MISSILE DEFENSE REVIEW

MDAA Spotlight Series on Drone and Missile Warfare

Iran's Shahed-136 One-Way Attack Drone: Proliferated Challenge to Allied Defenses

By Alex Reed

5 Key Points

- The Shahed-136a delta-wing, pusher-propeller airframe of roughly 200 kg launch weight, a 40–90 kg warhead, and an inertial-plus-satellite guidance package giving a commonly cited range of 1,000–2,500 km at about 185 km/h.[1]
- Its decisive attribute is economics, not sophistication. Units costing $20,000–$50,000 and employment in ongoing wars forces defenders to expend interceptors costing tens of thousands to several million dollars each, an unfavorable cost-exchange that can exhaust magazines faster than they can be refilled.[2]
- Production has industrialized far beyond Iran. Russia's Alabuga plant in Tatarstan, built under a 2023 franchise deal, has driven output into the thousands per month and the per-drone price down from roughly $200,000 in 2022 to about $70,000 by 2025.[3]
- The blueprint-driven, composite-and-commercial-parts design has proliferated to Russia, the Houthis, Hezbollah, and Iraqi militias, and has been mirrored by the United States in its own low-cost clone, LUCAS, fielded under CENTCOM's Task Force Scorpion Strike.[4]
- No single defense suffices. Current practice layers radar and acoustic detection, electronic-warfare jamming and GNSS spoofing, gun systems, interceptor drones, and missiles such as Coyote, while EW-resistant variants of the Shahed (fiber-optic, Starlink-linked, anti-jam antennas) steadily push the problem back toward costly kinetic defeat.[5]

A Cheap Weapon Capable of Strategic Reach

Few weapons have reshaped the economics of aerial attack as quickly as the Shahed-136. Designed by Iran's Shahed Aviation Industries and built by the HESA conglomerate under the IRGC Aerospace Force, it is the prototypical *one-way attack drone* — a loitering munition which flies a pre-programmed course into a fixed target and is detonated on impact. Its significance lies less in any single performance figure than in a combination of long reach, low price, and mass producibility. These attributes enable forces to conduct the kind of deep strikes against capital regions and critical infrastructure that were once the exclusive domain of expensive cruise and ballistic missiles.

This brief examines what the Shahed-136 is, why it is effective, how Iranian and Russian production has evolved, how the design has proliferated, the specific danger it poses to U.S. and allied forces, and the layered counter-drone measures that exist today. The broader lesson is uncomfortable: the Shahed has democratized non-nuclear strategic strike, and the defensive response remains a work in progress.

Anatomy of the Shahed-136

The Shahed-136 is a delta- or flying-wing airframe roughly 3.5 m long with a 2.5 m wingspan and a launch weight near 200 kg. It is built largely from composite honeycomb and fiberglass materials, which keeps it cheap and allows dispersed, low-skill assembly. A rear-mounted *MD550* four-cylinder piston engine — a copy of the German Limbach L550, also produced in China — drives a two-bladed pusher propeller for a cruise speed of about 185 km/h. The drone is launched near-horizontally from a rail using a jettisoned rocket booster, so the complete launch rack fits on the bed of an ordinary truck, enabling mobile "shoot-and-scoot" operations.[6]

The baseline Iranian warhead is roughly 40–50 kg of high explosive; an effective charge of about 40 kg is often likened to several 155-mm artillery shells — enough to destroy or badly damage a substation, fuel depot, or command node. Russian-produced Geran-2 variants have fielded heavier and more specialized payloads, including thermobaric, fragmentation-with-incendiary, and combined-effect warheads reaching up to about 90 kg.[7]

Guidance is deliberately austere: an inertial navigation system backed by satellite positioning (initially GLONASS or GPS), which enables the drone fly extended distances without a continuous control link. The Shahed's range is estimated to be between 1,000 and 2,500km depending on variant and payload. The baseline drone carries no camera or seeker, so it is best understood as a cheap, long-range, fire-and-forget munition against fixed coordinates rather than a precision hunter of moving targets — though later variants are eroding that distinction.[8]

What Makes the Shahed Effective

The Shahed's effectiveness is structural, and its rests on several reinforcing features:

- **Cost-exchange asymmetry.** A $20,000–$50,000 drone routinely draws fire from interceptors costing far more — from $15,000 interceptor drones up to multimillion-dollar surface-to-air missiles. Even a high intercept rate is a losing proposition, if each engagement costs the defender ten to a hundred times what it costs the attacker.
- **Saturation.** Shaheds are rarely used alone. Mixed salvos pair them with decoy drones (Gerbera, Parodiya) and ballistic, cruise, or hypersonic missiles, overwhelming radar pictures and forcing defenders to sort cheap threats from lethal ones in seconds.
- **Low signature.** A small composite airframe flying low and slow produces a modest radar cross-section that is poorly matched by air defenses optimized for faster, higher-flying targets. Its the slow speed paradoxically complicates some engagements and stretches detection-to-intercept timelines.
- **Simplicity and dispersibility. A Shahed's lack of** exotic materials, use of a commercial engine, and truck-mounted rail-launch mode mean the system can be produced at scale and launched from many dispersed, hard-to-pre-empt locations.
- **Rapid adaptation.** Because the airframe is a software-and-subcomponent platform, anti-jam antennas, new navigation modes, heavier warheads, and jet engines can be

bolted on it in months, so each defensive fix tends to be answered by a counter-modification before it can be fielded widely.

The Evolution of Iranian — and Russian — Drone Production

Iran fielded the Shahed-136 around 2021 as a sanctions-era answer to its lack of access to high-end strike systems, and Iranian facilities alone are assessed to produce more than 200 airframes per month. The decisive shift came in 2023, when a roughly $1.75 billion franchise agreement established licensed manufacture of the Geran-2 export variant at the Alabuga Special Economic Zone in Tatarstan, with a target of 6,000 airframes.[9]

Alabuga production expended faster than Western estimates anticipated — from 7–10 drones per workday at the outset to roughly 20 per day across two shifts, then to about 170 per day by spring 2025. Ukrainian military intelligence assessed total Shahed-type output near 2,700 per month by mid-2025, and Ukraine's commander-in-chief cited Russian drone output of around 404 per day in January 2026 (a figure that likely includes decoys and other types), against an assessed plant ceiling of 5,000–5,500 per month. By late 2025, Russia had fired well over 57,000 Shahed-class drones at Ukraine since 2022.[10]

Industrialization also drove price collapse and localization. Russia reportedly paid roughly $200,000 per drone in 2022 but about $70,000 by 2025, having localized close to 90 percent of Geran production — a shift that Western and Ukrainian sources say has marginalized Tehran on its own design, with Moscow iterating on new Geran variants and China filling the engine-and-electronics supply chain.[11]

The platform's capabilities have advanced significantly since its first fielding four years ago. The jet-powered Shahed-238 / Geran-3, operational from late 2025, trades the piston engine for a compact turbojet for speeds of 500–600 km/h. Newer Geran-4 and Geran-5 derivatives add larger warheads, air-launch options, and modem-based control: the Geran-5, fielded in early 2026, reportedly carries a 90 kg warhead, uses a Chinese Telefly jet engine, and can be released from Su-25 aircraft. Anti-jam upgrades (the Kometa-M controlled-reception-pattern antenna), Starlink-based command-and-control, and fiber-optic guidance are progressively hardening the family against electronic attack -.[12]

Proliferation Beyond Iran

The same blueprint-driven simplicity that lowers cost also lowers the barrier to weapon proliferation. Within roughly three years of its first major combat use, the design had

proliferated to at least six actors. Russia operates it as the Geran-1/-2; the Houthis in Yemen field it as the Waid-1/Waid-2 and used it against Red Sea shipping; Hezbollah and Iraqi Shia militias have employed Shahed-family drones supplied through IRGC channels against targets across the Middle East.[13]

Iran has used the platform directly in state-on-state strikes as well. The April 2024 "True Promise" barrage launched more than 300 drones and missiles at Israel, and in the 2026 exchanges Shahed salvos were fired from Iran and by proxies in Yemen, Iraq, and Lebanon against U.S. bases in Qatar, Bahrain, Kuwait, the UAE, Jordan, and Saudi Arabia, as well as Israel. The dispersed, multi-origin launch model turns the Shahed into an instrument of Iranian regional power projection independent on Iranian territory alone.[14]

The Danger to the U.S. Military

For U.S. forces, the threat is neither hypothetical nor distant. On 28 January 2024, a one-way attack drone launched by an Iranian-backed Iraqi militia struck Tower 22, a U.S. outpost in northeastern Jordan, killing three American soldiers and wounding dozens — the first U.S. service deaths from this class of weapon. In the February 2026 exchanges, Iran used Shaheds against the U.S. Fifth Fleet headquarters at NSA Bahrain; defenders stopped most, but by CENTCOM's own account a few penetrated, causing minimal damage to a base that remained operational.[15]

Three dangers compound. First, the cost-exchange trap: defending fixed forward bases with high-end interceptors against waves of $35,000 drones can deplete Patriot, THAAD, and air-to-air magazines faster than industry can replace them. Expensive platforms like the MQ-9 are far too costly to attrit in a saturation fight. Second, terminal-phase gaps: dispersed, low-altitude approaches expose coverage seams over high-value installations and the civilian infrastructure around them. Third, the homeland dimension: reported drone swarms over U.S. installations — including incidents associated with Barksdale Air Force Base — show that GPS-denial-resistant, autonomously navigating drones can be operationalized against strategic sites, a concern that maps directly onto national-capital-region defense.[16]

Implications and Benefits of Shahed One-Way Attack Drones

The strategic ramification of Shahed fielding, evolution, and operational availability is that inexpensive, long-range drones have become a weapon of choice for non-nuclear strikes — effects against capital regions and critical infrastructure that traditional were preserved for

high-end military capabilities,, especially nuclear or conventional missile weapon systems. For the attacker, the benefits are obvious: low unit cost, mass producibility from commercial supply chains, dispersed and survivable launch, deniability when fired through proxies, and a favorable cost-exchange that lets a weaker actor impose disproportionate defensive costs on a stronger one. These are the same attributes that led the United States to build its own clone of the Shahed.[17]

The drawbacks temper the picture. Slow speed and modest accuracy make the baseline drone vulnerable to layered defenses and ill-suited to mobile or hardened targets; effects are coercive and attritional rather than decisive, and large salvos against capital regions almost inevitably inflict collateral civilian harm that carries political and legal cost. Our net assessment from recent operations is that one-way attack drones raise the stakes and stress defenses without, on their own, compelling an adversary to abandon its aims.

Countering the Shahed: What Exists Today

There is no single effective operational countermeasure or mitigation strategy; An effective counter-drone defense architecture against the Shahed 136 requires layering, integrating sensing, battle management, non-kinetic effects, and a tiered mix of kinetic options:

- **Detection and battle management.** Ku-band radars (KuRFS-class), acoustic and electro-optical sensors, and command-and-control systems such as FAAD C2 build the track picture and assign the cheapest viable effector to each threat. The Army's FS-LIDS packages KuRFS radar, the CUAEWS electronic-warfare system, and Coyote interceptors into one integrated node.
- **Electronic warfare (non-kinetic).** RF jamming and GNSS spoofing already defeat the majority of drones in large Shahed barrages at near-zero cost per engagement — the approach Ukraine has leaned on with systems like its new LIMA system. Its limit is the growing population of EW-resistant Shaheds (fiber-optic, Starlink-linked, anti-jam antennas) that force a shift back toward kinetic or directed-energy defeat.
- **Gun systems.** Gun-based defenses such as the 35-]mm Gepard, at roughly $5,000 per burst, are highly cost-effective but short-ranged and limited in duration — a valuable last layer, not a wide-area solution.
- **Interceptor drones.** Cheap drone-on-drone interceptors are the fastest-scaling answer: Ukraine reached on the order of 1,000 interceptor drones per day in 2026, and the U.S. Merops / AS3 Surveyor system, at roughly $15,000 a shot and hardened

against EW, has reported intercept rates against Shahed-type targets as high as 95 percent.

- **Kinetic interceptors.** The rail-launched Coyote spans hard-kill (Block 2) and a recoverable, non-kinetic, reusable variant (Block 3NK) demonstrated against swarms in early 2026; the Army is locking in multi-year supply because counter-drone demand now sits alongside its most stressed missile-defense stocks.
- **Directed energy and the offensive mirror.** High-power lasers and microwave weapons are maturing as effectively unlimited-magazine options for the EW-resistant tail of the threat. In parallel, the United States has reverse-engineered the concept into its own low-cost LUCAS one-way attack drone (about $35,000 versus roughly $1.3 million for a Tomahawk), fielded under CENTCOM's Task Force Scorpion Strike — turning the cost-exchange logic back on Iran.

The cost-exchange comparison below captures why the layering matters — the goal is to push as many engagements as possible toward the cheap end of the table.

Indicative cost-exchange snapshot (open-source estimates)

System	Approx. unit cost	Role
Shahed-136 / Geran-2	$20K–$50K	Attacker (one-way)
LUCAS (US clone)	~$35K	Attacker (one-way)
Gepard 35mm burst	~$5K	Gun, last layer
AS3 Surveyor (Merops)	~$15K	Interceptor drone
Coyote Block 2	Tens of thousands	Kinetic interceptor
AIM-9 / AIM-120	$0.4M–$1M+	Air-to-air missile
Patriot PAC-3	~$4M	SAM (high-value defense)

Figures are rounded open-source estimates and vary by source, variant, and component sourcing.[18]

Implications and Recommendations

The Shahed-136 should be considered as a permanent fixture of the missile and drone defense operating environment, rather than a passing Ukrainian or Gulf phenomenon. Several recommendations follow for U.S. and allied homeland and base defense:

- **Win the cost curve, not just the intercept.** Prioritize cheap effectors — EW, interceptor drones, guns — as the default, reserving high-value missiles for the high-end ballistic and hypersonic threats they were built for. and Scale interceptor production with the same multi-year demand certainty now applied to PAC-3 and THAAD.
- **Build genuinely integrated, layered architectures.** Detection, battle management, non-kinetic and kinetic effects must operate as one system at fixed bases and in capital regions, with interagency and civil-defense coordination, since collateral damage in populated areas is now a near-certain feature of these attacks.
- **Plan against the adaptation cycle.** Assume EW-resistant, jet-powered, and autonomously navigating variants will keep appearing on a months-long cadence, and field test postures against both the high-end mixed-salvo scenario and the lower-end pure-drone saturation scenario.

Above all, the Shahed-136 is a reminder that mass and price, not exquisite performance, increasingly define the long-range strike threat in an area of unmanned offensive missile and drone capabilities. Defending against it is less about any one interceptor than about constructing a resilient, affordable, and integrated defense — and about being willing to adopt the adversary's own economics in return.

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