is therefore not whether to modernize, but how and under whose architecture modernization unfolds. Without confronting technological dependence as a political problem, one that spans industry, code, and consciousness, defense modernization will continue to reproduce foreign hierarchies and, most gravely, undermine national security. Strategic autonomy, in this sense, is no longer secured at the level of flags or procurement lists, but at the level of infrastructures, epistemic authority, and the capacity to refuse alignment disguised as necessity.

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Autoria

1 Isabela Wagnerovna Rocha-Dashicheva

Master in Political Science at the University of Brasília; Doctoral candidate in Political Science

https://orcid.org/0000-0001-8488-5528 • isabelarocha.contato@gmail.com

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