Infantry, Not Autonomy:

Why the Future of Warfare Still Depends on Humans at the Edge

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Abstract

The war in Ukraine has catalysed a doctrinal inflection point. While often portrayed as a watershed for autonomous systems and drone warfare, the conflict has, paradoxically, reaffirmed the primacy of infantry in determining strategic outcomes. This paper argues that the widespread deployment of unmanned systems by Ukrainian forces was not the result of pre-war doctrine, but a necessity borne of attritional crisis, a compensatory response to the exhaustion of its trained ground forces and the overwhelming volume of Russian artillery. Through a review of battlefield evolution from 2022 to 2025, this study traces the transition from high-lethality, decentralised infantry warfare to static firepower attrition, and ultimately to standoff drone saturation. It finds that while drones extended reach and preserved capability, they could not substitute for the functions of human soldiers in clearing, holding, stabilising, and exploiting ground. The paper introduces a new category of military capability: edge-executed, doctrine-aligned decision support, logic systems embedded alongside the operator, not in place of them. These systems are emerging as critical enablers for infantry survivability and lawful execution in contested electromagnetic environments. The analysis concludes with implications for force design, procurement priorities and human-machine integration in NATO-aligned militaries.

1. Introduction and Literature Positioning

The full-scale Russian invasion of Ukraine in February 2022 marked the largest land conflict in Europe since the Second World War. As Russian forces surged across the border, many Western analysts predicted a short, high-intensity campaign defined by conventional force-on-force dynamics, driven by superior Russian mass and firepower. However, what unfolded was an operational and strategic surprise: Russia's initial momentum was stalled, then reversed, by a highly decentralised Ukrainian defence grounded in light infantry manoeuvre, terrain exploitation, and shoulder-launched anti-armour weapons. This early phase of the war reaffirmed what decades of counterinsurgency and high-tech procurement cycles had often neglected: infantry, when enabled and empowered, remain decisive.

Yet as the conflict evolved, so too did the character of war. By mid-2022, the frontline had ossified into entrenched positions, dominated by saturation artillery and supported by defensive depth. Battles in places like Bakhmut and Avdiivka became grinding contests of endurance. Faced with high casualties and an accelerating depletion of trained personnel, Ukraine was forced to adapt, not through traditional mobilisation, but through innovation. The solution was not doctrinally planned; it emerged from necessity. Drone warfare became the proxy for manpower Ukraine could no longer afford to lose.

Across 2023 and into 2025, Ukraine transformed itself into the most drone-integrated battlefield force in history. FPVs, loitering munitions, long-range autonomous strike platforms, and AI-assisted targeting systems were deployed in layered combinations to disrupt Russian tempo and suppress artillery advantage. But even at the peak of this technological adaptation, a growing body of military analysis and field reporting began to converge on a critical insight: drones could shape the fight, but they could not decide it. The tasks of clearing, consolidating, holding and stabilising ground, the essential functions of strategic control remained exclusively human.

Literature Positioning

This paper draws on validated battlefield data, doctrinal shifts, and procurement responses across NATO and Ukrainian forces from 2022–2025. It advances the argument that the most urgent capability gap now facing Western-aligned militaries is not autonomous firepower, but embedded cognitive support for infantry under contact. In other words: not less human presence, but more human survivability.

There exists a substantial and growing body of research on the role of autonomy and unmanned systems in modern conflict. Works such as Scharre's Army of None (2018) and Horowitz's studies on military innovation have shaped much of the contemporary policy conversation around autonomy and lethality. More recent publications, such as Watling and Reynolds' work for RUSI (The Russia–Ukraine War: Lessons for Western Forces, 2023), have begun to reflect the complexity of the Ukrainian battlespace, including the role of improvisation, technical adaptation and human-machine teaming.

However, a gap remains in the literature: most analyses treat drones and autonomous systems as either revolutionary actors in their own right or as evidence of an ongoing technological tipping point. This paper departs from that frame. It does not argue against drone warfare, rather, it places it within the broader arc of force design. It asserts that drones emerged as a tactical bridge, not a doctrinal destination. It also introduces a concept under-represented in the current literature: runtime-executed, doctrine-aligned decision logic at the edge, designed not to replace infantry but to restore their cognitive overmatch under pressure.

By recasting the Ukraine war not as a story of autonomous systems, but as a story of human adaptation under technological constraint, this paper seeks to reframe strategic procurement, battlefield AI integration and the future role of infantry in NATO-aligned doctrines.

2. The Early War (Feb–May 2022): Infantry as Asymmetric Overmatch

The opening phase of Russia's full-scale invasion of Ukraine in early 2022 unfolded in a manner that confounded many strategic forecasts. Expectations had centred on a Russian lightning offensive, a rapid decapitation of the Ukrainian government through airborne assault, followed by armoured advances intended to overwhelm defences before NATO or international support could meaningfully intervene. In reality, the early months of the war revealed a different picture: one in which Ukrainian infantry, enabled by modern anti-tank weapons and decentralised command, imposed a severe cost on Russian manoeuvre forces.

Ukraine's resistance during this phase was characterised by:

- Tactical agility in urban and semi-urban terrain
- High lethality per soldier, driven by modern Western anti-armour systems
- Decentralised authority, allowing junior commanders and even squad leaders to act autonomously
- Local knowledge of terrain, used to set ambushes, channel advances and deny key routes

During the battles for Kyiv, Chernihiv and Sumy, Ukrainian forces successfully ambushed and destroyed dozens of Russian battalion tactical groups (BTGs). In many instances, infantry units as small as platoon or section strength were responsible for disabling columns of armour by exploiting choke points, terrain features, and the vulnerability of Russian logistics. The reliance on NLAWs (Next generation Light Anti-tank Weapons), Javelin missiles and Stugna-P systems allowed light units to defeat armour with high precision and at relatively low risk.

Operational Outcomes

According to data compiled by the Institute for the Study of War (ISW) and verified by multiple open-source intelligence (OSINT) platforms (e.g. Oryx), Ukraine destroyed over 1,000 Russian tanks and armoured vehicles in the first two months of the war, with a large portion attributed to man-portable systems rather than air or artillery strikes. The city of Bucha became emblematic of this early attrition, with column after column of Russian vehicles destroyed in urban bottlenecks.

Furthermore, the failed Russian airborne assault on Hostomel Airport underscored the effectiveness of ground-based Ukrainian resistance. Paratroopers, intended to act as a vanguard force, were isolated and eventually neutralised when follow-on mechanised support was delayed or interdicted by Ukrainian ambushes.

This period represented a form of doctrinal inflection for Ukraine. The pre-2022 Ukrainian Armed Forces were not structured for long-term expeditionary war, nor did they possess deep reserves of trained infantry. However, the experience of 2014–2015 (Crimea and Donbas) had led to the cultivation of a resilient, flexible cadre of junior leaders, particularly within airborne and territorial defence formations. These units, in combination with the mass mobilisation of volunteers, formed the foundation of the early resistance.

NATO training programmes under the Joint Multinational Training Group-Ukraine (JMTG-U), in particular those led by the UK, Canada, and the US, had focused heavily on small-unit leadership, fire team manoeuvre and independent decision-making at the squad level. This emphasis on non-commissioned officer empowerment proved decisive in the face of Russian command rigidity.

Implications for Force Design

This early phase provides a powerful counterpoint to theories of platform dominance.

It demonstrated that under the right conditions, namely, local initiative, anti-armour capability and environmental familiarity. Light infantry could deliver strategic effects against a conventionally superior force. The lesson was not about mass but about coherence at the tactical edge, enabled by mission clarity and empowered decision-making.

However, this period was short-lived. The tempo that allowed infantry to roam, strike, and reposition soon collapsed under the weight of Russia's doctrinal fallback: industrial artillery saturation. As the war transitioned into its second year, the very infantry that had proven decisive began to suffer unsustainable losses.

This leads to the next phase of analysis: the war's regression into firepower attrition and the consequential pressure to find technological substitutes for human force.

3. The Industrial Phase (Mid-2022–2023): Artillery Dominance and Infantry Attrition

As the initial Russian offensive faltered and Kyiv remained in Ukrainian hands, the character of the war shifted dramatically. By mid-2022, Russia had abandoned hopes of a rapid collapse and instead entrenched itself in the eastern and southern theatres. The conflict entered a new phase: one increasingly defined not by mobility or manoeuvre, but by attrition, positional warfare and saturation firepower.

Russia reverted to its historic strength: artillery dominance, supported by extensive defensive layering and deep logistical lines. The Donbas region became the focal point of this transformation. Cities such as Sievierodonetsk, Lysychansk, and later Bakhmut and Avdiivka became battlegrounds not for tactical movement, but for the ability to absorb and deliver enormous volumes of indirect fire.

Russian Artillery Doctrine: Scale and Saturation

Russian artillery usage during this period has been estimated at peaks of 40,000–60,000 shells per day, particularly in 2022–2023 offensives. This firepower was concentrated in narrow sectors, creating devastating local superiority. According to NATO intelligence summaries and corroborated by Defence Express reporting (2023), Russia maintained a 6:1 or greater artillery ratio over Ukrainian forces throughout most of 2022.

This disparity was further supported by:

- Pre-positioned ammunition stocks dating back to the Soviet era
- Shorter logistical chains due to operational proximity to Russian borders
- A political willingness to absorb high levels of equipment and personnel loss

The result was a battlefield shaped not by initiative, but by the ability to withstand and respond to sustained bombardment.

Ukrainian Constraints and Casualties

Ukrainian infantry, particularly those defending critical towns, bore the brunt of this firepower. Trench warfare returned in its most brutal form, with soldiers enduring near-constant shelling, drone-directed strikes and infantry assaults layered into artillery patterns.

Battlefield reporting and multiple open-source casualty analyses suggest that Ukraine experienced unsustainable infantry losses during this period. For instance:

- In Bakhmut, Ukrainian troops reportedly faced casualty rates of 200–400 per day at peak intensity, according to BBC and ISW battlefield assessments (Dec 2022 – May 2023).
- In Avdiivka, a similar defensive posture was held at great cost, with Russia committing wave tactics while Ukraine countered with diminishing reserves and limited counter-battery capability.

The burden fell disproportionately on:

- Airborne and special forces units used as frontline stabilisers
- Newly mobilised infantry with insufficient time for full-spectrum training
- Volunteer Territorial Defence forces lacking heavy equipment or logistical endurance

Stretched Command and Tactical Exhaustion

Compounding the physical attrition was the cognitive fatigue suffered by frontline commanders. Ukraine's decentralised tactical model, so effective in mobile defence, struggled under the static, fire-dominated conditions of entrenched warfare. Commanders faced:

- Overwhelming ISR feeds and limited staff support
- High tempo casualty replacement disrupting unit cohesion
- Inability to manoeuvre without entering prepared kill zones

This phase exposed a growing contradiction:

The Ukrainian infantry, once the source of tactical overmatch, had become the bottleneck.

And with no capacity to match Russia shell-for-shell, Ukraine faced a critical decision point. It could not regenerate trained infantry quickly enough. It could not sustain artillery duels. It needed a survivable, cost-effective method of striking. One that preserved human capital and restored tempo.

Doctrinal Stress and Technological Turn

It was under this pressure, not under the banner of innovation for its own sake, that Ukraine began its pivot to stand-off strike capability using unmanned systems.

This was not a doctrinal evolution in the Western sense. It was a battlefield necessity.

And it would reshape the next two years of the war.

4. The Drone Pivot (2023–2025): Standoff by Necessity

As the war approached its second year, Ukraine found itself facing a profound operational dilemma. Infantry casualties had mounted to unsustainable levels. Its artillery, while increasingly Western-supplied, remained outmatched in both volume and replenishment rate. And despite strategic successes in the Kharkiv and Kherson offensives, it was clear by late 2022 that decisive manoeuvre had been supplanted by fortified positions and firepower-driven attrition.

What emerged from this crucible was not a pre-planned doctrine of unmanned dominance, but a distributed, improvised and eventually formalised pivot toward drones. This was not a luxury. It was a compensatory adaptation, a way to continue fighting, disrupting and surviving without sacrificing further human capital.

Civil-Military Fusion and Tactical Innovation

Ukraine's embrace of drones was radical in its speed, scale and grassroots character. While military procurement systems around the world have often struggled to integrate emerging technologies at pace, Ukraine's survival imperative dissolved bureaucratic resistance.

By early 2023, a national drone mobilisation effort had been launched, engaging:

- Civilian drone hobbyists, who modified DJI-style quadcopters for ISR and strike use
- Volunteer-funded drone brigades, often operating semi-independently within brigade formations
- Ukrainian defence-tech startups, producing thousands of airframes and FPV kits per month

The Army of Drones initiative, launched in partnership with the Ukrainian Ministry of Digital Transformation, became the first state-backed, civil-military fusion drone programme of its kind in wartime. According to Ukrainian MOD data and reporting from Defence24 (2023), Ukraine was fielding between 10,000 and 30,000 drones per month across all categories by late 2023.

Layered Drone Doctrine

What began as tactical improvisation coalesced into a layered employment concept by 2024:

1. ISR Drones Fixed-wing and rotary systems used for artillery spotting, target validation, and patrol overwatch
2. FPV Kamikaze Drones Manually piloted, low-cost systems carrying shaped charges or fragmentation warheads used to strike tanks, trenches and personnel
3. Loitering Munitions Higher-end drones (e.g., RAM II, SHARK) capable of semi-autonomous engagement at medium range
4. Long-Range Strike Drones – Strategic operations against oil depots, airfields, and early-warning radars inside Russia, including Moscow and Engels Air Base

A defining moment came with Operation Spider Web (June 2025), during which 117 drones struck five Russian airfields, destroying or damaging at least 20 strategic aircraft. The strike, using preloaded mission routes, onboard logic and denied GPS environments, marked the high point of Ukraine's standoff capability.

AI Guidance and EW Resistance

To survive increasingly dense Russian electronic warfare, Ukrainian drone teams began integrating:

- Onboard visual recognition systems, reducing dependency on pilot feeds
- AI-enhanced navigation algorithms, capable of terrain-matching and signal hopping
- Pre-encoded flight paths, enabling "fire-and-forget" missions without real-time control

These enhancements allowed Ukraine to maintain tempo even as Russia deployed jammers, spoofers and electronic countermeasure units. Notably, Ukraine's "Osa" FPV drones, launched in 2025, demonstrated autonomous strike capability in EW-contested zones. A technological milestone for tactical drone warfare.

Operational Impact

Drone integration allowed Ukraine to:

- Sustain counter-battery operations at depth without artillery parity
- Conduct deep strike disruption of fuel, rail and C2 nodes
- Deny Russian rear-area sanctuaries that were previously unreachable
- Compensate for the manpower gap created by infantry attrition

Drones created friction, ambiguity and loss of initiative across Russian tactical and strategic levels. However — and this became increasingly clear by mid-2025 — they did not replace the infantry's role in exploiting or consolidating gains.

Limitations of the Drone Paradigm

By late 2024, several operational and doctrinal limitations became visible:

- Drones did not hold ground positions cleared by strikes often reverted without human follow-on
- EW countermeasures escalated degrading drone efficacy in some front-line zones
- Drone losses rose with up to 50% attrition on some missions, as reported by Ukrainian open-source drone brigades
- Moral asymmetry emerged public concern over remote warfare without stabilising human presence in liberated towns

The result was a paradox: Ukraine had built one of the most advanced drone-enabled forces in the world, yet could not convert that advantage into territorial control without returning to infantry-enabled operations.

Conclusion of the Pivot Phase

Ukraine's drone pivot was an extraordinary demonstration of national resilience, technological agility, and operational ingenuity. It temporarily reversed the tempo imbalance, allowed for cost-effective strategic strikes and denied Russia a sense of rear-area security.

But it did not — and could not — decide the war.

For that, the soldier was still needed.

And increasingly, attention turned to the next challenge: how to support those soldiers cognitively, doctrinally and technically in a battlespace now defined by fragmentation, saturation and ambiguity.

5. Strategic Reversion (2024–2025): Infantry as the Centre of Gravity

By the end of 2024, the strategic narrative that had celebrated drones as the new kings of the battlefield began to fracture. Despite the undeniable tactical success of Ukraine's drone-centric approach, including deep strikes, artillery suppression and asymmetric disruption. The operational reality revealed a consistent limitation: drones could not hold what they had cleared.

This realisation triggered a doctrinal reversion. Not a retreat from innovation, but a rediscovery of the irreplaceable strategic utility of infantry. Ukraine's own planners, as well as NATO analysts and observers, began to re-emphasise the role of the human soldier not as a supplement to autonomy, but as the centre of gravity in modern, layered warfare.

Why Drones Could Not Close the Loop

Several key observations led to this reorientation:

- **Lack of Consolidation**

Positions degraded by drone attack were often reoccupied by Russian forces within hours or days. Ukrainian forces lacked sufficient infantry depth to stabilise gains without risking additional attrition.

- **Human Presence as Political Capital**

In areas where drones struck but no Ukrainian troops followed, Russian psychological operations and propaganda were able to claim continuity of control. Where Ukrainian soldiers physically entered and raised flags, the political and psychological weight of liberation was palpable.

- **EW Adaptation and Diminishing Returns**

By mid-2025, Russia had begun to saturate key sectors with layered electronic warfare systems. This sharply degraded the reliability of drone reconnaissance and strike missions, especially in contested areas like Zaporizhzhia and Kupiansk.

- **Rear-Area Penetration ≠ Frontline Breakthrough**

Strategic drone strikes in Crimea and central Russia disrupted fuel flows and airbase operations but failed to produce tactical breakthroughs at the front. Without infantry to exploit the disarray, these strikes became tempo interruptions, not decision enablers.

- **Civil–Military Disconnect**

As drone operations expanded in strategic reach, they also became more remote both physically and emotionally — from the Ukrainian public. Footage of drone kills travelled quickly, but so did images of destroyed towns without Ukrainian presence. Morally and politically, the absence of infantry after a strike was interpreted as abandonment.

The Infantry's Enduring Value in the 2025 Battlespace

This forced both Ukrainian planners and NATO-aligned observers to revise assumptions. Infantry was not an anachronism, it was the strategic mechanism by which war is made real.

- Infantry holds ground. They stabilise liberated populations and enforce new lines of control.
- Infantry exploits disruption. When drone strikes disorganise enemy defences, only human units can manoeuvre through the resulting gaps.
- Infantry ensures legitimacy. Civilians do not surrender to a drone. They surrender to a soldier who can provide order.

Doctrine Revisions and Procurement Responses

In response to these real-world dynamics, a number of doctrinal and structural changes began to emerge in 2024–2025:

- Ukraine launched new mass infantry training programmes with accelerated but enhanced survivability doctrine. These focused not on traditional mass mobilisation, but on creating small, doctrinally enabled, survivable infantry teams.
- NATO lessons-learned briefs began to prioritise infantry support enablers over expensive autonomy programmes. The focus shifted toward equipping dispersed soldiers to survive and operate in contested electromagnetic and physical terrain.
- UK and Scandinavian military reviews re-emphasised "strategic presence" over standoff-only capabilities. This included investment in distributed logistics, doctrinally-aligned battlefield logic tools, and manned overwatch for drone teams.

Not a Rejection of Drones — But a Rebalancing Around Humans

Importantly, this shift does not represent a rejection of drones or autonomous systems. Rather, it is a rebalancing of expectations and a redesign of integration.

The new consensus is clear:

- Drones are best understood as enablers, not finishers.
- Autonomous systems can shape the battle, but only humans can secure it.
- Without infantry, there is no strategic permanence, only tactical disruption.

The Emerging Battlefield Equation

The war in Ukraine is increasingly characterised by a new formula:

Drones shape. Artillery suppresses. Logic supports. But infantry decides.

The rest of this paper now turns to the capabilities required to support that infantry. Not by replacing them with AI, but by restoring cognitive overmatch under fire, through systems designed to work with them, not instead of them.

6. Decision Support at the Edge: A New Class of System

If the Ukrainian experience has reaffirmed the primacy of infantry, it has also exposed the scale of cognitive and operational burden now placed upon them. Today's dismounted soldier is not only a shooter, observer and communicator. They are, increasingly the node through which fragmented data, inconsistent orders, degraded comms and doctrinal ambiguity must be resolved. In real time, under fire and often in isolation.

This is not simply a problem of leadership or equipment. It is a systems architecture gap.

What the frontline soldier lacks is not motivation, nor even situational awareness but trusted cognitive augmentation: a way to make doctrinally sound, legally compliant and operationally effective decisions in the absence of full connectivity or centralised oversight.

This paper introduces a conceptual solution to this gap: a new class of system best described as edge-executed, doctrine-aligned decision support.

What These Systems Are — And Are Not

These systems are not autonomous weapon systems. They do not seek to replace the human in the loop. Instead, they:

- Embed runtime-executed logic alongside the operator, not in the cloud
- Translate pre-authorised mission rules, ROEs, and doctrinal playbooks into adaptive logic frameworks
- Operate in low-power, low-bandwidth environments, including under jamming or electromagnetic denial
- Fuse sensor inputs, mission context, and legal parameters into actionable prompts or warnings

They are silent co-pilots. Not decision-makers, but doctrinal filters. Ensuring the soldier is never left with signal overload, legal uncertainty, or tactical paralysis.

In effect, they are battlefield interpreters of intent, running in software, hosted at the tactical edge.

Why They Are Needed

The cognitive demand on frontline units is now unprecedented. Consider:

- Jammed comms in EW-contested sectors leave junior leaders without support or fallback
- Multiple ISR feeds from drones, manned platforms and sensors arrive asynchronously, often uncorrelated
- ROEs shift by district and target type, requiring real-time updates that may never reach the edge in time
- Situational ambiguity, such as unclear friend/foe status in drone footage or disputed civilian presence, turns hesitation into mission failure

No human, unaided, can be expected to resolve this in the moment.

Doctrine alone cannot save them.

Autonomy risks overreach.

What's needed is logic. Runtime-executed, human-aligned logic, that supports the user without overpowering them.

Key Characteristics of Edge-Based Decision Logic Systems

- **Local Execution**

Runs on ruggedised, soldier-borne or vehicle-mounted systems without relying on cloud infrastructure or uninterrupted satellite comms.

- **Clause-Level Doctrinal Encoding**

Captures unit-specific ROE, mission playbooks, legal triggers and engagement thresholds in executable form. Preserving both control and compliance.

- **Fail-Operational Design**

Continues to support decision-making even when disconnected, degraded, or under cyber/EW compromise.

- **Human-Centric Interface**

Provides lightweight, unobtrusive decision nudges, not command overrides. Ensuring the operator retains judgment, while operating within known mission parameters.

- **Auditability**

Enables lawful and accountable decision chains. Not through surveillance, but through transparent logic flows that can be reviewed and interrogated after action.

Strategic Role in Future Conflict

This new class of system is not a weapon.

It is a survivability architecture.

It is how we restore tempo when comms fail.

How we maintain legality when centralised oversight is impossible.

And how we enable doctrine to scale, not through staff officers and paperwork, but through embedded logic running quietly beside the warfighter.

The power of such systems is not in what they do, but in what they prevent:

- Preventing hesitation under uncertainty
- Preventing unlawful engagements through overload or confusion
- Preventing mission failure when the network goes dark

Why Now

The convergence of battlefield saturation, drone saturation, electronic warfare and doctrine fragmentation has created the perfect storm. Infantry are more decisive than ever and more exposed to complexity than ever.

If we do not provide them with systems that translate intent into executable logic under fire, we risk designing forces that are technologically rich but cognitively bankrupt at the edge.

And that is a war no software can win.

7. Procurement and Policy Implications: Rewiring Spend Around Survivability and Execution

Modern militaries have spent the past two decades reconfiguring procurement strategy around a particular set of assumptions: that centralised networks, persistent connectivity, exquisite ISR and platform superiority would offset manpower risks and enable precision dominance. The war in Ukraine has comprehensively challenged this logic.

In the crucible of real, contested, large-scale conflict, it has become evident that tactical survivability and doctrinal execution under pressure are now the true limiting factors in force effectiveness. Systems that cannot survive the network going down are not systems, they are liabilities. Platforms that require cloud access to decide are brittle. Troops that cannot act lawfully under degraded conditions are paralysed.

If procurement does not adapt to these facts, then technology will continue to evolve in ways that outstrip its usefulness.

Reprioritising the Procurement Hierarchy

The current paradigm tends to favour investment in:

- Large, long-lead platforms (e.g. armoured vehicles, drones, ISR aircraft)
- Top-down C2 systems with persistent data demands
- Centralised AI capabilities requiring data-centre-level compute and integration

But the operational environment demands a reverse weighting. The edge must now come first.

Procurement must shift toward:

- **Edge-Deployed Decision Support**

Software-defined logic systems that empower small infantry teams to interpret, decide and act doctrinally under duress

- **Low-SWaP Survivability Kits**

Ruggedised, mission-specific systems that increase cognitive protection and execution speed, not just physical protection

- **Runtime-Adaptive Systems**

Tools that can be updated pre-mission, embedded with clause-level logic, and executed without reliance on external feeds

- **Human-in-the-Loop Platforms with Cognitive Alignment**

Systems that keep operators in control without demanding constant input or perfect connectivity. Providing ambient rather than autonomous support

- **Procurement Accelerators Focused on Infantry Enablement**

Reforming acquisition channels to allow low-cost, low-latency field capability to scale faster than gold-plated, slow-moving programmes

Strategic Consequences for NATO and Allied Forces

The Ukraine conflict has catalysed a new recognition among Western planners:

- Light infantry is not cheap it is mission-critical
- Edge survivability is not an afterthought it is a capability tier in its own right
- Ambient logic support is no longer optional it is what enables distributed operations to remain lawful, effective and scalable

This should influence not only what is purchased, but how effectiveness is measured.

Force design must move beyond platform counts and data bandwidth to consider:

- How many decisions can be executed at the edge within 10 seconds?
- How many infantry teams can operate doctrinally even when blind to HQ?
- How many missions can proceed legally and with tempo even under comms denial?

These are now strategic metrics and the systems that support them must be procured accordingly.

Doctrine as Code: Enabling Execution, Not Automation

Perhaps most urgently, procurement must embrace the idea that doctrine must now be executable in code. Not as a replacement for command, but as a protective framework.

This is a philosophical pivot:

- From autonomy to alignment
- From systems that guess, to systems that understand the rules
- From software that interprets data, to software that interprets mission context

Just as ROE are briefed and absorbed before contact, future systems must carry them as logic and enforce them in runtime, with the operator always in command.

Recommendation to Policy-Makers

1. Define and protect the new category of edge logic support. Include it in capability roadmaps
2. Fund runtime systems through fast-lane innovation tracks, outside legacy platform acquisition cycles
3. Mandate auditability and fail-operational design in all cognitive support tools, ensuring both trust and survivability
4. Educate tactical commanders in the use of embedded decision systems as force multipliers, not replacements
5. Benchmark new metrics for battlefield success: tempo under denial, lawful action under ambiguity, mission execution with minimal overhead

The Policy Crossroads

Nations are now at a strategic fork in the road.

They can:

- Continue chasing autonomy at scale and risk fielding brilliant machines but paralysed operators

Or:

- Invest in human-led warfare with cognitive edge support and build survivability into every contact

The first path is attractive in theory.

The second path wins wars.

8. Conclusion and Further Research

The war in Ukraine has, through pain and innovation, revealed the future shape of warfare. That future is not post-human. It is hyper-contested, cognitively saturated and brutally human-dependent. It is a battlefield where small units, often disconnected, must make lawful decisions under fire. A battlefield where platforms matter less than the ability to act now, lawfully, and with clarity. Even when the network is down and ambiguity reigns.

Drones have changed how wars are fought. But they have not changed who wins them.

The decisive actor remains the infantry soldier. Not simply because they can shoot, but because they are the only actor who can clear, hold, reassure and stabilise.

Yet the burden on that soldier has become intolerable.

They are surrounded by data, disconnected from hierarchy and forced to make split-second decisions that carry operational and political consequences.

This paper has argued that what they need is not replacement, but reinforcement.

Not autonomy, but embedded logic.

Not artificial intelligence in the cloud, but ambient decision support at the edge, aligned with their mission, their doctrine and their intent.

Strategic Summary

- The early Ukrainian war effort showcased infantry-led asymmetry, not platform superiority.
- Russian artillery dominance in 2022–2023 broke tempo and forced a shift to standoff strike.
- Drones filled a vital gap, but by 2024–2025, their strategic limits were clear: they could not occupy or consolidate.
- A reversion to infantry-led operations emerged. Not nostalgically, but out of operational necessity.
- A new capability class is now needed: edge-executed, doctrine-bound logic systems that make the infantry more survivable, lawful and effective under ambiguity.

This is not a rejection of AI or autonomy.

It is a demand that we apply them in the right place, at the right time, for the right reason. In support of the only actor that can ultimately win a war: the human.

Recommendations

1. Reallocate procurement priority toward infantry survivability through embedded logic tools.
2. Mandate mission-specific logic deployment as part of standard operating procedures in contested environments.
3. Develop a shared doctrine-to-runtime pipeline across NATO forces to ensure lawful edge decision support at scale.
4. Reframe cognitive load as a battlefield vulnerability and fund systems that mitigate it as critically as body armour or air defence.

Further Research

The following domains merit urgent exploration by policymakers, defence technologists and military strategists:

- Quantitative modelling of operator decision tempo with and without embedded edge logic

- Longitudinal studies of human–runtime teaming in contested environments

- Simulated denial environment testing for runtime systems across infantry formations

- Legal auditability frameworks for clause-level logic execution

- Interoperability standards for doctrine-as-code across multinational task forces

This future will not be won by firepower alone.

It will be won by humans who can act under fire, with clarity, speed and lawful effect. Backed not by dashboards, but by decision logic that travels with them.

The conclusion is simple. The design challenge is urgent.

And the answer is already walking the battlefield.

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