Center for Analytical Studies and Countering Hybrid Threats

SAYARI

## EXECUTIVE SUMMARY

# Corporate Structures and Commercial Ties of Russia's Military-Industrial Complex: Vulnerabilities to Sanctions Pressure

Analytical Report | Center for Analytical Studies and Countering Hybrid Threats (CASCHT) | Kyiv, 2026

## 1. PURPOSE & CONTEXT

**Four years of full-scale war have exposed a fundamental failure of sanctions policy.** Despite thousands of restrictions, Russia's military-industrial complex (MIC) not only continues to operate but is ramping up production of key armament types. The direct consequence is an intensifying campaign of missile and air strikes against Ukrainian territory, civilian infrastructure, and civilian lives.

This report, produced by CASCHT (Kyiv) diagnoses why mass sanctioning of enterprises fails and presents a methodology for a fundamentally different approach: systemic precision pressure on the critical nodes of production chains.

The optoelectronic sector was selected as the object of study because its strategic weight on the modern battlefield has grown sharply — from thermal-imaging sights to missile homing heads and UAV sensors. It serves as a test case for a methodology applicable to all branches of the MIC.

> **Central argument:** Fragmentary sanctions against individual final producers are ineffective. Synchronized, multi-partner pressure directed simultaneously at several critical upstream nodes can achieve a strategic effect with minimal effort and minimal harm to partner-state economies.

## 2. RESEARCH SCOPE & METHODOLOGY

### Object of study

The optoelectronic sector of the Russian MIC, comprising five interconnected sub-sectors: **optical, laser, infrared, thermal-imaging, and electronic.** The study focuses on the **thermal-imaging subsector**. Research began with 139 enterprises and expanded to 238 legal entities through commercial-tie tracing.

### Dual-track methodology

- **Analytical (OSINT):** enterprise profiles, open registers, state procurement data, weapons licences, corporate ties, import verification. All selected legal entities underwent review along three lines:
    - Open registers and information from other open sources; enterprises were assessed for inclusion in the defense-industry register, its economic activity code, participation in state procurement and its volume, weapons licences, the presence of subsidiaries and controlled structures etc.
    - Procurement from abroad — verification of direct and indirect import supplies;
    - Corporate ties — verification of the enterprises' ties with other MIC structures.

- **Technical:** big-data ingestion of ~5 million objects and 34 million ties, filtered via Harmonized System (HS)-code, stop-list thesauri, and ontological verification. Results were cross-checked against actual production capacities.

**Sayari Graph, the global corporate and trade network platform, was used across the methodology: to establish commercial ties during the analytical track; and to identify relevant entities at scale during the technical one.**

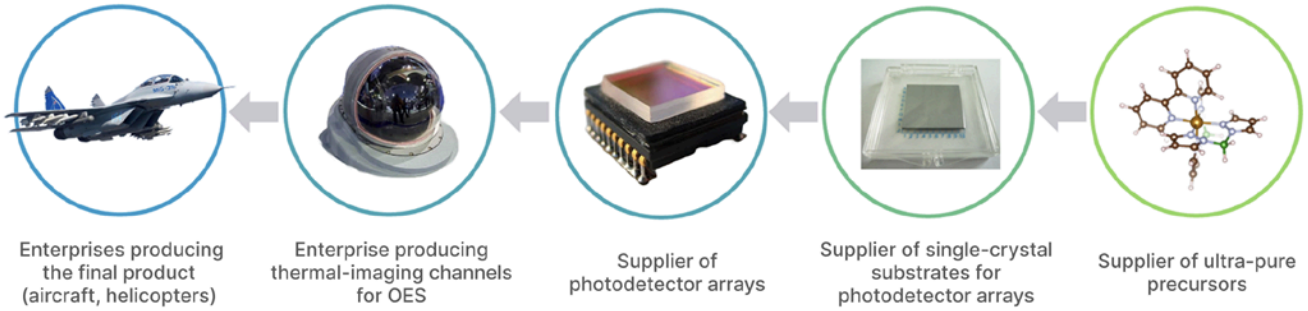
## 3. Overview of Russia's optoelectronic sector: the roles and functions of enterprises in production chains

CASCHT systematized the roles and functions of 238 enterprises identified in Russia's optoelectronic sector. The study maps this network using a 12-level role model[1] and examined in detail three strategically critical enterprises: one from each of the optical, laser, and infrared sub-sectors. Selection was based on monopolistic position, strategic output, and hub status within the supply chain.

| Sub-sector | Enterprise | Role | Feeds into | Sanctions status |
|---|---|---|---|---|
| **Optical** | **Lytkarino Optical Glass Plant (LZOS)** | Monopoly producer of optical glass and glass-ceramics — the raw material for virtually all Russian military optics, from tank sights to space reconnaissance mirrors. | Night-vision devices for T-72/T-80/T-90 tanks; targeting systems for Mi-family helicopters; space reconnaissance systems. | Ukraine + USA. Key supply-chain nodes — including a major Chinese-equipment import channel — are unsanctioned. |
| **Laser** | **JSC «NII «Polyus» named after M.F. Stelmakh» (Moscow)** | Russia's leading scientific-production centre in the field of laser technologies and the main laser structure of the Shvabe holding. Russia's only centre for laser gyroscopes and inertial navigation — the guidance "brain" of precision cruise and ballistic missiles. | Iskander-K cruise missile; Iskander-M ballistic missile; Orion strike drone; Kalibr cruise missile. | USA, EU, Ukraine, Canada, Japan. Chemical precursor and semiconductor crystal suppliers remain largely unsanctioned. |
| **Infrared** | **Moscow Plant Sapfir (MZ Sapfir)** | Sole producer of heat-sensing chips — the core of thermal-imaging sights and missile homing heads. Without its detectors, no Russian thermal sight or homing head functions. | Iskander-M; Krasnopol-M2 guided artillery; Tor-M1/M1V air-defence system. | **Ukraine only — absent from US, EU, and UK lists. Critical gap.** |

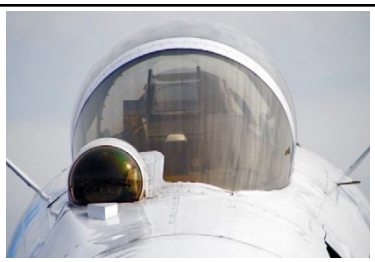
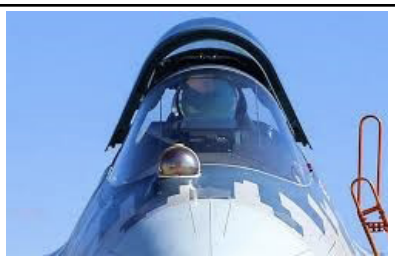
## 4. The production chain of the thermal-imaging component of airborne optoelectronic systems (OES)

To build an end-to-end chain, the most current airborne OES were chosen as the starting point and traced from the final producer of the finished product in the direction reverse to the production process, all the way back to the supply of primary raw materials:



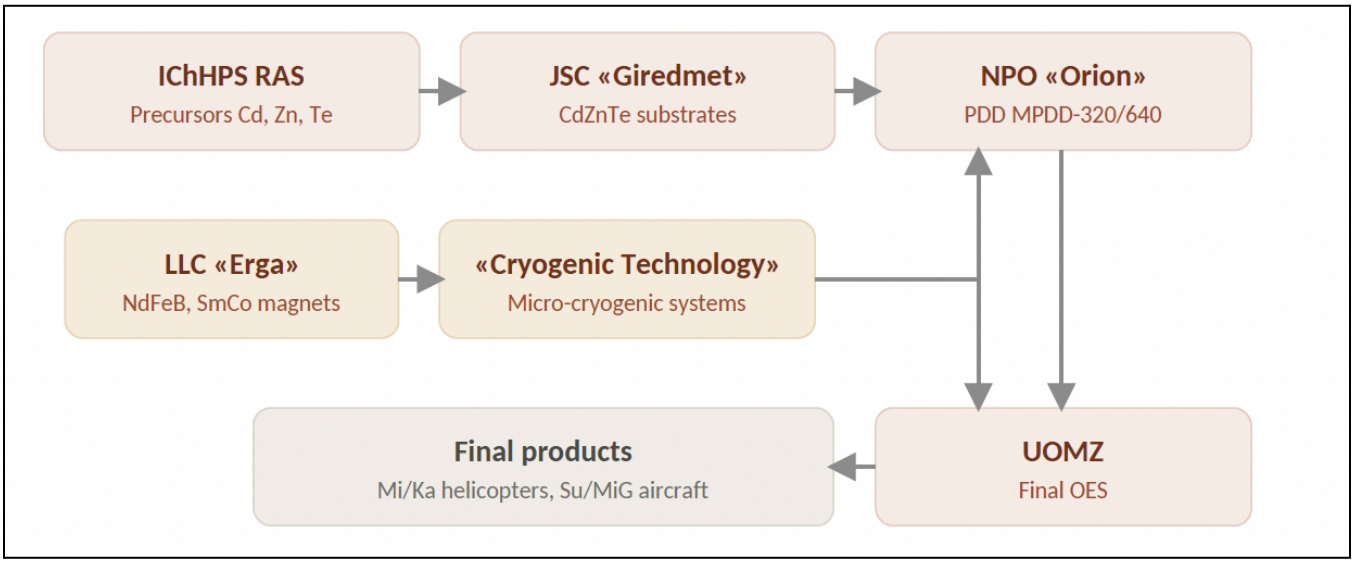

[1] The categorization of the enterprises of the optoelectronic sector of the Russian MIC by their place within production chains and a list of the TOP-20 critical enterprises are available via the link

**Three current airborne OES** were traced in reverse from the finished weapon system to primary raw materials — GOES-321M (Mi-family helicopters), OLS-35 (Su-35), and 101KS-V (Su-57) — exposing both critical nodes and the sanctions-circumvention network.

| ES-321M — the sole OES for the Mi family of helicopters | OLS-35 optical-locator station for the Su-35 | Quantum optical-locator station (QOLS) 101KS-V for the Su-57 |
|---|---|---|
|  |  |  |
| **Key functions**<br>• Night combat<br>• Concealed piloting and safety<br>• Long-range reconnaissance and target detection<br>• Guidance of precision weapons<br>• Automatic tracking (“Target lock”) | **Key functions**<br>• Hunting. stealth aircraft (Stealth)<br>• Concealed launch of air-to-air missiles<br>• Operation against ground and surface targets | **Key functions**<br>• Preserving full radar stealth (Stealth mode)<br>• Hunting Western 5th-generation fighters (F-22 and F-35)<br>• Concealed and sudden launch of missiles<br>• Autonomous operation under powerful EW |

## KEY FINDINGS:

**Six critical nodes with no domestic alternatives**



Each enterprise is a monopolist in its production segment and indispensable to Russia's thermal-imaging aviation-weapons production:

| Enterprise | Role & key vulnerability |
|---|---|
| **Joint-Stock Company «Production Association Ural Optical-Mechanical Plant» named after E.S. Yalamov (UOMZ, Yekaterinburg)** | Sole integrator of airborne OES; covers the entire combat-aviation fleet (Ka-52, Mi-8/24/28, Su-27/30/35/57). Sanctions: USA, EU, UK, Australia, Canada, Switzerland, New Zealand, Ukraine. |
| **Joint-Stock Company State Scientific Centre of the Russian Federation Scientific-Production Association "Orion" (Moscow)** | Only enterprise with series production of matrix photodetector devices (MPDD-320, MPDD-640). Supplies OES for aviation, ground, and naval platforms. Sanctions: USA, EU (full block). |
| **Joint-Stock Company State Scientific-Research and Design Institute of the Rare-Metals Industry "Giredmet" (Moscow)** | Sole profile supplier of CdZnTe substrates on which MCT thermal-imaging arrays are grown. Reject rates reach 90%; precursor purity is decisive. Sanctions: Ukraine only — critical Western gap. |
| **The G.G. Devyatykh Institute of Chemistry of High-Purity Substances of RAS (Nizhny Novgorod)** | Only producer of ultra-pure MOCVD precursors (dimethylcadmium, diethyltellurium, diisopropyltellurium). Academic status exploited to access Western equipment. Sanctions: none. |
| **JSC «NTK Cryogenic Technology»** | Sole supplier of micro-cryogenic cooling systems for infrared detector arrays (MCT operates at ~90 K). Rare-earth magnet raw material 95% imported from China. Sanctions: Ukraine only. |
| **LLC «Erga» (Kaluga)** | Only Russian enterprise with a fully automated NdFeB/SmCo rare-earth magnet line. Critical for cryogenic systems and UAV motors. Blanks: Ningbo Alvin (China) via Turkish transshipment. Sanctions: none. |

## 5. THE SHVABE HOLDING: NETWORK & IMPORT DEPENDENCE

The Shvabe holding (Rostec) concentrates the core competencies of Russia's optoelectronic instrument-making. CASCHT analysed 64 enterprises.

### Systemic import dependencies

| Material / Component | Vulnerability & sourcing |
|---|---|
| Germanium (Ge, $GeO_2$, $GeCl_4$) | CRITICAL. Despite a domestic cluster, Russia continues mass import from China. Until 2025, 90% of germanium wafer demand was covered by imports. |
| Gallium arsenide (GaAs) | CRITICAL. No domestic single-crystal production. Key supplier: AXT Inc. (USA)/AXT-Tongmei (Beijing), reaching Shvabe via pass-throughs (LLC Makro EMS, MEGA SM, MegaClassic, TSK). |
| Indium antimonide (InSb) & MCT | HIGH. Partly imported via LLC Laser Components and directly from China North Industries Group (211th Institute). Single domestic bottleneck: IPP SB RAS. |
| Cryogenic cooling (SCI04R) | HIGH. Actual producer: China North Industries Group (211th Institute), certified via LLC Laser Components. Procurement routinely designated «urgent single-supplier». |
| Microelectronics / PCBs | HIGH. Channel: Shvabe Opto-Electronics (Shenzhen/Meizhou) — USA, UK, Ukraine sanctions — supplies US Microchip Technology microcontrollers to JSC UOMZ. |
| Process equipment / MEMS | CRITICAL. Photolithography: ASML, Nikon/Canon (no country produces these independently). LLC Mapper (sole MEMS supplier for laser gyroscopes) fully dependent on imported wafers, US photoresists, and foreign lithography. |

### Sanctions-circumvention architecture

Russia operates a three-level circumvention system purpose-built around the optoelectronic sector:

- Level 1 — corporate subsidiaries of production enterprises acting as pass-throughs for sanctioned goods.
- Level 2 — nominally civilian Shvabe entities (Shvabe-Moscow, Shvabe-Systems, RT Fotonika, NPO Fotonika) importing dual-use goods under civilian guise.
- Level 3 — Rostec/Rosatom foreign presences: Shvabe Opto-Electronics (Shenzhen/Meizhou), LLC Shvabe (Belarus), Turkish transshipment (ERGA Makine Sanayi ve Ticaret Limited, Izmir).

**The system's defining characteristic is high adaptability: blocking one intermediary immediately activates another. Targeting individual intermediaries is therefore ineffective.**

## 6. CONCLUSIONS & RECOMMENDATIONS

### Why current sanctions underperform

- Sanctions target final producers and integrators at the top of the chain; the upstream enterprises they depend on remain outside restrictions.
- Absence of coordinated multi-jurisdictional pressure allows Russia to exploit regime gaps — no US/EU sanctions on Giredmet, MZ Sapfir, IChHPS RAS, NTK Cryogenic Technology, or LLC Erga.
- Academic institutions (IChHPS RAS) exploit scientific status to access Western equipment under cooperation agreements, channeling output to MIC enterprises.
- China functions as the primary alternative supply route; Turkish and Belarusian transshipment reduces traceability.

**The proposed shift:** from mass sanctioning of final producers — to synchronized precision pressure on critical upstream nodes, coordinated simultaneously across all partner jurisdictions.

Three principles: (1) Reconstruct full production chains before designing sanctions packages. (2) Direct simultaneous pressure at several critical nodes so the holding cannot reorient in time. (3) Tackle the scientific institutions that cooperate closely with the MIC and disable their access to technologies and procurement of commodities used in the MIC-related production chains.

**Expected impact:** asymmetric — maximum disruption to Russia's combat-aviation and missile production with minimal effect on partner-country economies.

*This executive summary is based on the full analytical report 'Corporate Structure and Commercial Ties of Russia's Military-Industrial Complex: Vulnerabilities to Sanctions Pressure' (CASCHT, Kyiv, 2026). Full report and data: contact@cascht.com*

*The Center for Analytical Studies and Countering Hybrid Threats (CASCHT) is an NGO based in Kyiv, Ukraine. The Center studies how authoritarian regimes wage hybrid war against democratic states, and builds mechanisms to identify and counter overt and covert threats. It works with state authorities, Ukrainian and international NGOs, and the media to inform policy and expose these threats to the public.*