

COMMAND, CONTROL, AND SUPPLY: INTEGRATING C2 THEORY INTO MILITARY SUPPLY CHAIN RESILIENCE MODELS — LESSONS FOR ROMANIA AND NATO'S EASTERN FLANK

Dănuț-Dumitru DUMITRAȘCU, Robert-Cristian TRIF

“Lucian Blaga” University of Sibiu, Romania
roberteristian.trif@ulbsibiu.ro, dan.dumitrascu@ulbsibiu.ro

Abstract: *This paper examines the relationship between Command and Control (C2) theory, the exercise of authority in military operations and Supply Chain Resilience (SCRes), the ability to recover from disruptions, within a military logistics framework, focused on Romania's strategic position on NATO's Eastern Flank. A systematic documentary analysis of four comparative cases was conducted: Enhanced Forward Presence (eFP), NATO Exercise Steadfast Defender 2024, the ongoing Ukraine conflict, and Romania's integration into NATO collective logistics processes. C2 functions were mapped to the four SCRes phases: readiness, response, recovery, and growth. Results indicate that rapid decentralized decision-making and flexible resource allocation are primary antecedents to disruption recovery in military contexts. An integrated C2-SCRes framework is proposed, identifying research gaps in C2 digitalization, strategic stockpiling, and LOGFAS command integration.*

Keywords: C2 theory, supply chain resilience, NATO Eastern Flank, Romania, military logistics

1. Introduction

The resurgence of large-scale conventional warfare on the European continent, exemplified by Russia's full-scale invasion of Ukraine in February 2022, has fundamentally reconfigured the strategic calculus of NATO's Eastern Flank. Romania, as the Alliance's largest member state bordering the Black Sea littoral and sharing a proximate security environment with Ukraine and the Republic of Moldova, occupies a position of exceptional strategic salience. Its territory serves as both a logistics hub for eastern operations and a transit corridor for Alliance resources. Despite voluminous literature on Supply Chain Resilience (SCRes) within commercial and humanitarian contexts, the military domain remains comparatively under-theorized, particularly at the intersection of Command and Control (C2)

structures and logistics resilience. C2, broadly defined as the exercise of authority and direction by a properly designated commander over assigned forces, constitutes the organizational backbone through which military logistics are conceived, authorized, and executed. The absence of a rigorous framework linking C2 functions to the phased dynamics of SCRes represents a lacuna with both theoretical and practical consequences for NATO planners.

This paper addresses that gap by developing an integrated C2-SCRes framework that maps C2 functions onto the four canonical SCRes phases: readiness, response, recovery, and growth [9, 14]. The paper makes three contributions:

- (1) it advances SCRes theory by situating it within a hierarchical military context;
- (2) it provides defence planners with a diagnostic tool linking C2 reforms to

logistics resilience improvements;
(3) it identifies research gaps in C2 digitalization, strategic stockpiling, and LOGFAS command integration.

2. Methodology and Literature Review

2.1 Theoretical Foundations

C2 theory is grounded in the canonical work of Alberts and Hayes [1], who conceptualize it as comprising the rights, processes, and behaviors through which a commander organizes and directs forces. Mission Command, enshrined in NATO AJP-01 [11], emphasizes decentralized execution within a commander's intent, critical for logistics resilience, as it enables subordinate initiative when communications are degraded [4]. Atkinson and Moffat [2] extended C2 theory into network-enabled operations, where information superiority translates to decision superiority. NATO's LOGFAS (Logistics Functional Area Services) system embodies this logic in the logistics domain.

SCRes has been extensively theorized, with foundational contributions by Christopher and Peck [6], who define it as the ability of a supply chain to return to its original state after disruption. Hohenstein et al. [9] advance a four-phase model: readiness, response, recovery, and growth, that structures most contemporary SCRes research. Antecedents include redundancy, flexibility, collaboration, and agility [3, 18]. Military supply chains share these dynamics but are distinguished by the authority of command dimension: decisions about redundancy and flexibility are embedded in hierarchical C2 structures absent in commercial contexts [14, 20].

2.2 Research Design

This paper employs systematic documentary analysis [5, 19], comparing four purposively selected cases across three criteria:

- (1) direct relevance to NATO collective logistics in Eastern Europe;
- (2) sufficient documentary evidence in open source and declassified NATO publications; and
- (3) temporal coverage spanning pre-conflict, exercise, active-conflict, and integration contexts.

The documentary corpus comprised three layers of sources:

- (1) primary NATO publications — Allied Joint Publications (AJP-01, AJP-4), SHAPE logistics directives, NATO Summit Declarations, and NSPA annual reports [13];
 - (2) national documents — Romanian Ministry of National Defence White Papers [15];
 - (3) peer-reviewed academic literature on SCRes and military logistics [3, 6, 9, 14, 18, 20].
- Case selection followed purposive logic: each case was chosen to represent a distinct C2-logistics configuration (prepositioned multinational force, large-scale reinforcement exercise, active high-intensity conflict, and host-nation integration process), ensuring analytical coverage of all four SCRes phases.

The coding procedure mapped four C2 functions — anticipation, decision-making, coordination, and adaptation — operationalized from Alberts and Hayes [1] and NATO AJP-01 [11], onto Hohenstein et al.'s [9] four SCRes phases. Each case was coded independently against this matrix. Documentary evidence was then triangulated across cases: where a finding appeared in at least two independent sources from different cases, it was treated as a robust cross-case pattern; single-source findings are explicitly flagged as case-specific. The resulting analytical matrix is presented in Section 4, and the comparative evidence base is summarized in Table 1.

Table 1. Comparative Case Study Analysis: C2 Dimensions and SCRes Phases

Case Study	C2 Dimension	SCRes Phase	Key Lesson
eFP (2017–present)	Interoperability; multinational coordination	Readiness & Response	Prepositioned nodes reduce response latency; SLOs compress resupply decision time
Steadfast Defender 2024	Scalability; LOGFAS data speed	Response & Recovery	LOGFAS data lag degraded CLOP under surge; airlift prioritization C2 gaps exposed

Ukraine (2022–present)	Agility; civil-military nexus; EW	Response & Growth	Ramstein compressed decision cycles; commercial logistics fill C2 gaps; EW degrades digital C2
Romania–NATO Integration	Standardization; LOGFAS adoption	Readiness & Growth	ADAMS movement gap persists; lessons-identified-not-learned institutional pattern

Source: Authors, based on documentary analysis. eFP = Enhanced Forward Presence; LOGFAS = Logistics Functional Area Services; CLOP = Common Logistics Operating Picture; EW = Electronic

3. Case Studies

3.1 Enhanced Forward Presence (2017–present)

The Enhanced Forward Presence (eFP), established after the 2016 Warsaw Summit and subsequently expanded at the 2022 Madrid Summit [10], deploys multinational battle groups under the framework nation model — a C2 architecture in which one lead nation assumes operational command while contributing nations retain national logistics chains. Romania has hosted a France-led eFP Battle Group at Cincu since 2022 [10], with logistics support centered on Mihail Kogalniceanu Air Base, the Alliance's primary Black Sea logistics hub. As of 2024, the eFP posture has been progressively enhanced: battle group ceilings were raised, prepositioned equipment sets expanded, and multinational logistics coordination deepened under the Enhanced Vigilance Activity (EVA) framework [21].

In the readiness phase, eFP logistics demonstrated strong anticipation through prepositioned stocks, Host Nation Support (HNS) agreements, and Standing Logistic Orders (SLOs) that pre-authorize supply actions below specified thresholds, effectively delegating decision rights and compressing response time. The response phase revealed structural tension in multinational C2: parallel national logistics chains generate coordination friction under surge demand. Recovery dynamics are institutionalized through LOGFAS, though varying national adoption rates attenuate its utility during recovery operations. The key finding is that predelegated decision rights embedded in SLOs represent the critical C2 mechanism for the readiness-to-response

transition.

3.2 Steadfast Defender 2024 and Ukraine Conflict

Steadfast Defender 2024, NATO's largest exercise since the Cold War, with ~90,000 personnel, explicitly tested Eastern Flank reinforcement under Article 5 conditions [12]. Romania's Mihail Kogălniceanu served as primary air point of debarkation (APOD) while the Romanian Logistic Brigade coordinated HNS under a dual C2 relationship. The exercise revealed that LOGFAS data population speed under surge is a systemic constraint: units generated data at varying rates, degrading the Common Logistics Operating Picture (CLOP) precisely when visibility was most needed. Coordination seams between ACO and ACT logistics staffs manifested as conflicting prioritization of limited strategic airlift, a C2 decision-rights gap unresolved within exercise timescales.

The Ukraine conflict (2022–present) provides an unprecedented laboratory for large-scale logistics under contested conditions. The Ramstein Donor Coordination Platform developed ad hoc C2 arrangements with decision cycles measured in days rather than the weeks characteristic of formal NATO processes: achieved through simplified authority delegation, bilateral arrangements bypassing multilateral clearance, and intensive use of commercial logistics providers (Figure 1). Russian electronic warfare disrupted GPS-dependent logistics coordination, directly demonstrating the vulnerability of digitized C2 under EW pressure and underscoring the readiness-phase imperative of maintaining analogue backup procedures [8, 16].

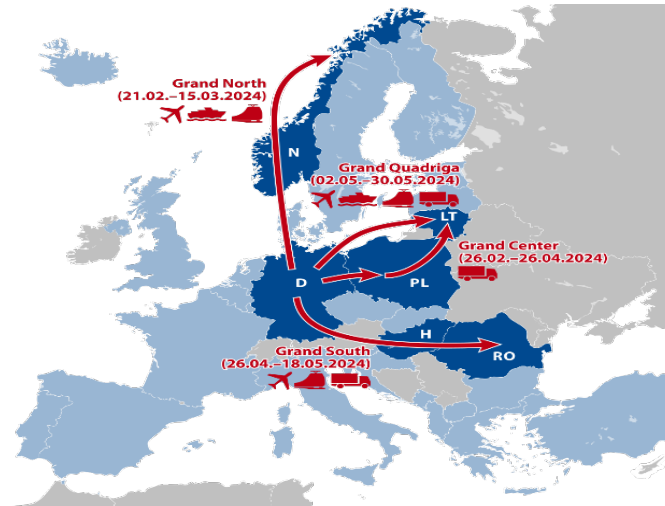


Figure 1: A map of the Quadriga 2024 maneuver with their four partial maneuvers

3.3 Romania–NATO Logistics Integration

Romania's integration into NATO collective logistics has accelerated since 2014, with key institutional developments including the NSPA Regional Support Centre at Bucharest [13], expanded HNS capacity at Mihail Kogălniceanu, and progressive LOGFAS implementation. The C2 architecture is multi-layered: Allied Land Command (LANDCOM) at Izmir provides strategic logistics C2; the Multinational Corps Southeast (MNC-SE) at Sibiu coordinates operational logistics; Romanian formations interface with Alliance systems through LOGFAS. Romanian military assessments [15] indicate that CORSOM (Movement Coordination Centre Europe) and LOGREP module adoption is relatively mature at brigade level and above, while the ADAMS movement module interface with civilian transport authorities remains incomplete, the most significant gap in the movement coordination chain. This pattern, lessons identified but not institutionalized, indicates that the growth phase of SCRes faces organizational inertia within the Romania–NATO logistics integration process [7].

3.4 Integrated C2–SCRes Framework

Synthesizing findings across the four case studies, we propose an Integrated C2–SCRes Framework (Figure 2) mapping C2 functions onto SCRes phases. The central argument is that effective military supply chain

resilience is fundamentally a C2 problem: authority

relationships, decision architectures, and coordination mechanisms determine how effectively logistics capabilities are mobilized under disrupted conditions.

In the readiness phase, anticipation, institutionalized through logistics estimates, pre-positioned stocks, and SLOs, reduces disruption probability and impact. In the response phase, decentralized decision rights operationalized through mission command compress activation time; the Steadfast Defender 2024 airlift conflict and Ukraine's Ramstein arrangements provide contrasting evidence of what pre-delegation failure and success respectively look like in practice. Recovery requires coordination across multiple actors, C2 coordination in this phase is primarily a function of LOGFAS interoperability, STANAG compliance, and established command

relationships. Growth requires adaptation: systematic capture and institutionalization of lessons through NATO's Lessons Learned Policy (MC 0458). Romania's LOGFAS integration exhibits the adaptation challenge most clearly, the organizational-command pathway from lesson identification to capability improvement remains insufficiently direct.

Table 1 presents the full framework matrix, and Table 2 provides the comparative case analysis.

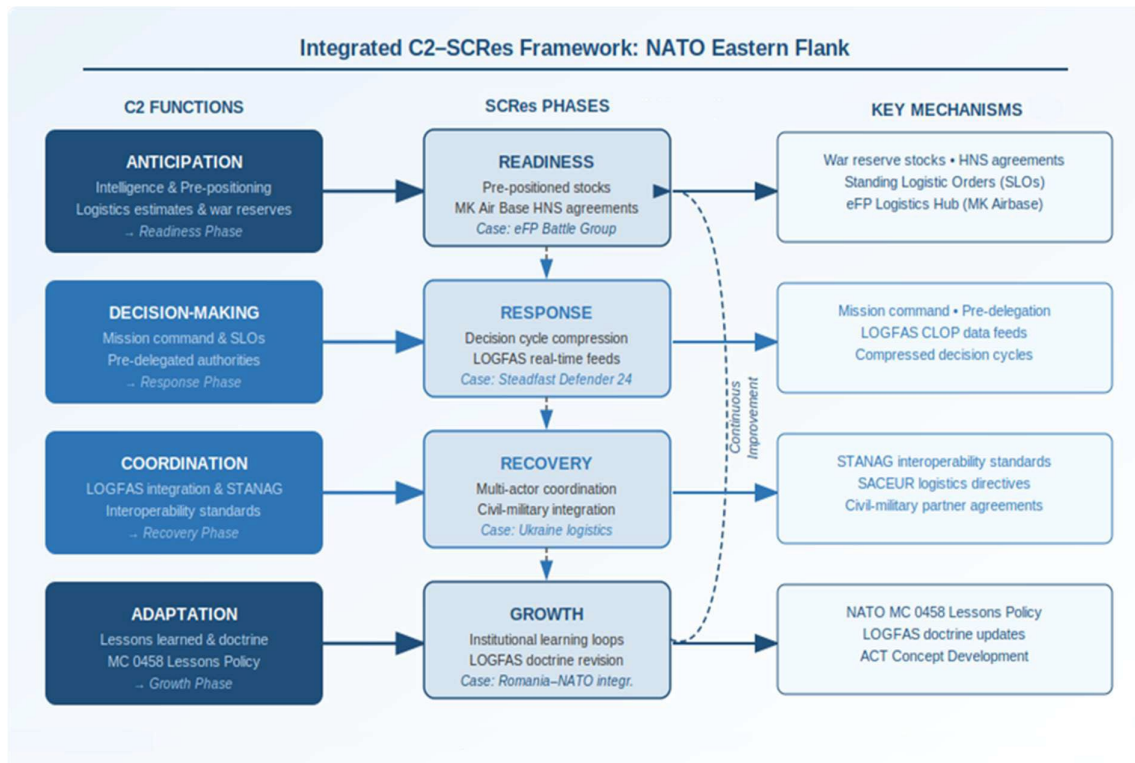


Figure 2: Integrated C2–SCRes Framework. Source: Authors, based on Hohenstein et al. [9] and Alberts & Hayes [1].

Table 2. Integrated C2–SCRes Framework: Functions, Mechanisms, and Applications

SCRes Phase	C2 Function	Key Mechanism	Application (Romania/NATO)
Readiness	Anticipation	Intelligence; logistics estimates; pre-positioning	eFP hub; MK Air Base stockpiling; HNS agreements
Response	Decision-Making	Mission command; SLOs; predelegated authority	LOGFAS real-time CLOP; standing NATOLog orders
Recovery	Coordination	Cross-functional integration; STANAG interoperability	SACEUR Log. Directive; Allied Land Command liaison
Growth	Adaptation	Lessons-learned loops; doctrine revision	ACT Concept Dev.; NATO MC 0458; Romanian TRADOC

Source: Authors, based on documentary analysis. SLOs = Standing Logistic Orders; HNS = Host Nation Support; LOGFAS = Logistics Functional Area Services; MK = Mihail Kogălniceanu; SACEUR = Supreme Allied Commander Europe; ACT = Allied Command Transformation

4. Discussion

4.1 Theoretical Contributions

This paper advances SCRes theory in three ways. First, it introduces the authority of command dimension as a structural feature of military supply chains that shapes resilience outcomes in ways not captured by existing frameworks developed in commercial or humanitarian contexts [6, 17]. Authority relationships, who directs logistics assets, under what conditions, and with what accountability, are constitutive of

military logistics resilience. Second, the framework disaggregates SCRes "flexibility" into procedural flexibility (what SLOs permit) and authority flexibility (who can authorize departures from standard procedure), analytically distinct constructs requiring different policy interventions. Third, the paper contributes to emerging literature on logistics resilience in contested environments where adversarial action targets both physical infrastructure and the C2 systems directing it [8, 20].

4.2 Practical Implications

For Romanian defence planners, three priority actions emerge:

- (1) completing LOGFAS ADAMS module integration with civilian transport authorities, the most critical gap in the logistics C2 architecture under surge;
- (2) expanding SLO scope to cover wider supply categories and higher thresholds, compressing response time without sacrificing accountability;
- (3) formalizing commercial logistics integration through standing arrangements defining C2 relationships and activation protocols. For NATO planners, investment in C2 digitalization must be accompanied by analogue backup capabilities and EW-resilient communication means, the Ukraine conflict demonstrates the cost of C2 fragility in contested electromagnetic environments [8].

4.3 Research Gaps and Limitations

Six research gaps are identified, each with associated near-, medium-, and long-term research implications:

(1) C2 digitalization under EW pressure. Examining LOGFAS latency and data integrity under electronic warfare conditions in NATO Eastern exercises. In the near term, this gap risks real-time CLOP degradation in high-intensity conflict; in the medium term, without resolution, LOGFAS-dependent decision cycles will be structurally slower than adversary action; in the long term, unaddressed digitalization fragility undermines Alliance interoperability investments across the Eastern Flank. Future research should develop simulation frameworks — combining EW environment models with LOGFAS load-testing — and pilot analogue fallback procedures in exercises such as Steadfast Defender and Griffin Lightning.

(2) Strategic stockpiling optimization. Optimal pre-positioning modelling calibrated to Romanian geography and eFP surge scenarios. Near-term, current pre-positioning reflects Cold War-era logics rather than contemporary Black Sea threat

geometry; medium-term, the absence of demand-modelling tools leaves Alliance reinforcement timelines exposed to logistics bottlenecks; long-term, unoptimized stocks risk fiscal inefficiency and operational under-resourcing simultaneously. Future research should apply operations research methods to NATO-sourced logistics data, integrating civilian infrastructure capacity into wargame-validated pre-positioning models.

(3) LOGFAS command integration across Eastern Flank HQs. Comparative study of adoption rates across Baltic, Polish, and Romanian headquarters. Near-term, uneven adoption produces asymmetric Common Operating Picture fidelity; medium-term, divergent adoption trajectories will widen capability gaps between Flank nations; long-term, failure to standardize risks fragmenting the Alliance logistics information architecture precisely where threat pressure is greatest. Future research should conduct structured interviews with J4 logistics staffs at MNC-SE, MNC-NE, and national corps headquarters to map adoption barriers and codify best-practice implementation pathways.

(4) Civil-military logistics interfaces. Formalizing contractor integration into C2 chains based on Ukrainian precedents [16, 22]. In the near term, informal contractor coordination — as observed in Ukraine — introduces accountability gaps and command ambiguity; medium-term, unregulated civil-military logistics interfaces create legal and operational exposure in Article 5 scenarios; long-term, the strategic weight of commercial logistics in contemporary conflict necessitates formal C2 doctrine. Future research should develop model standing arrangements for Host Nation commercial logistics activation, drawing on Ukraine Ramstein coordination lessons and Romanian national emergency frameworks.

(5) Cyber-resilient C2 architectures. Simulating supply chain disruptions from C2 network degradation via cyberattack. Near-

term, LOGFAS and NATO logistics networks represent high-value cyber targets with limited redundancy; medium-term, cyber-induced C2 degradation could paralyze logistics coordination during the critical first hours of an Article 5 activation; long-term, adversary cyber capabilities are advancing faster than NATO C2 hardening programmers. Future research should integrate cyber-wargaming methodologies into logistics exercise design, quantifying the operational impact of graduated network degradation scenarios.

(6) AI-assisted logistics anticipation. Piloting machine-learning demand forecasting integrated with the NATO Common Logistics Operating Picture (CLOP). Near-term, current CLOP relies on human-populated data with inherent latency; medium-term, without predictive analytics, Alliance logistics planning will remain reactive rather than anticipatory; long-term, adversary adoption of AI-enabled logistics will create a decision-cycle asymmetry unless NATO responds in kind. Future research should design pilot programmers integrating ML demand forecasting with LOGFAS data feeds, evaluated against surge-scenario benchmarks in partnership with ACT and the NSPA [23].

5. Conclusions

This paper has developed an Integrated C2-SCRes Framework through systematic

documentary analysis of four comparative cases: Enhanced Forward Presence, Steadfast Defender 2024, the Ukraine conflict, and Romania's NATO logistics integration. The framework's central finding is that military supply chain resilience is fundamentally a C2 problem: the authority relationships, decision architectures, and coordination mechanisms of C2 determine how effectively logistics capabilities are mobilized under disrupted conditions. Rapid decision-making through decentralized authority and flexible resource allocation emerges as primary antecedents to effective disruption recovery.

For Romania and NATO's Eastern Flank, three near-term priorities are identified: completing LOGFAS integration to close the logistics information gap, expanding predelegation authorities through SLOs, and formalizing commercial logistics integration arrangements. We also identify six gaps in current research: C2 digitalization, strategic stockpiling, LOGFAS integration, civil-military interfaces, cyber-resilient C2, and AI-assisted anticipation, the aforementioned constitute a structured agenda for the scholarly and practitioner community committed to strengthening logistics resilience on NATO's Eastern Flank, where the tools of deterrence and defense are directed by the C2 systems linking strategic intent to operational execution.

References

- [1] Alberts D. S., Hayes R. E. Understanding Command and Control. CCRP Publication Series, DoD; 2006. Available: <https://apps.dtic.mil/sti/html/tr/ADA457162/>. Accessed 04.15.2026.
- [2] Atkinson S. R., Moffat J. The Agile Organization. CCRP Publication Series; 2005.
- [3] Brandon-Jones E., Squire B., Autry C. W., Petersen K. J. A contingent resource-based perspective of supply chain resilience. *J Supply Chain Manag.* 2014; 50(3): 55–73. <https://doi.org/10.1111/jscm.12050>.
- [4] Brehmer B. The dynamic OODA loop. *Proc. 10th ICCRTS*; 2005.
- [5] Bryman A. *Social Research Methods*. 5th ed. Oxford University Press; 2016.
- [6] Christopher M., Peck H. Building the resilient supply chain. *Int J Logist Manag.* 2004; 15(2): 1–14. <https://doi.org/10.1108/09574090410700275>.
- [7] Ciobanu I., Popescu D. Territorial defence logistics: The Romanian case. *Rom J Def Stud.* 2022; 15(1): 22–41.

- [8] Dragoi A. Black Sea maritime logistics under A2/AD conditions. *J Strategic Stud.* 2023; 46(4): 789–812.
- [9] Hohenstein N.-O., Feisel E., Hartmann E., Giunipero L. Research on the phenomenon of supply chain resilience. *Int J Phys Distrib Logist Manag.* 2015; 45(1/2): 90–117. <https://doi.org/10.1108/IJPDLM-05-2013-0128>.
- [10] NATO. Madrid Summit Declaration [Internet]. NATO;2022. https://www.nato.int/cps/en/natohq/official_texts_196951.htm. Accessed 04.15.2026
- [11] NATO. AJP-01: Allied Joint Doctrine (Ed. F, Ver. 1). NATO Standardization Office; 2023.
- [12] NATO Allied Command Transformation. Steadfast Defender 2024: Exercise summary and lessons identified. HQ SACT; 2024.
- [13] NATO Support and Procurement Agency. Annual Report 2023 [Internet]. NSPA; 2023. <https://www.nspa.nato.int>. Accessed 03.15.2026.
- [14] Ponomarov S. Y., Holcomb M. C. Understanding the concept of supply chain resilience. *Int J Logist Manag.* 2009; 20(1): 124–143. <https://doi.org/10.1108/09574090910954873>.
- [15] Romanian Ministry of National Defence. White Paper on Defence [Internet]. Romanian MND; 2020. <https://www.mapn.ro>. Accessed 05.10.2026.
- [16] Martin, B., Barnett, D. S., & McCarthy, D. (2023). Russian Logistics and Sustainment Failures in the Ukraine Conflict: Status as of January 1, 2023. RAND Corporation, RR-A2033-1, https://www.rand.org/pubs/research_reports/RRA2033-1.html. Accessed 03.10.2026.
- [17] Tachizawa E. M., Yew Wong C. Towards a theory of multi-tier sustainable supply chains. *Supply Chain Manag.* 2014; 19(5/6): 643–663. <https://doi.org/10.1108/SCM-02-2014-0070>.
- [18] Wieland A., Wallenburg C. M. The influence of relational competencies on supply chain resilience. *Int J Phys Distrib Logist Manag.* 2013; 43(4): 300–320. <https://doi.org/10.1108/IJPDLM-08-2012-0243>.
- [19] Yin R. K. Case Study Research and Applications. 6th ed. SAGE Publications; 2018.
- [20] Zsidisin G. A., Wagner S. M. Do perceptions become reality? *J Bus Logist.* 2010; 31(2): 1–20. <https://doi.org/10.1002/j.2158-1592.2010.tb00140.x>.
- [21] NATO Vilnius Summit Communique, 2023. <https://www.nato.int/en/about-us/official-texts-and-resources/official-texts/2023/07/11/vilnius-summit-communique>. Accessed 03.26.2026
- [22] Kofman, Lee & Fink, War on the Rocks, 2023. <https://warontherocks.com/most-read-war-on-the-rocks-articles-of-2023/>. Accessed 02.20.2026.
- [23] NATO ACT, Logistics Innovation: AI and ML in NATO Supply Chains, 2024. <https://www.nato.int/en/what-we-do/deterrence-and-defence/natos-role-in-logistics>. Accessed 03.15.2026.