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Defense Innovation at an Inflection Point

The Rise of New Primes like Anduril and the Changing Military-Tech Ecosystem

David T. Caldwell[1]

Introduction

Few periods in modern history rival the current pace of technological transformation witnessed by the defense sector. Over the past few years, the United States Department of Defense (DoD), along with allied militaries worldwide, has grappled with rapid shifts in the global security environment. From the use of drones in Ukraine and the Middle East to advanced naval threats in the Indo-Pacific, the urgency to develop flexible, cost-effective, and AI-driven solutions is clear. Traditional defense contractors—such as **Lockheed Martin**, **Boeing**, and **Raytheon**—still command the lion's share of government budgets, but a fresh cohort of **"new-prime"** or **"disruptor"** startups is beginning to prove their mettle.

Anduril Industries, founded in 2017, epitomizes this emergent wave[2]. With a software-centric approach, private venture capital funding, and a willingness to build prototypes before official government solicitations, the company has rapidly expanded. Yet, Anduril's achievements are neither isolated nor monolithic. A broader reconfiguration of the defense-industrial landscape is unfolding—one that includes **Palantir**, **Epirus**, **Scale AI**, and more, all seeking to reimagine how advanced technologies integrate with large-scale military programs.

In this essay, we delve into the intersection of high-tech autonomy, software-driven development, and contemporary defense imperatives. While Anduril figures prominently—given its multi-billion-dollar valuation and major contracts—this narrative extends beyond one company. It is a story about how militaries are rapidly adapting to new paradigms, the challenges (and controversies) that come with disruptive innovation, and the future trajectory of a sector once characterized by big, slow, and expensive platforms.

[1] David T. Caldwell is a defense writer focusing on national security, military innovation, and U.S. foreign policy. With a background in political science and years of field research, he offers clear, data-driven insights into defense programs and strategic developments.

[2] CNBC Disruptor 50, 2024

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Historical backdrop: From monolithic primes to tech disruptors

Throughout the latter half of the 20th century and into the early 2000s, the U.S. defense landscape was dominated by an **oligopoly** of major contractors commonly termed as "primes"—Lockheed, Boeing, Northrop, Raytheon, and General Dynamics, among others. These firms specialized in large platforms like fighter jets, aircraft carriers, satellites, and strategic missile systems. While these incumbents forged decades-long partnerships with government agencies, critics argued the resulting processes sometimes stifled innovation and led to cost overruns and extended development schedules.

Several overlapping forces, however, started reshaping this status quo:

1. **Budgetary pressures and rising threats:** Despite consistently high defense budgets—topping $850 billion for the U.S. in 2024—**competition from peer adversaries** (notably China and, to an extent, Russia) introduced pressure to adopt new technologies faster[3]. The so-called "great power competition" demands agility rather than just mass.
2. **Commercial tech boom:** Silicon Valley's strides in AI, machine learning, and edge computing overshadowed parallel developments within classical defense R&D pipelines. Major breakthroughs in **drone autonomy**, **cloud computing**, and large-language models came from consumer- or enterprise-focused companies. By the mid-2010s, the Pentagon recognized it risked losing its technological edge if it did not partner with or replicate commercial patterns of innovation.
3. **Lessons from recent conflicts:** The role of armed drones in Syria, Iraq, and, more recently, Ukraine underscores the potency of smaller, cheaper, and networked autonomous platforms. Large, expensive, or "exquisite" systems remain vital for deterrence, but the unstoppable infiltration of cost-effective unmanned systems revealed a capability gap—one that smaller, nimble companies like Anduril, Palantir, and Epirus have moved to fill.
4. **Private venture capital:** Historically, private VC funds were hesitant about defense, citing complicated contracting rules and modest exit opportunities. By 2017, well-known VC firms such as Founders Fund, Andreessen Horowitz, and General Catalyst realized that strategic tensions and the AI revolution might create an entirely new wave of "unicorn" defense startups. Anduril's early funding success exemplified how receptive private capital had become.

These dynamics set the stage for **Anduril's** entry. Let us next examine Anduril's approach, but it's essential to acknowledge that it is not the only "disruptor" in the game. Its rapid ascent, however, is illustrative of the broader shift.

[3] Financial Times

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The Anduril blueprint

The founding framework

Anduril was co-founded by **Palmer Luckey**, who rose to prominence by creating the Oculus Rift VR headset and later selling Oculus to Facebook for $2 billion. Post-Facebook, Luckey teamed with **Trae Stephens** (a Founders Fund partner and former Palantir executive), **Brian Schimpf**, **Matt Grimm**, and **Joe Chen**[4]. Unlike many defense startups that wait for official solicitations or "Requests for Proposals," Anduril invests in R&D up front. This risk-on mindset is common in commercial tech but atypical in defense, where contractors often rely heavily on cost-plus contracts or incremental prototypes mandated by the Pentagon.

Early products and pilots

Their first marquee solution was a set of **autonomous surveillance towers** (branded "Sentry Towers"), initially proposed for border security as an alternative to a physical wall. By 2020, the U.S. Customs and Border Protection (CBP) had agreed to deploy many such towers, demonstrating how a "proof-of-concept" approach could quickly convert to a real contract. The towers combine cameras, radar, thermal imaging, and AI-driven analytics to autonomously detect movement and categorize potential threats, feeding data into Anduril's "Lattice" software [(NBC coverage cited in earlier references)].

From that foundation, the company expanded to:

- **Counter-UAS**: Drones designed to intercept or neutralize smaller UAVs, known as "Anvil" or "Interceptor" systems.
- **Ghost**: A family of rotorcraft UAVs for intelligence, surveillance, and reconnaissance (ISR).
- **Maritime**: Large extra-large unmanned undersea vehicles (XL-AUVs) for navies.

Self-funded prototyping strategy

Two cornerstones define Anduril's self-funded model:

1. **Speed**: Instead of waiting 3–5 years for program budgets to materialize, Anduril invests up front to build near-finished prototypes in under 12 months. This is reminiscent of commercial software's "minimum viable product" approach.
2. **Integration with government**: Even though Anduril builds proactively, it engages government agencies early in the design cycle, ensuring each iteration aligns with real operational demands.

[4] CNBC

This strategy can be high-risk. If the Pentagon or an allied ministry does not award a follow-on contract, the sunk costs rest on Anduril's shoulders. But in practice, the readiness to show a working solution has proven appealing to agencies pressed for time.

Key systems and their strategic implications

While the above offers a general overview, the company's specific programs highlight the deeper transformations underway in defense technology.

Roadrunner: Reusable interceptor concept

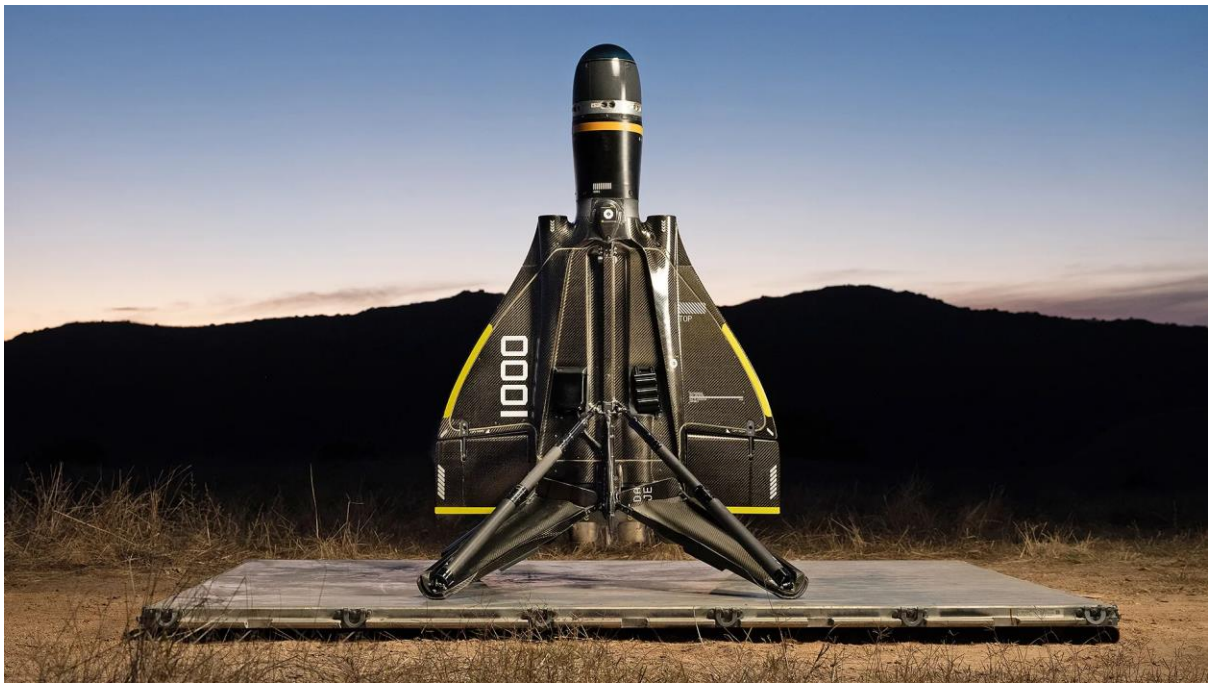

Image 1: Roadrunner is a twin-jet–powered drone

Unveiled in December 2023, **Roadrunner** is a twin-jet–powered drone that can launch vertically and intercept aerial threats like drones, cruise missiles, and potentially manned aircraft. The craft can also be recovered if it does not detonate its payload, effectively merging the categories of UAV and guided munition. Roadrunner exemplifies the shift from multi-million-dollar intercept missiles to cheaper, partially reusable systems, designed for mass deployment in contested airspaces[5].

Key observations

1. **Cost-efficiency vs. reliability**: While Roadrunner's "low six-figure" price point (per unit) undercuts the $1 million+ cost of many interceptors, questions remain about reliability in high-threat environments.

[5] FlightGlobal

2. **Modularity**: The system is built around open architecture, enabling warhead or sensor swaps, consistent with modern demands for flexible deployment.
3. **Production scalability**: Anduril's broader plan is to build thousands per year if needed, a radical departure from the typical defense production lines that deliver 20–50 specialized missiles monthly.

Barracuda: Low-cost cruise missiles

Image 2: Anduril "Barracuda," a family of affordable, air-breathing missiles

In September 2024, Anduril announced "Barracuda," a family of affordable, air-breathing missiles. These are intended to swarm enemy defenses or function individually, bridging the gap between conventional standoff munitions costing millions of dollars and smaller, short-range loitering drones[6].

Strategic significance:

- **Swarm doctrine**: The concept of saturating enemy air defenses with numerous inexpensive munitions is increasingly attractive to militaries like the U.S. and its allies.
- **Rapid iterations**: Because Barracuda relies on standardized subsystems, updates to sensors or guidance can be pushed quickly, akin to a software patch.
- **Competition**: Traditional missile contractors (e.g., Raytheon, MBDA) have dominated cruise missiles. Barracuda's selling point is speed of production and a lower price bracket.

[6] Defense Update

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Lattice command & control

Image 3: Anduril's Lattice Operating System

Central to all Anduril systems is **Lattice**, the "operating system" that fuses data from sensors, drones, and other devices into an integrated battlefield picture. Lattice's edge-computing model reduces reliance on massive centralized server farms, thereby enhancing resiliency if communications are jammed. The platform is also designed to incorporate data from **non–Anduril** systems, addressing a longstanding challenge of cross-platform interoperability[7].

In December 2024, the company launched the Lattice Software Development Kit (SDK), enabling other companies to create applications for the Lattice Mesh platform without requiring approval from Anduril. Initially, the company revealed a group of 10 partners, including startups like Apex (focused on space systems) and Saronic (specializing in unmanned boats), as well as major corporations like Oracle and Textron. In short, the SDK will eventually be open to any company wishing to develop software for Lattice.

Why it matters:

- **JADC2 alignment**: The DoD's Joint All-Domain Command & Control (JADC2) initiative aspires to link every sensor to every shooter. Lattice's open framework positions Anduril favourably in that conversation.

[7] Anduril in 2023: A year in review

- **Competition with Palantir**: Palantir's Gotham and Foundry software lines are also pitched as data-integration tools. Industry insiders speculate that future "digital backbone" awards could go to whichever system best demonstrates user-friendliness and broad plugin capabilities.

Collaborative Combat Aircraft (CCA) - a pivotal contract

If there's any indicator of the defense ecosystem's willingness to embrace new players, it's the **Collaborative Combat Aircraft** program. In April 2024, the U.S. Air Force announced that Anduril (along with General Atomics) had been chosen to develop prototypes for "loyal wingman" drones over more established names such as Boeing, Northrop, and Lockheed[8].

CCA in brief: The Air Force envisions up to 1,000 uncrewed jets operating semi-independently alongside 200–300 advanced fighters. These CCAs might carry extra munitions, conduct reconnaissance, or serve as decoys. The project underscores a shift away from purely manned air superiority toward a blend of manned and unmanned teams.

Anduril's edge

Image 4: Anduril's Fury, an autonomous air vehicle (AAV)

[8] Defense News

- **Fury**: Through the September 2023 acquisition of Blue Force Technologies, Anduril inherited "Fury," a large fighter-like UAV that's presumably a prime CCA contender.
- **Software DNA**: The CCA concept demands robust autonomy and real-time adaptability, factors aligning with Anduril's software-first ethos.
- **Self-financing**: Unlike prime contractors that wait for cost-plus deals, Anduril invests its own capital to accelerate testing, a gamble that might yield quick results if the Air Force finalizes the program by 2026.

Potential pitfalls

- **Integration**: Partnering an uncrewed "loyal wingman" with an F-35 or F-22 requires secure data links, advanced sensor fusion, and trust from pilots. Achieving that synergy is no small technical feat.
- **Funding gaps**: For all the hype, the CCA program must still pass congressional scrutiny. Shifts in budget or political priorities could reduce or delay the scale of orders.

The funding dimension: Big bets and big risks

Massive VC inflows

By August 2024, Anduril had raised $1.5 billion in Series F funding at a $14 billion valuation[9]. For a defense-focused entity under a decade old, that is extraordinary. This phenomenon reflects:

1. **Investor belief in growth**: VCs see a trillion-dollar global arms market hungry for agile solutions.
2. **Success stories**: SpaceX paved the way, showing how private money can disrupt government-monopolized sectors. Palantir's 2020 IPO also showcased public appetite for "government-tech."

"Arsenal-1" Megafactory

Anduril is directing a portion of its new capital to "Arsenal-1," a 5-million-square-foot manufacturing hub for producing unmanned aerial vehicles (UAVs) and missiles. The facility aims to produce thousands of defense systems annually and represents a shift from traditional, low-volume military manufacturing to a more scalable model. The project is intended to accelerate production timelines, reduce costs, and provide a consistent supply of technology to the U.S. military and its allies.

Arsenal-1 adopts high-volume manufacturing techniques used in consumer industries like automotive and electronics, differing from the defense sector's typical low-volume, high-cost

[9] TechCrunch

production lines. This approach is designed to increase production speed and lower costs while maintaining precision. If effective, it could change how military hardware is produced and improve supply chain efficiency.

Image 5: "Arsenal-1," a planned 5-million-square-foot manufacturing hub in Ohio

Challenges:

- **Workforce**: Skilled labour in advanced composites, electronics assembly, and AI-driven robotics remains limited in the US. Scaling from prototypes to mass production tests Anduril's operational management.
- **Supply chain**: The semiconductor shortage in 2021–2022 highlighted vulnerabilities in obtaining high-performance chips crucial for advanced weapons. Guaranteeing a stable supply of specialized microelectronics is no trivial matter.

Sustainability of private defense investment

Critics question whether private investors accustomed to short ROI timelines can remain patient when the DoD or foreign governments might take years to validate or fully adopt new systems. A high-profile example is the Army's Integrated Visual Augmentation System (IVAS) program, where Microsoft faced repeated delays and technology challenges. Anduril's "spend first" approach works as long as Series G or further capital infusions remain feasible—but it could be precarious if the broader capital market turns bearish on defense or Anduril fails to secure enough large contracts.

Consortium alliances and open architecture

In December 2024, the **Financial Times** reported that Anduril and **Palantir** were discussing forming a consortium with **SpaceX**, **OpenAI**, and others to bid on major U.S. government projects[10]. Such alliances underscore a few central trends:

1. **Silicon valley + defense collaboration**: The lines between "pure commercial" AI and "military" AI are blurring. Tech giants with large cloud infrastructures and AI models see synergy with specialized defense integrators like Anduril.
2. **Rebundling the supply chain**: By pooling advanced capabilities—SpaceX for launches, OpenAI for large-language AI, Palantir for data analytics—this consortium aims to offer comprehensive end-to-end systems.
3. **Competition with incumbents**: Lockheed or Boeing historically coordinate entire systems themselves, bundling specialized suppliers. Now, new "virtual primes" or consortiums might accomplish the same, but using a more modular, software-driven approach.

Ethical, Legal, and Geopolitical Implications

Autonomous weapons and public backlash

As systems like Roadrunner, Barracuda, or advanced AI-based command & control become operational, concerns about fully autonomous lethal capabilities intensify. International law around lethal autonomous weapons remains unsettled, and various civil-society groups push for restrictions. Anduril has stated it supports "human-in-the-loop" paradigms, but the line between partial and full autonomy can blur on fast-moving battlefields.

Export controls and alliance management

Many of these advanced platforms incorporate sensitive technologies, e.g., proprietary AI or custom semiconductors. Export approvals under ITAR or allied frameworks complicate Anduril's desire to sell widely abroad. Meanwhile, the US government itself is cautious about which technologies can be shared with partners. For instance, some are urging the US to expedite drone exports to allied states in Asia or Eastern Europe to check strategic rivals.

Chinese sanctions

In mid-2024, China imposed sanctions on Anduril and related executives, citing arms sales to Taiwan and other "activities detrimental to China's sovereignty"[11]. While the direct business impact might be minimal—Anduril likely has no plans to engage China's market—this underscores the risk of becoming entangled in Sino-Western geopolitical competition. It also

[10] Financial Times
[11] The Hindu

signals that smaller companies can now face the same diplomatic and legal complexities once reserved for major primes.

Demand drivers in the next decade

Great power rivalry

Pentagon war games repeatedly highlight the need for "affordable mass." If conflict arises in the Western Pacific or Eastern Europe, the sheer volume of munitions and UAVs could determine operational success. The impetus for thousands of cheaper drones is therefore strong, reinforcing Anduril's "mass production" thesis.

Joint all-domain operations

Linking sensor data from ground vehicles, fighter jets, naval vessels, and satellites requires real-time computing and robust AI. With the U.S. pushing for a unified data architecture, and NATO similarly exploring integrated systems, the prospects for software innovators are bright.

Tech-savvy workforce

Nearly every advanced system—whether made by Boeing or Anduril—now depends on advanced software to handle sensor fusion, autonomy, and user interfaces. The demand for top-tier software engineers in the defense sector outstrips supply, placing competitive pressure on contractors to recruit from big tech.

Potential pitfalls in supply chain, reliability, and scale

Hardware bottlenecks

The 2021–2022 global chip shortage reminded the defense community that advanced FPGAs, GPUs, and microprocessors are not easily ramped up. If Anduril and peers hope to mass-produce thousands of drones or missiles, they must secure stable semiconductor sources. That might involve further acquisitions or strategic partnerships with foundries specialized in defense-grade chips.

Testing and validation

Building prototypes is one thing; subjecting them to **operational test and evaluation** (OT&E) under real battlefield conditions is another. Often, advanced prototypes show promise yet fail in extreme environments—arctic conditions, high electromagnetic interference, or contested communications. The U.S. Army's experiences with the Microsoft-developed Integrated Visual Augmentation System (IVAS) exemplify how "leading-edge" can become a multi-year struggle if user acceptance stumbles.

Congressional and public oversight

Contracts for lethal autonomous weapons or advanced AI sometimes spark congressional scrutiny, especially if cost overruns appear or ethical lines are crossed. Anduril's private capital model does not shield it from Senate or House committees that demand accountability for how technologies are deployed or whether they inadvertently put warfighters at risk.

Broader ecosystem interplay

Partnerships with allies

Anduril's expansion into Australia—most notably, a $100 million contract to develop large undersea drones for the Royal Australian Navy—shows that allied governments are also searching for next-gen solutions outside of legacy prime contractors[12]. As the AUKUS deal highlights, the Indo-Pacific region's security environment has spurred deeper technology-sharing, and new disruptors see an opening.

Cross-industry consortia

The rumoured consortium with Palantir, SpaceX, OpenAI, and others signals broader realignment. If militaries want advanced satellites (SpaceX), robust data analytics (Palantir), large-language AI (OpenAI), or specialized drones (Anduril), forging multi-company alliances might streamline solutions. But dealing with multiple agile companies can also create friction if they lack the integrated supply chains or project-management capabilities typical of single prime contractors.

Rival non-U.S. disruptors

While Anduril is distinctly American, Europe, Israel, and parts of Asia have their own emerging defense startups. Israel's drone and missile industries, for instance, have already gained global traction. The question is whether Anduril's approach spurs non-U.S. governments to cultivate similar ecosystems, or if they rely on U.S. imports.

Public debates over autonomy and the worker dimension

Lethal autonomy

Groups like the Campaign to Stop Killer Robots have, for years, lobbied the UN to ban fully autonomous weapon systems. Even if Anduril asserts its systems are designed with "human in the loop," the tech potentially could be used in advanced ways that test these boundaries. Over

[12] Anduril in 2023

time, the gap between partial and full autonomy could shrink, especially as AI algorithms improve via real-world data.

Domestic labour and high-tech manufacturing

Anduril's approach promises thousands of manufacturing jobs across states like California, Mississippi, Indiana, and North Carolina. For regions historically reliant on heavy industries or older forms of manufacturing, a new wave of skilled-labour factories can be a boon. Yet it also demands specialized engineering training and robust supply chains. Tech-savvy labour might be scarce outside main hubs, requiring relocations or expansions of community-college skill programs.

Inferring the future of defense tech

Given the speed with which Anduril and its peers have grown, it is instructive to glimpse possible scenarios over the next five to seven years:

- **Scenario A: A "new normal" with hybrid primes:** The biggest primes adopt the Anduril model—accelerating product cycles, forming in-house venture arms, and acquiring small AI shops. Meanwhile, new disruptors like Anduril are integrated into the mainstream, resulting in a hybrid market with multiple "mid-tier primes" that bridge large and small solutions.
- **Scenario B: Consolidation or mega-mergers:** If the Pentagon decides it's more comfortable working with fewer large entities, it might push for or allow acquisitions of smaller disruptors by older primes. This could hamper the "disruptor energy" if smaller firms lose autonomy post-acquisition.
- **Scenario C: Tri-polar tech race:** As the U.S. invests billions, so do China and perhaps the EU. We might witness a technology race reminiscent of the Cold War, but with AI, quantum computing, and advanced semiconductors as the main battlegrounds. In such an environment, smaller disruptors remain crucial to keep pace in innovation.

Conclusion

Anduril Industries' swift rise—from developing "smart border" surveillance towers to forging AI-driven missile interceptors—mirrors a defense industry at an inflexion point. Rather than exclusively awarding multi-decade, cost-plus contracts to the usual primes, governments see the potential in small, agile disruptors that have proven adept at software, sensor fusion, and next-gen manufacturing. Multiple major developments underscore this transformation:

1. **Mass-production mindset**: The "Arsenal-1" concept, seeking to churn out thousands of drones or missiles a year at cost points previously unthinkable in the defense world.
2. **Autonomous Systems**: Ghost, Roadrunner, Barracuda—these are signs that tomorrow's conflicts will revolve heavily around AI-driven platforms rather than solely on manned jets or tanks.
3. **Consortiums and partnerships**: Aligning with Palantir, SpaceX, or other high-tech firms reveals new supply-chain or "system of systems" approaches that challenge legacy models.

However, the hype must be met with caution. The defense testing cycle is stringent, supply chains remain vulnerable, and legislative or ethical roadblocks could derail unbridled ambitions. Meanwhile, an uncertain geopolitical climate—complete with sanctions, export controls, and shifting alliance structures—adds volatility.

Yet, in a 2025 context, the momentum feels irreversible. Anduril's story, though unique, is part of a larger narrative: defense technology is no longer the exclusive domain of century-old manufacturing giants. The next wave—defined by AI, automation, venture capital, and rapid prototyping—has arrived. How effectively these "disruptors" mesh with large militaries and their labyrinthine procurement systems will determine whether they can actually reshape the battlefield or merely spark incremental reforms.

Bottom line

As we step deeper into the 2020s, watchers of the defense sector can anticipate that the lines between "commercial tech" and "military innovation" will blur further. Companies like Anduril show how a start-up approach can empower militaries to respond to fast-evolving threats. The measure of success will be how well they navigate the formidable challenges—scaling production, ensuring interoperability, and maintaining a moral and legal footing—in a domain where the stakes are high and failures are rarely forgiven.

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