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INSOURCING TO RESPOND: MAKE-OR-BUY DECISIONS IN MILITARY LOGISTICS AND DISASTER RELIEF CAPACITY IN THE 2024 RIO GRANDE DO SUL FLOODS

INTERNALIZAÇÃO COMO RESPOSTA: DECISÕES DE PRODUZIR OU COMPRAR NA LOGÍSTICA MILITAR E NA CAPACIDADE DE ASSISTÊNCIA EM DESASTRES DURANTE AS ENCHENTES DE 2024 NO RIO GRANDE DO SUL

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Leandro Fernandes da Silva Roman[1]

ABSTRACT

Purpose — This paper examines how a make-or-buy decision taken in the preparedness phase — the insourcing of maintenance for the ground-vehicle fleet of Brazil's National Air Mail System (SISCAN) — affected logistics availability and cost and, ultimately, the capacity of the Brazilian Air Force to respond to the 2024 Rio Grande do Sul floods.

Design/methodology/approach — A longitudinal single-case study draws on 48 months of availability and cost records (2021–2024) from the Brazilian Air Force integrated logistics information system, comparing an outsourced regime (2021–2022) with an insourced regime (2023–2024) through goal-conformance and correlation analyses, interpreted through the resource-based view and service viability theory.

Findings — Mean logistics availability rose from 62.4% to 81.1% after insourcing, while unit cost increased by roughly 5% in real terms. Daily conformance with the 70% availability target more than doubled, and the cost–availability association dissipated as performance plateaued. The insourced fleet subsequently sustained the largest logistics operation conducted by the Brazilian Air Force since the Second World War.

Research limitations/implications — The evidence comes from a single, non-experimental case; alternative explanations for the observed gains are examined.

Practical implications — The study offers selective-insourcing criteria for state organisations with dual defence–humanitarian mandates.

Originality/value — It connects sourcing governance in military logistics to humanitarian preparedness using rare longitudinal indicator data from an operational military fleet employed in disaster relief.

Keywords: Humanitarian logistics; Military logistics; Insourcing; Outsourcing; Disaster response; Resource-based view; Logistics availability; Brazil.

RESUMO

Objetivo — Este artigo examina como uma decisão de "fazer ou comprar" tomada na fase de preparação — a internalização da manutenção da frota de veículos terrestres do Sistema de Correio Aéreo Nacional (SISCAN) do Brasil — afetou a disponibilidade logística e os custos e, em última análise, a capacidade da Força Aérea Brasileira de responder às enchentes de 2024 no Rio Grande do Sul.

Desenho/metodologia/abordagem — Um estudo de caso único longitudinal baseia-se em 48 meses de registros de disponibilidade e custos (2021–2024) provenientes do sistema integrado de informações logísticas da Força Aérea Brasileira, comparando um regime de terceirização (2021–2022) com um regime de internalização (2023–2024) por meio de análises de conformidade com metas e de correlação, interpretadas à luz da Visão Baseada em Recursos e da teoria da viabilidade de serviços.

Resultados — A disponibilidade logística média aumentou de 62,4% para 81,1% após a internalização, enquanto o custo unitário cresceu cerca de 5% em termos reais. A conformidade diária com a meta de 70% de disponibilidade mais do que duplicou, e a associação entre custo e disponibilidade dissipou-se à medida que o desempenho atingiu um patamar estável. Posteriormente, a frota internalizada sustentou a maior operação logística realizada pela Força Aérea Brasileira desde a Segunda Guerra Mundial.

Limitações/implicações da pesquisa — As evidências provêm de um único caso não experimental; explicações alternativas para os ganhos observados são examinadas.

Implicações práticas — O estudo oferece critérios de internalização seletiva para organizações estatais com mandatos duplos: defesa e assistência humanitária.

Originalidade/valor — O trabalho conecta a governança de suprimento na logística militar à preparação humanitária, utilizando dados longitudinais raros de indicadores de uma frota militar operacional empregada em ações de socorro a desastres.

Palavras-chave: Logística humanitária; Logística militar; Internalização; Terceirização; Resposta a desastres; Visão baseada em recursos; Disponibilidade logística; Brasil.

1. INTRODUCTION

Between late April and May 2024, sustained extreme rainfall produced the worst flooding ever recorded in the Brazilian state of Rio Grande do Sul. Emergency declarations covered the overwhelming majority of the state's municipalities, and the event generated one of the largest disaster-driven displacement episodes in the country's history, together with severe damage to transport, health and energy infrastructure (Souza et al., 2026). The federal response, conducted under the designation Operation Taquari II, mobilised the armed forces alongside civil defence agencies, state and municipal governments and civil society. Official accounts describe it as the largest humanitarian logistics mobilisation undertaken by the Brazilian military in decades and, for the Brazilian Air Force, the largest logistics operation since the Second World War (Ministério da Defesa, 2024; Força Aérea Brasileira, 2024).

Responses of this scale rest on an unglamorous precondition: the vehicles, handling equipment and maintenance capacity that move relief cargo must exist, and must be serviceable, on the day the

disaster strikes. Humanitarian logistics research has examined in depth how relief flows should be planned, coordinated and distributed once a disaster occurs (Balcik et al., 2010; Holguín-Veras et al., 2012), and a substantial body of work discusses when and how military assets should be engaged in relief operations and how civil–military coordination can be improved (Pettit and Beresford, 2005; Heaslip and Barber, 2014, 2016). What this literature rarely asks is where the response capacity of those military assets comes from. The availability of a military logistics fleet during a crisis is not a given. It is the outcome of governance decisions taken years earlier, in the preparedness phase, about how the sustainment of that fleet is organised — and, in particular, about whether its maintenance is outsourced to contractors or performed with the organisation's own resources.

Preparedness has not been ignored, of course. A well-developed stream studies where to preposition stocks and locate facilities before disasters strike (Balcik and Beamon, 2008), and the general case for investing in preparedness rather than paying for improvisation during response was made early in the field's development (Van Wassenhove, 2006). Recent reviews of resource management in disaster relief confirm, however, that scholarly attention concentrates heavily on the allocation and optimisation of resources within the response phase (Geng et al., 2024). Definitional work has begun to acknowledge outsourcing to commercial companies as one of the forces expanding the scope of humanitarian logistics (Kembro et al., 2024), yet the make-or-buy governance of the assets that deliver relief — the upstream decision that determines whether those assets will be available at all — has attracted little empirical attention. Part of the reason is prosaic:

longitudinal performance records of military logistics fleets are rarely released for research.

This paper asks how make-or-buy decisions over logistics sustainment, taken in the preparedness phase, condition the availability of military logistics assets for disaster response. It examines the ground-vehicle fleet of SISCAN, the National Air Mail System of the Brazilian Air Force — a constitutionally mandated state activity that combines territorial integration with humanitarian assistance — operated by the Air Force Logistics Transport Centre (CTLA), the service's sole logistics transport centre. In January 2023, after two years under a contract logistics support arrangement, the Air Force insourced the maintenance of that fleet. The study compares 48 months of availability and cost records (2021–2024) across the two sourcing regimes and then follows the insourced fleet into Operation Taquari II, when it was placed under sustained crisis demand.

The setting deserves a word of institutional context. The National Air Mail Service (Correio Aéreo Nacional) is among the oldest continuous state activities of the Brazilian federation: created in the early 1930s and consolidated under the Air Force in 1941, it is charged with carrying the presence of the state — transport, development and humanitarian assistance — to the remotest parts of a continental territory, a mandate inscribed in successive federal constitutions. Its logistics arm has therefore always faced a dual demand profile: routine integration flights and cargo movements on the one hand, and surge deployments for disasters and calamities on the other. The ground-vehicle fleet studied here is the terrestrial backbone of that system, collecting and delivering cargo, positioning materiel at air bases and moving the equipment that

loads and unloads military transport aircraft. When the 2024 floods came, it was this fleet that became the ground link of the federal air bridge. The make-or-buy decision examined below is thus not an administrative footnote; it governs the serviceability of an asset on which a constitutional humanitarian mandate depends.

Three contributions follow. First, the paper extends humanitarian logistics research upstream, treating sourcing governance in the preparedness phase as an antecedent of response capacity rather than taking military assets as exogenous. Second, it applies the resource-based view (Barney, 1991) to a state organisation with a dual defence–humanitarian mandate, arguing that the strategic value of sustainment capabilities is revealed — and can only be fully priced — under crisis contingencies. Third, it contributes a longitudinal indicator dataset from an operational military fleet subsequently employed in a major disaster, of a kind seldom available to researchers. The remainder of the paper reviews the relevant literature and theory, describes the method and data, presents the findings, and discusses their implications and limits.

2. LITERATURE REVIEW AND THEORETICAL BACKGROUND

2.1. Humanitarian Logistics And The Military

Humanitarian logistics consolidated as a research field around the recognition that disaster relief poses logistical problems distinct from commercial supply chains, unfolding across preparation, immediate response and reconstruction phases (Kovács and Spens, 2007). Performance in this setting is judged by speed, coverage and the relief of suffering rather than by cost alone, and the field has drawn selectively on private-sector practice while insisting on its

own distinctiveness (Van Wassenhove, 2006). Post-disaster environments differ from business logistics in their objectives, in the state of knowledge about demand, in decision-making structures and in the periodicity and volume of flows (Holguín-Veras et al., 2012). Coordination among heterogeneous actors — international agencies, governments, non-governmental organisations, the private sector and the military — remains one of the field's persistent difficulties (Balcik et al., 2010). Recent definitional work argues that the scope of humanitarian logistics has been expanding, citing cash-based interventions, the outsourcing of humanitarian functions to commercial companies and the stronger involvement of local actors as forces reshaping the field's boundaries (Kembro et al., 2024). The structuring role of government has also gained attention: analysis of the 2023 Morocco earthquake response shows how whole-of-government coordination conditions what the relief system as a whole can deliver (Malhouni and Mabrouki, 2025).

Why preparedness-side capacity so often goes underfunded has a structural answer. Relief funding is event-driven and frequently earmarked, arriving after disasters and tied to visible response activities, which starves the quieter investments — trained staff, information systems, serviceable assets — whose returns accrue only when the next disaster comes (Van Wassenhove, 2006; Balcik et al., 2010). Sustainment of logistics assets sits squarely in that shadow: maintenance is invisible when it works, and its costs are continuous while its benefits are contingent. Organisations under such incentives face a standing temptation to convert fixed sustainment structures into variable contracted costs. Whether that conversion is prudent or corrosive depends on questions the humanitarian literature has largely left to defence management — which is one more reason to study the two fields' intersection.

Within this landscape, militaries occupy a particular position. They are among the few actors holding heavy transport, engineering capacity and the ability to deploy self-sustained forces at short notice, and typologies of relief operations have long distinguished military, non-military and composite response models (Pettit and Beresford, 2005). A dedicated stream examines the difficulties of civil–military cooperation in relief — differences of mandate, culture, planning horizon and humanitarian principles — and proposes ways of organising the interface (Heaslip and Barber, 2014). Later assessments found progress on that interface slower than hoped (Heaslip and Barber, 2016). Behind the coordination question sits a structural tension inside military organisations themselves: they are pressed toward efficiency in peacetime yet must hold dormant capacity that can be activated quickly when disruption strikes (Kovács and Tatham, 2009). The tension parallels the ambidexterity that humanitarian organisations more broadly must manage between exploiting existing capabilities and exploring new ones (Narayanan and Altay, 2024).

Measurement is a further point of contact between the humanitarian and commercial literatures. Logistics management holds that performance can only be improved where it is monitored, and that indicator systems are what allow an organisation to know whether an activity is working at all (Christopher, 2016). Humanitarian supply chains have struggled with this discipline — objectives are contested, demand is unknowable in advance and flows are episodic (Holguín-Veras et al., 2012) — but preparedness is the phase in which measurement is most tractable, because the asset base can be observed continuously between disasters. Equipment availability, the share of an asset fleet serviceable for tasking at a given time, is arguably the single most informative

preparedness indicator for a logistics provider: it aggregates the effects of maintenance quality, parts supply and management attention into the one quantity that matters when mobilisation is ordered. It is the indicator this study places at the centre of its analysis.

Across these streams, the military asset itself tends to enter the analysis as a stock of capacity whose existence and serviceability are assumed. Preparedness-side research has concentrated on prepositioning and facility location (Balcik and Beamon, 2008) and on the general argument for investing before disasters rather than during them (Van Wassenhove, 2006), while reviews confirm that resource-management scholarship clusters within the response phase (Geng et al., 2024). The organisational question of how the sustainment of response assets is governed — outsourced or insourced, and with what consequences for availability when a disaster arrives — sits at the intersection of humanitarian logistics and defence management, and neither field has examined it with longitudinal evidence. That intersection is where this paper is positioned.

2.2. Sourcing Decisions In Defence Logistics

The make-or-buy question is among the oldest in management. In the core-competence tradition, organisations should retain the activities that underpin their distinctive capability and contract out the rest (Prahalad and Hamel, 1990). Transaction cost economics frames the same choice as a comparison of governance costs, with asset specificity, uncertainty and the hazards of opportunism pushing transactions toward internal organisation (Williamson, 2008). In logistics specifically, outsourcing promises cost reduction,

flexibility and access to specialised capabilities (Christopher, 2016), but sourcing choices cannot rest on immediate cost alone once the risk of supply disruption is brought into the calculation (Chopra and Meindl, 2021).

Defence organisations add layers of their own. Contract logistics support and its performance-based successors shift payment from inputs toward outcomes such as fleet availability, and contingency frameworks have been proposed to match contract types to the robustness a military demand requires and to the supply risk the provider can absorb (Glas et al., 2013). Yet defence buyers answer to contingencies that commercial buyers do not — embargoes, geopolitical crises, mobilisation — and supplier incentives tend to weaken at precisely the moment demand surges, when dormant capacity must move to action (Kovács and Tatham, 2009). A contract that performs acceptably in routine conditions can fail exactly when the mission depends on it.

Contract logistics support itself carries a history worth recalling. The instrument is commonly traced to the mobilisation of the Second World War and its aftermath, when the demand for specialised manpower — first for training, then for the maintenance behind large-scale airlift — outran what uniformed establishments could supply, and it spread thereafter to the sustainment of aircraft, vehicles and equipment across allied and partner forces, including Brazil's, where such contracts became one of the standard administrative tools for sustaining materiel through its life cycle in partnership with the domestic defence industrial base. In practice these contracts are administered through indicators — the availability of the supported fleet and the logistics cost of its operation — and they demand from the buyer a competence that is

easy to underestimate: defining scopes, monitoring performance and preserving continuity without ceding control of sensitive knowledge. The commercial literature is candid about the hidden costs of contracting — contract management, inspection and the exposure to provider underperformance (Christopher, 2016) — and about the need to distinguish activities close to the core mission from those distant from it before anything is transferred. For a defence buyer, misclassifying a core-close activity as core-distant is not a commercial inconvenience; it is a strategic exposure.

The empirical literature on insourcing is thin relative to the volume of work on outsourcing, and it concentrates in commercial settings; a rare Brazilian study compares outsourced and insourced warehouse operations in industry (Doratiotto and Vieira, 2019). For military fleets with humanitarian mandates, the evidence is thinner still. Two cautions frame this study's contribution. The literature does not support blanket conclusions in either direction: many outsourcing disappointments trace to contract design and monitoring rather than to outsourcing as such, and insourcing carries its own costs in capital, competence-building and inflexibility. What is needed is not another verdict but evidence on when the balance tips — and, for state organisations with emergency mandates, evidence that prices the crisis contingency explicitly.

2.3. Theoretical Lenses: Resource-Based View And Service Viability

The resource-based view attributes persistent performance differences to resources that are valuable, rare, imperfectly imitable and non-substitutable (Barney, 1991), and it has retained its position as a workhorse of strategic management despite sustained critique

(Barney, 2001). Translating the framework to a public military organisation requires one substitution: competitive advantage becomes mission assurance — the capacity to execute a constitutional mandate under adverse conditions. Read this way, the candidate strategic resources in military sustainment are recognisable: accumulated tacit knowledge of a specific fleet, personnel whose loyalty and security clearances cannot be bought on the market, the ability to operate in austere areas, and integration with military command structures.

Each of the four attributes carries an operational question. Value asks whether a resource lets the organisation exploit opportunities or neutralise threats — whether it raises the efficiency and effectiveness with which the mandate is executed. Rarity asks how many other organisations hold the resource; a maintenance ecosystem shaped around a specific military fleet, its protocols and its operating areas has few holders by construction. Imperfect imitability asks whether others could reproduce the resource, and at what cost disadvantage; capabilities built through years of institutional accumulation, embedded in organisational culture and protected by confidentiality, resist replication. Non-substitutability asks whether an equivalent resource could perform the same function; for fleet sustainment under crisis conditions, the candidate substitutes are precisely the contractors whose incentives weaken under surge. Under this reading, internalisation is indicated when the resources at stake are strategic and not readily transferable or replicable by third parties: it secures control of the resource in any scenario, protects sensitive information and methods, develops competences that cannot be bought on the market, and underwrites operational resilience where contracted arrangements may fail. None of this abolishes the case for contracting genuinely

peripheral services; it disciplines the perimeter within which contracting is safe.

The argument this paper builds on is that these attributes are largely latent in normal times. When demand is stable and the market is functioning, a maintenance contractor can look perfectly substitutable, and a sourcing analysis confined to steady-state costs will conclude as much. Crises invert the picture: it is precisely when a disaster strikes that substitutes become unavailable at any price, that contractor incentives weaken, and that the inimitability and non-substitutability of an in-house capability stop being abstractions. A sourcing evaluation that omits such contingencies therefore systematically underprices two of the four VRIN attributes. This is a claim about evaluation method as much as about the decision itself, and it is testable against what happens when a crisis arrives.

If the resource-based view supplies the logic for insourcing, it does not by itself supply the test of whether an insourcing decision delivered. For that, the study borrows from services management. Service quality is judged by comparing expectations against perceived performance (Parasuraman et al., 1988), and Fitzsimmons and Fitzsimmons (2004) treat a service delivery system as viable when it performs on two axes at once: effectiveness, or performance against expectation, and efficiency, or the cost–benefit relation. Crossing the two axes yields four outcomes — extremely viable when both surprise positively; unviable when both disappoint; viable with an economy focus when cost discipline compensates for missed performance; and viable with a mission focus when performance justifies elevated cost. The reliability dimension of quality lends itself to objective measurement, and Ishikawa's

classical tools are suited to two-variable analysis: the histogram for effectiveness, read against a performance target, and the scatter diagram with linear correlation for efficiency, read as the relation between what is paid and what is obtained (Ishikawa, 1990). One lens explains the decision; the other disciplines its evaluation.

3. METHOD

3.1. Research Design And Case Setting

The study is a longitudinal single-case design with embedded quantitative analysis. The case is the ground-vehicle fleet of SISCAN: 35 vehicles — trucks, crane trucks, tractor units and semi-trailers — operated by the Air Force Logistics Transport Centre (CTLA), the Brazilian Air Force's sole logistics transport centre, responsible for ground logistics operations and for preparing all cargo carried by the service's aircraft or by contracted vessels. Between January 2021 and December 2022, maintenance of the fleet was performed under a contract logistics support arrangement with a private provider; in January 2023, the Air Force insourced the activity, executing it thereafter with its own personnel and infrastructure.

The case was selected for three reasons. It is revelatory, in that complete monthly indicator series of this kind are rarely released for research. It provides a natural before–after comparison across sourcing regimes with an essentially stable fleet, mission and measurement system. And it is followed by a stress episode — Operation Taquari II, from April 2024 — that allows the insourced capability to be observed under crisis demand rather than only under routine conditions. A single case cannot support statistical generalisation, and none is claimed; the design trades breadth for

depth and data completeness, aiming at analytic generalisation to theory.

Some further detail bounds the comparison. The fleet's composition and size were essentially constant across the window, and its mission profile — cargo collection and delivery, positioning of materiel at air bases and support to aircraft loading — did not change with the sourcing regime. The contract biennium was administered by an inspection commission of the operating organisation using the same indicators later applied to the insourced operation, which removes the most common source of before–after incomparability in sourcing studies: a change of yardstick accompanying the change of regime. Monthly periodicity was chosen for the core series because it matches the cadence at which the operating organisation itself steers the activity; the daily availability records provide a robustness check at finer granularity.

3.2. Data And Measures

Logistics availability (DL) is the institutional availability indicator of the Brazilian Air Force. For a fleet of n units in a given month, it is computed as:

$$\mathrm{DL} = \sum (d1 + d2 + \ \ldots \ + dn) \,/\, (30 \cdot n)$$

where d is the number of days in the month on which each unit was available for tasking. Monthly values for January 2021 to December 2024 (48 observations) were extracted from SILOMS, the Air Force's integrated logistics information system, together with daily availability records aggregated per biennium (730 days each). The availability target for SISCAN equipment, set by the system's central logistics authority, is 70%.

Logistics cost (CL) is expressed in Brazilian reais per kilometre travelled (BRL/km), the steering parameter used by the operating organisation, and derives from the maintenance-and-supply cost centre defined in the Air Force's costing instructions — the cost centre concentrating the direct and indirect expenditures for maintenance, supply and contract support of a given project. The service's operating-cost framework distinguishes several cost centres — fuel and lubricants, simulators, and equipment or aircraft modernisation among them — but only the maintenance-and-supply centre captures the expenditures actually governed by the sourcing decision studied here, which is why it was adopted as the financial indicator; the values are compiled annually by the responsible directorate and centre. Cost records were supplied by the operating organisation with its authorisation. All contracts are domestic, so no exchange-rate adjustment applies; real-terms comparisons deflate by cumulative IPCA consumer-price inflation, approximately 28% across the study window (IBGE, 2025). Documentary sources on Operation Taquari II comprise official communications of the Ministry of Defence and the Air Force (Ministério da Defesa, 2024; Força Aérea Brasileira, 2024).

3.3. Analytical Procedures

Three complementary analyses were performed. First, biennial means of DL and CL were compared across regimes, in nominal and real terms. Second, conformance with the 70% target was assessed at monthly and daily granularity, including a conformance index — the share of periods at or above target — and the before–after ratio of conforming periods. Third, the association between monthly CL and DL was measured with Pearson's linear correlation coefficient:

$$r = [n\sum xy - \sum x \sum y] \,/\, \sqrt{([n\sum x^2 - (\sum x)^2] \cdot [n\sum y^2 - (\sum y)^2])}$$

computed for the full 48-month series and for each calendar year, with 95% confidence intervals obtained via the Fisher z-transformation and two-tailed t-tests; an ordinary least squares fit is reported for visualisation. Following the quality-analysis convention, an improvement in service quality is indicated when the performance and cost indicators are strongly and positively associated and the amplitude of performance variation is at least as large as that of cost (Ishikawa, 1990). Finally, the effectiveness and efficiency results were mapped onto the service viability matrix (Fitzsimmons and Fitzsimmons, 2004) to classify the insourcing decision. One caveat applies throughout: within each calendar year, CL assumes only two values, reflecting semester price steps, so annual correlation coefficients effectively contrast semester means and are reported descriptively rather than inferentially.

3.4. Validity Considerations

Construct validity benefits from the fact that DL and CL are institutionally defined indicators whose definitions did not change across regimes, and from their system-generated character, which limits retrospective adjustment. Internal validity is the design's principal constraint: the regime change was a management decision, not an experiment, and no counterfactual fleet exists; alternative explanations for the observed changes — maturation, contemporaneous investment and utilisation shocks — are examined explicitly in the discussion. All statistics reported below were recomputed directly from the primary monthly records reproduced in Table I, so that every figure in the text can be verified by the reader. The data were provided with the authorisation of the operating organisation, and the study involves no human subjects.

Reliability of the account rests on the traceability of every quantitative claim to the primary series, and on the use of documentary sources of public record for the operational narrative. External validity is bounded in the manner of all case research: what travels is not the point estimates but the mechanisms — the latency of VRIN attributes under routine conditions, the elasticity and saturation bands in the cost–availability relation, and the lifecycle reading of sourcing — whose portability other cases can test.

4. FINDINGS

4.1. Availability And Cost Across Sourcing Regimes

Table I reports the full monthly series; Figure 1 displays it. Mean logistics availability rose from 62.42% in the outsourced biennium (2021–2022) to 81.08% in the insourced biennium (2023–2024) — an absolute gain of 18.7 percentage points and a relative gain of 29.9%. Mean logistics cost rose from BRL 3.73/km to BRL 5.03/km, a nominal increase of 34.7%. Deflating by cumulative consumer-price inflation of roughly 28% over the window (IBGE, 2025) leaves a real cost increase of approximately 5%: most of the nominal growth reflects inflation rather than a structural rise in the cost of operating the fleet.

The averages understate the contrast. Under the outsourced regime, availability was not only lower but unstable, oscillating between 38% (April 2021) and 79%, with repeated relapses below 60% even after months of apparent recovery. The insourced regime opens with a transition semester in the first half of 2023 (56–73%) and then settles into a sustained band: from July 2023 to December 2024, monthly

availability never fell below 73% and reached 97% at its peak. The change is a shift of level and of stability, not a run of good months.

A year-by-year reading sharpens the picture. In 2021, with cost at its lowest levels (BRL 3.22–3.61/km), availability repeatedly failed to reach even a minimum operating standard, falling to 38% in April: low expenditure was buying little, which points to constraints in maintenance, parts supply or the allocation of human and financial resources under the contract. The cost steps of 2022 (BRL 3.96–4.13/km) accompanied a partial recovery — several months above 70% and a peak of 79% in November — but relapses to the mid-40s and 50s persisted, and the biennium closed with the fleet below target in fifteen of twenty-four months. The first insourced semester of 2023 reads as a transition: availability held in the 56–73% range while the new arrangement absorbed the workload, before climbing steadily through the second semester to 83–87%. In 2024 the fleet operated in an excellence band throughout: 88–97% in the first half — including the months in which the flood response began — and 76–91% in the second half, under the sustained employment discussed in Section 4.5.

Table I. Monthly logistics availability (DL) and logistics cost (CL) of the SISCAN ground-vehicle fleet, 2021–2024

Month/Year	Logistics availability (%)	Logistics cost (BRL/km)
Jan-2021	62	3.22
Feb-2021	55	3.22
Mar-2021	40	3.22
Apr-2021	38	3.22

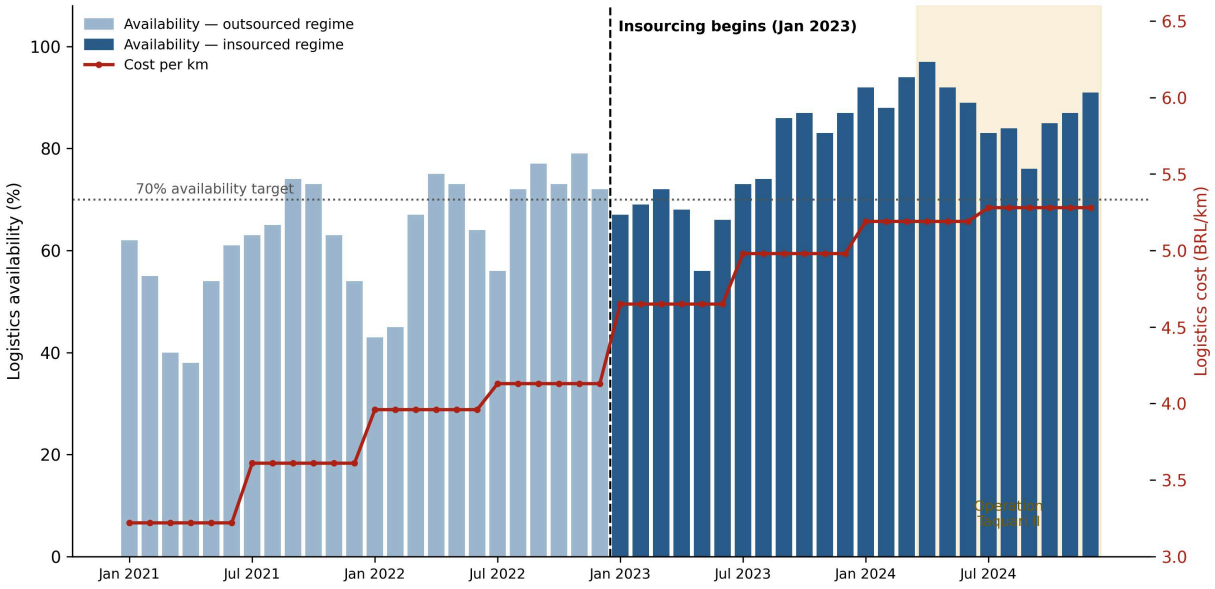
May-2021	54	3.22
Jun-2021	61	3.22
Jul-2021	63	3.61
Aug-2021	65	3.61
Sep-2021	74	3.61
Oct-2021	73	3.61
Nov-2021	63	3.61
Dec-2021	54	3.61
Jan-2022	43	3.96
Feb-2022	45	3.96
Mar-2022	67	3.96
Apr-2022	75	3.96
May-2022	73	3.96
Jun-2022	64	3.96
Jul-2022	56	4.13
Aug-2022	72	4.13
Sep-2022	77	4.13
Oct-2022	73	4.13
Nov-2022	79	4.13
Dec-2022	72	4.13
Jan-2023	67	4.65
Feb-2023	69	4.65
Mar-2023	72	4.65

Apr-2023	68	4.65
May-2023	56	4.65
Jun-2023	66	4.65
Jul-2023	73	4.98
Aug-2023	74	4.98
Sep-2023	86	4.98
Oct-2023	87	4.98
Nov-2023	83	4.98
Dec-2023	87	4.98
Jan-2024	92	5.19
Feb-2024	88	5.19
Mar-2024	94	5.19
Apr-2024	97	5.19
May-2024	92	5.19
Jun-2024	89	5.19
Jul-2024	83	5.28
Aug-2024	84	5.28
Sep-2024	76	5.28
Oct-2024	85	5.28
Nov-2024	87	5.28
Dec-2024	91	5.28

Source: *Brazilian Air Force integrated logistics information system (SILOMS) and operating-organisation cost records, reproduced with*

authorisation.

Figure 1. Monthly logistics availability (bars) and logistics cost (line) across sourcing regimes, 2021–2024



Source: *prepared by the author from the records in Table I.*

4.2. Conformance With The Availability Target

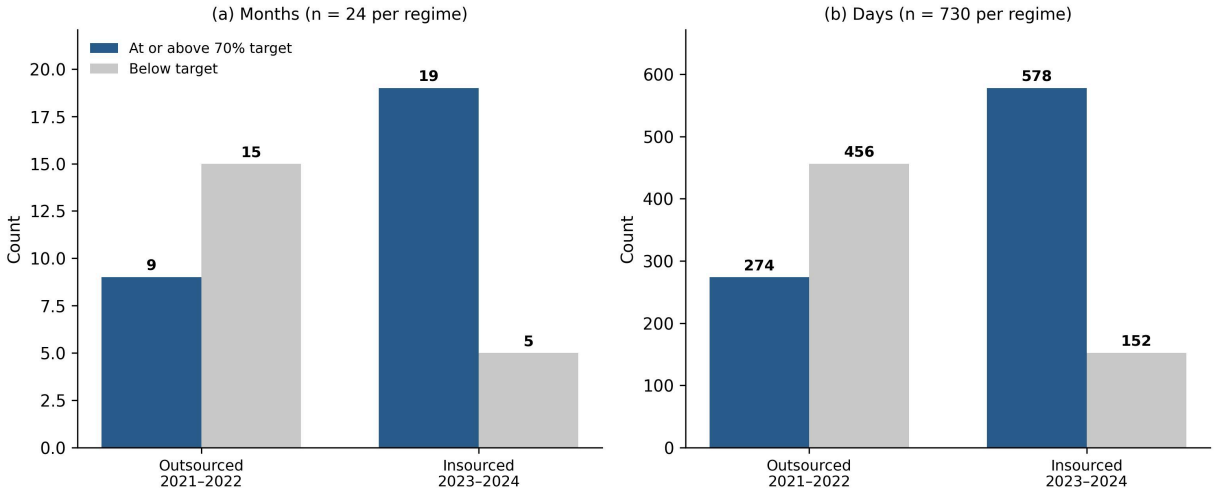
Figure 2 summarises conformance with the 70% target. On a monthly reading, the outsourced biennium produced 9 of 24 months at or above target (37.5%) against 19 of 24 (79.2%) under insourcing. The daily records tell the same story at finer grain: 274 of 730 days in conformance (37.5%) before, 578 of 730 (79.2%) after — an absolute gain of 304 conforming days, with days below target cut by two-thirds (456 to 152). Expressed as a conformance index, the share of periods meeting the target moved from 0.375 to 0.792, a ratio of 2.11: after insourcing, the fleet met its availability target slightly more than twice as often as before.

That the monthly and daily proportions coincide exactly (37.5% against 79.2% on both readings) indicates that the improvement is systemic rather than the product of a few exceptional months.

Under the quality-analysis convention that both the mean and the variability of a process matter (Ishikawa, 1990), the insourced regime improved on both counts: a higher average and a drastically narrower band of oscillation.

In operational terms, the doubling of conformance has a simple meaning: for a planner deciding whether the fleet can accept a tasking on a randomly chosen day, the probability of finding it at or above its availability target moved from roughly one in three to roughly four in five. For an organisation whose mandate includes responding to calamities that arrive without notice, that difference is not a decoration on the mean; it is the difference between a capability that can be assumed and one that must be checked.

Figure 2. Conformance with the 70% availability target by sourcing regime: (a) months; (b) days



Source: *prepared by the author from SILOMS monthly and daily availability records.*

4.3. The Cost–availability Relationship Over Time

Table II reports the correlation analysis; Figure 3 shows the scatter. Over the full series, monthly cost and availability are strongly and positively associated ($r = 0.782$; $r^2 = 61.2\%$; 95% CI 0.640–0.872; $p <$

0.001): across the four years, higher expenditure per kilometre accompanies higher availability, the pattern one would expect of a capacity-recovery trajectory in which spending funds maintenance upgrades, parts replenishment and process consolidation. The fitted relation, DL = 15.94·CL + 1.99, is reported for visualisation only, since correlation carries no causal claim.

The magnitude of the fitted slope invites a reading, offered with the caution the design demands. Taken at face value, each additional real of expenditure per kilometre accompanied close to sixteen percentage points of availability across the window — but the slope aggregates a regime change with a price trend, and no part of it should be treated as a purchasable exchange rate. Its honest use is comparative: fitting each biennium separately, the insourced regime shows a relation roughly twice as steep and markedly tighter than the outsourced one (34.6 against 17.4 percentage points per real, with correlations of 0.80 against 0.51), which is another way of stating the finding that resources converted into availability more readily after the function was taken in-house.

The annual sub-series reveal a more differentiated dynamic. In 2021 the association is strong and significant (r = 0.640; p = 0.025): from a low base, cost increments accompanied availability gains, consistent with an initial rebalancing effort. In 2022 the association weakens (r = 0.445; p = 0.147, with a confidence interval spanning zero): availability recovered, but with month-to-month heterogeneity that blurs the statistical picture. In 2023 — the insourcing year — the coupling is at its tightest (r = 0.813; p = 0.001; r^2 = 66.2%), with availability responding closely to the resources committed. In 2024 the association inverts (r = −0.706; p = 0.010): with availability already in

an excellence band of 83–97%, the small mid-year cost step (BRL 5.19 to 5.28/km) coincided with somewhat lower second-half availability.

Two readings of the 2024 inversion are plausible, and they are complementary rather than competing. The first is saturation: at excellence levels, marginal expenditure no longer purchases measurable availability, a diminishing-returns pattern with direct budgeting implications. The second is operational: the second half of 2024 corresponds to the sustained phase of Operation Taquari II, by which point the fleet had been running continuous relief cycles since April; accumulated wear from that employment would plausibly depress availability irrespective of monthly expenditure. Given the two-level structure of cost within each year (Section 3.3), the annual coefficients contrast semester means and should be read descriptively. What the series supports with confidence is narrower and more useful: the tight positive coupling of the recovery phase does not persist once the system reaches a high-availability regime.

Read across the four years, the series suggests two operating bands. While availability remained below roughly 70–80% — the situation of 2021 through mid-2023 — it displayed elasticity to expenditure: cost increments were accompanied by availability gains, whether under the contractor's price steps or the insourced regime's early consolidation. Once availability settled above roughly 85–90%, that elasticity vanished, and monthly variation in availability became statistically unrelated, or even inversely related, to monthly cost. The bands are descriptive regularities of one case, not laws; their budgeting use is developed in Section 5.3.

Against the quality criterion that performance amplitude should match or exceed cost amplitude (Ishikawa, 1990), the window as a

whole passes comfortably: availability gained 29.9% while real cost rose approximately 5%.

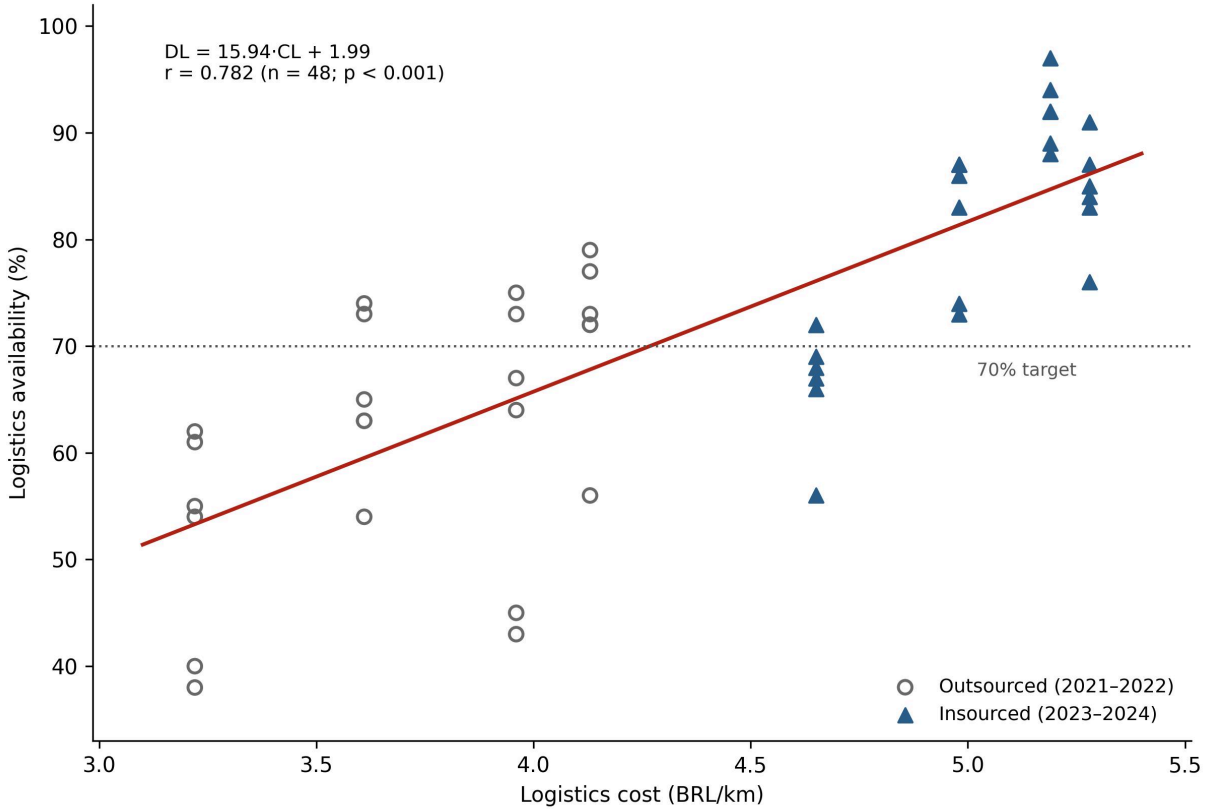
Table II. Pearson correlation between monthly logistics cost and logistics availability, full series and by year

Period	n	r	r^2 (%)	95% CI for r	p (tw tail
2021–2024	48	0.782	61.2	[0.640, 0.872]	< 0.0
2021	12	0.640	41.0	[0.105, 0.888]	0.02
2022	12	0.445	19.8	[−0.173, 0.812]	0.14

⚠ Esta tabela possui muitas colunas e foi cortada para impressão. Para visualizá-la completa, acesse o artigo original em: https://revistatopicos.com.br/artigos/insourcing-to-respond-make-or-buy-decisions-in-military-logistics-and-disaster-relief-capacity-in-the-2024-rio-grande-do-sul-floods?noblockage

Notes: *Confidence intervals via Fisher z-transformation; p-values from two-tailed t-tests. Within each calendar year, CL assumes only two values (semester price steps), so annual coefficients effectively contrast semester means and are reported descriptively. Source: computed by the author from the records in Table I.*

Figure 3. Monthly logistics cost against availability with ordinary least squares fit, by sourcing regime



Source: *prepared by the author from the records in Table I.*

4.4. Viability Assessment

Mapping these results onto the service viability matrix (Fitzsimmons and Fitzsimmons, 2004) requires a judgement on each axis. On effectiveness, the insourced regime exceeded the institutional target in four of every five periods, doubled the conformance frequency of the preceding regime and shifted the level of performance by nearly 19 percentage points — performance beyond the expectation formed by both the target and the prior period. On efficiency, an availability gain of 29.9% was obtained for a real cost increase of roughly 5%, and the cost–availability association through the recovery phase indicates that resources committed were converted into performance. Both axes therefore fall in the favourable region, placing the decision in the extremely viable quadrant.

The intermediate quadrants of the matrix are worth naming, because they describe real policy situations even though neither applies here. A regime of missed availability targets tolerated for the sake of cost containment — viable with an economy focus — is a defensible posture in fiscal retrenchment, when equipment employment is deliberately reduced; a regime of rapid target attainment purchased at sharply elevated cost — viable with a mission focus — can be rational under imminent-employment conditions, when effectiveness outweighs expense. The finding of this case is precisely that neither trade-off had to be made: the availability gain did not come at a real cost that would demand the mission-focus justification, and the cost discipline did not come at the price of the target.

The classification claims less than it may appear to. It does not assert that insourcing is generally superior to contracting, nor that this fleet should remain insourced indefinitely; it asserts that, for this fleet, over this period, against this target, the insourcing decision delivered effectiveness and efficiency beyond expectation. The boundary conditions of that statement are taken up in the discussion.

4.5. The Insourced Fleet Under Stress: Operation Taquari II

When the floods struck at the end of April 2024, the fleet had spent four consecutive months at 88–97% availability. Within 48 hours of the declaration of public calamity, the operating organisation mobilised dozens of medium and heavy vehicles in exclusive allocation to the relief effort, running continuous cycles to collect food, drinking water, tents, generators and field hospitals, delivering directly to affected populations or feeding strategic air hubs from

which military transport aircraft operated; the deployment was sustained until the end of 2024 (Força Aérea Brasileira, 2024; Ministério da Defesa, 2024).

The fleet's role in the operation was that of a ground bridge. Ground transport linked donation reception and distribution centres located in several states to the strategic air vectors staged at federal air bases, from which KC-390 Millennium, C-105 Amazonas and KC-30 multi-role tanker transport aircraft flew relief into the affected region; the same vehicles moved outsize strategic loads, including field hospitals and an aircraft-towing unit exceeding twenty tonnes, and delivered hundreds of tonnes of donations by road in the operation's first weeks (Força Aérea Brasileira, 2024). The arrangement operated inside a wider whole-of-government network — army, navy, civil defence agencies, municipal governments and volunteer networks — that official accounts credit with moving thousands of tonnes of donated and support cargo in what was described as the largest humanitarian campaign registered in the country (Ministério da Defesa, 2024). Multimodal integration of this kind rationalises routes and reduces duplicated effort, a service-operations principle the episode illustrates concretely (Fitzsimmons and Fitzsimmons, 2004); it also concentrates demand on precisely the asset class studied here, since every air movement begins and ends with trucks.

The indicator series shows what the capability did under that demand. Across the eight months of sustained operation, from May to December 2024, monthly availability never fell below 76% and averaged 84% — above target throughout, under employment conditions far beyond routine. This is not a controlled test, and no causal weight is placed on it. But the episode is precisely the

contingency for which the resource-based logic prices sustainment capability, and the series shows that the capability held. A counterfactual can only be sketched with caution: at the availability level of the outsourced regime — a 62% average with troughs near 40% — the same mobilisation would have demanded substantially more fleet slack, or external hiring at crisis prices, to field the same serviceable vehicles. The sketch is speculative and is flagged as such; the observed record is not.

5. DISCUSSION

5.1. Theoretical Implications

The first implication runs upstream. Humanitarian logistics has treated the capacity of responding organisations — military capacity in particular — largely as an exogenous stock to be coordinated, allocated and optimised once disaster strikes (Balcik et al., 2010; Geng et al., 2024). The present case shows that stock to be a governed outcome: the availability the fleet brought into Operation Taquari II was manufactured, over the preceding two years, by a sourcing decision. Preparedness research has given us prepositioning and facility location (Balcik and Beamon, 2008) and the general argument for investing ahead of disasters (Van Wassenhove, 2006); sustainment governance belongs on that same preparedness agenda. The finding also speaks to the definitional expansion of the field: where recent work registers the outsourcing of humanitarian functions to commercial companies as a boundary-shifting trend (Kembro et al., 2024), this case documents the reverse movement — the insourcing of humanitarian-relevant capacity by a state provider — and suggests the field should track both directions.

The second implication concerns the resource-based view. The case supports the argument, developed in Section 2.3, that the VRIN attributes of a sustainment capability are latent in routine conditions and revealed in crisis: the non-substitutability of an in-house maintenance capability is invisible in a steady-state business case and decisive when a disaster removes market alternatives. For public organisations with emergency mandates, this suggests a boundary condition on resource evaluation — sourcing analyses must price contingencies whose probability-weighted cost rarely appears in routine comparisons — and offers a mission-assurance reading of the framework consistent with the position that its value lies in specifying the conditions under which resources matter (Barney, 1991, 2001).

Third, the findings complement rather than contest adjacent streams. The civil–military coordination literature (Heaslip and Barber, 2014, 2016) presupposes a capable military logistics partner; this case adds that the capability itself depends on sourcing governance, making coordination and capacity complements in explaining relief performance. And the results refine, rather than reject, performance-based contracting: the contingency logic of matching contract types to robustness requirements (Glas et al., 2013) acquires a lifecycle dimension here. During capability recovery, direct control through insourcing converted resources into availability tightly; at the high-availability plateau of 2024, marginal expenditure stopped buying availability, which is exactly the regime in which selectively reintroducing performance-based instruments for specific subsystems becomes attractive. Sourcing, on this reading, is a dynamic policy rather than a one-shot verdict — a concrete expression, in asset sustainment, of the ambidexterity

humanitarian organisations are urged to cultivate (Narayanan and Altay, 2024).

A final theoretical remark concerns where, in the canonical phase structure of disaster relief — preparation, immediate response, reconstruction (Kovács and Spens, 2007) — decisions of this kind belong. Sourcing governance is unambiguously a preparation-phase choice, yet its effects were observed here in the response phase, two years later and under conditions its makers could not have specified in advance. That temporal displacement is what makes such decisions easy for research to miss: studied in the phase where they are taken, they look like administrative economics; studied in the phase where they bind, they are invisible unless longitudinal data connect the two. Designs that span phases, of the kind attempted here, are the methodological price of seeing preparedness governance at work — and they are also where the government-role literature (Malhouni and Mabrouki, 2025) and the humanitarian-logistics mainstream can most usefully meet.

5.2. Alternative Explanations

A single-case before–after design obliges candour about rival accounts. Maturation is the first: availability was already improving in late 2022 under the contractor, and part of the 2023–2024 gain could reflect the continuation of that trend. The pattern of the series argues against maturation as the principal driver — the post-2023 record is distinguished less by its peaks than by the disappearance of the relapses that punctuated 2021–2022, and the doubling of conformance frequency is a change in the character of the process, not merely its slope — but the possibility cannot be excluded.

Two further caveats belong in this inventory. The real-terms cost comparison depends on the deflator: general consumer-price inflation was used because the fleet's inputs — labour, parts, services — are procured domestically across heterogeneous markets, but a dedicated maintenance-cost index, were one available, could move the real increase by a few points in either direction without altering the qualitative conclusion. And regime changes can carry their own temporary energy: the attention, pride and scrutiny that accompany an organisation taking a function back in-house may lift performance for reasons that fade with routine. The two-year length and end-of-window stability of the insourced record weigh against a purely transitory reading, but only longer series can retire it.

Contemporaneous resourcing is the second. Insourcing arrived with a real cost increase of roughly 5%, plausibly including the recomposition of parts inventories, and the design cannot fully separate the governance effect from the resourcing effect. What can be observed is that under the outsourced regime successive cost steps (BRL 3.22 to 4.13/km, a nominal rise of 28%) bought far less availability than the insourced regime obtained for a smaller real increment. Third, utilisation: Operation Taquari II raised fleet employment sharply from April 2024, and heavy use ordinarily depresses availability. That bias runs against the insourced regime, which makes the sustained above-target record of 2024 conservative rather than flattering evidence. Fourth, measurement: the indicator definitions were constant and system-generated, but the daily records were not independently audited. Finally, and cutting across all of these, correlation is not causation and no counterfactual exists. The claims defended here are of plausibility and consistency — the timing of the discontinuity, the shift in level and stability, and the coherence of monthly and daily readings all

point the same way — and they invite multi-case replication rather than settle the question.

5.3. Implications For Practice And Policy

For state organisations that hold both defence and humanitarian mandates, the case suggests a disciplined test for selective insourcing built on four questions: how critical is the function to the emergency mission, as distinct from the routine one; do the underlying resources pass the VRIN test evaluated under crisis contingencies rather than steady-state conditions; how exposed is the organisation to supplier failure precisely during surges, when market alternatives vanish; and how much of the supposed saving from contracting is already consumed by the monitoring and contract-management apparatus the organisation must maintain regardless. Functions that score high across these questions are candidates for internal execution even when a steady-state cost comparison says otherwise.

The correlation dynamics carry budgeting guidance of their own. Below roughly 70–80% availability, the series shows expenditure translating into availability — the elasticity that justifies recovery investment and supports budget requests during modernisation cycles. Above roughly 85–90%, the association dissipates, and management attention should shift from how much to invest toward how well: process quality, training, critical-stock optimisation and targeted performance-based contracts for specific subsystems, steered by complementary reliability indicators such as failure intervals, repair times, maintenance backlog and parts lead times rather than by aggregate spending.

Nor is the lesson confined to militaries. Humanitarian organisations operate substantial vehicle fleets of their own, and face the same make-or-buy question over their maintenance under harsher funding conditions: event-driven, earmarked resources reward response-phase visibility and penalise the continuous costs of sustainment (Van Wassenhove, 2006; Balcik et al., 2010). The elasticity-and-saturation reading offered here gives such organisations a defensible language for donors — evidence that below a threshold, money spent on fleet sustainment converts into availability, and that availability is what converts into response — while the conformance metric offers a preparedness indicator that boards and back donors can audit between disasters. An organisation that can show its fleet meeting an availability target four days in five has a preparedness claim more concrete than most.

Two qualifications keep the prescription honest. The four-question test recommends selective insourcing, not wholesale reversal: functions that are genuinely core-distant, contestable in the market and stable in demand remain natural candidates for contracting, and the monitoring apparatus a public buyer must maintain is itself an argument for contracting less but better rather than not at all. And the findings concern a ground-vehicle fleet whose maintenance technology is comparatively accessible; capital-intensive sustainment of complex weapon systems, where the design authority resides with industry, poses a different make-or-buy problem, and extrapolation to it would outrun the evidence. Within those limits, the framework travels: any armed force or civil-protection agency that holds emergency logistics assets can ask the same four questions of each sustainment function it currently contracts, and can read its own availability–cost series for the elasticity and saturation bands documented here.

The relevance extends beyond one Brazilian fleet. Climate-linked disasters of the Rio Grande do Sul type are widely expected to recur, and their public-health and displacement footprints place armed forces in the role of logistics providers of last resort (Souza et al., 2026). Whole-of-government responses are only as strong as the internal readiness of each participating agency (Malhouni and Mabrouki, 2025). For the militaries that anchor such responses, the governance of sustainment — who maintains the fleet, under what incentives, with what resilience when contracts are stressed — is humanitarian preparedness policy by another name.

6. CONCLUSION

This paper asked how make-or-buy decisions over logistics sustainment, taken in the preparedness phase, condition the availability of military logistics assets for disaster response. Following the ground-vehicle fleet of Brazil's National Air Mail System across 48 months and two sourcing regimes, it found that insourcing maintenance was followed by an availability gain from 62.4% to 81.1%, obtained for a real cost increase of roughly 5%; by a doubling of conformance with the institutional availability target at both monthly and daily granularity; and by a cost–availability association that was tight during recovery and dissipated once the fleet reached a high-availability regime. Mapped onto the service viability matrix, the decision classifies as extremely viable, and the insourced fleet subsequently sustained eight months of continuous relief employment in Operation Taquari II without falling below its availability target.

The contribution is threefold: an upstream extension of humanitarian logistics that treats sourcing governance as an

antecedent of response capacity; a mission-assurance application of the resource-based view in which crisis contingencies reveal the strategic value of sustainment capabilities; and a longitudinal indicator dataset of a kind rarely available from operational military fleets.

For practitioners, the case reduces to a compact injunction. Treat the sustainment of emergency logistics assets as part of the emergency capability itself, not as an overhead to be minimised; evaluate its sourcing under the contingencies the mandate exists for, not under the routine in which contracts are negotiated; and read the availability–cost series continuously, because it tells decision-makers which regime they are in — one where money buys readiness, or one where only management can improve it.

The limits are those of the design. The evidence comes from one fleet in one country, observed without a counterfactual; the within-year cost structure restricts annual correlations to descriptive use; the subjective dimensions of service quality — responsiveness, assurance, empathy — were not measured and would require survey instruments; the account of Operation Taquari II rests on official documentary sources; and real-terms comparisons depend on the deflator chosen. Future research can relax each constraint: multi-case designs across services and countries comparing sourcing regimes and availability trajectories; the incorporation of reliability-engineering indicators alongside availability; finer-grained cost functions separating the resourcing and governance components of insourcing; and, most valuably for the humanitarian field, designs that link asset availability regimes to measured relief outcomes such as delivery times and population coverage. If disaster responses are only as good as the assets that arrive serviceable, then the decisions

that keep those assets serviceable deserve a standing place on the humanitarian logistics research agenda.

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Conflict of interest

The author is a serving officer of the Brazilian Air Force and directed the Air Force Logistics Transport Centre (CTLA) — the organisation that operates the fleet studied — from November 2022 to February 2025, a period that encompasses the insourcing decision and Operation Taquari II. This position is disclosed. To mitigate the risk of favourable self-assessment, the analysis relies exclusively on system-generated institutional indicators, reproduced in full in Table I so that every result can be independently recomputed. No financial conflict of interest exists.

Data availability

The monthly availability and cost series analysed in this study are reproduced in full in Table I. The underlying records originate from the Brazilian Air Force's integrated logistics information system (SILOMS) and were used with the authorisation of the operating organisation; further data are subject to institutional authorisation.

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[1] Escola Superior de Guerra (Brazilian War College), Rio de Janeiro, Brazil. ORCID: https://orcid.org/0009-0009-4454-1873. Lattes: https://lattes.cnpq.br/4514223340989125. E-mail: acesse o artigo original para visualizar o e-mail