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# Glass, Ships and War: A Structural Analysis of the 2025–2026 Global Optical Fibre and Cable Industry

Dr. Dayandhan Naik

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*Abstract:* **This paper examines the global optical fibre and cable sector during 2025–2026 as a strategic industrial system shaped by the interaction of material science, manufacturing concentration, digital infrastructure demand, maritime logistics and geopolitical rivalry. It argues that the sector cannot be understood simply as a telecommunications equipment market: it is a layered value chain in which the availability of high-purity glass preforms, fibre-drawing capacity, cable manufacturing, specialised installation and repair vessels, landing-station equipment and secure maritime corridors jointly determine the resilience of global connectivity. The period has been marked by a renewed acceleration in fibre demand associated with artificial-intelligence data centres, hyperscale cloud networks and backbone expansion, alongside tightening upstream supply and sharp price volatility. At the same time, submarine cables have become more visible as critical infrastructure exposed to accidental damage, sabotage concerns, regulatory screening and strategic competition. Using a qualitative, desk-based conceptual approach, the paper synthesises industry analysis, institutional reporting and recent research to map the sector's structural dependencies. It develops a five-layer framework covering materials, manufacturing, maritime deployment, network governance and geopolitical risk. The analysis finds that bottlenecks are cumulative: abundant demand does not automatically translate into deployable capacity when preforms, skilled production, cable ships, permits or repair access are constrained. It concludes that resilience requires diversified upstream capacity, transparent procurement, a stronger repair-vessel ecosystem, regional route redundancy, trusted but non-discriminatory security governance, and cooperation on incident response. The paper contributes a systems perspective for policymakers, investors, operators and researchers assessing the strategic future of optical connectivity.**

*Keywords:* **Optical fibre, Glass preform, Submarine cable, Cable-laying ships, Supply-chain resilience, Geopolitical competition, AI data centres, Maritime security.**

## I. INTRODUCTION

Optical fibre is often described as the physical foundation of the digital economy. Its strategic significance, however, is more extensive than the familiar image of a strand of glass carrying pulses of light. Fibre must be made from exceptionally pure materials, drawn with precision, protected inside cable structures, transported across borders, installed on land or beneath the sea, connected to terminal equipment and maintained over decades. Each stage depends on specialised knowledge, capital, energy, logistics and regulatory permissions. The resulting infrastructure is simultaneously industrial, commercial, technological and geopolitical.

The title 'Glass, Ships and War' captures three mutually dependent dimensions. 'Glass' represents the upstream material and manufacturing base, including preforms and optical fibre. 'Ships' represents the specialised maritime capacity required to install, survey and repair submarine cable systems. 'War' is used broadly to describe the strategic contest surrounding critical infrastructure: armed conflict and maritime insecurity, but also sanctions, export controls, investment screening, technology restrictions and competition over routes and suppliers. The term does not imply that every cable disruption is deliberate or that commercial rivalry is equivalent to armed conflict.

Developments in 2025–2026 make this systems perspective particularly important. Industry analysis reports a renewed demand cycle for optical fibre and cable, driven in part by AI data-centre expansion and high-capacity network investment. CRU identifies tightening glass-preform availability as a key constraint and describes sharp price increases in early 2026, while its 2025 industry review highlights changing fibre specifications and the international expansion of Chinese suppliers [1], [2]. Meanwhile, the International Telecommunication Union (ITU) warns that ageing submarine cable systems, new demand and lengthy repair times create a resilience challenge for the global network [3].

This paper asks four questions: (1) how is value and dependency distributed across the optical fibre and submarine cable chain; (2) why have demand growth and upstream constraints produced renewed price and supply pressure; (3) how do ships, maritime geography and geopolitical competition shape the reliability of cable deployment and repair; and (4) what policy and industry responses can improve resilience without fragmenting the global connectivity system?

## II. METHOD AND CONCEPTUAL APPROACH

The paper adopts a qualitative, desk-based conceptual research design. It synthesises publicly available industry analysis, institutional reports and recent academic work relevant to optical fibre manufacturing, submarine cable investment, maritime deployment and infrastructure security. The analysis is organised around value-chain mapping and structural bottleneck analysis rather than a statistical econometric model. It therefore identifies relationships, dependencies and plausible policy implications; it does not claim to estimate causal effects or independently verify proprietary market forecasts.

Evidence is treated according to source type. Institutional publications such as the ITU Global Connectivity Report provide system-level context. Industry sources, including CRU and TeleGeography, provide timely information on prices, investment and operational conditions, but their market observations are interpreted as reported assessments rather than universal or independently audited facts. Academic research on the political economy of submarine cables is used to explain concentration among system suppliers and the strategic implications of network ownership [4]. The 2025–2026 period is the principal focus; earlier structural facts are included only where needed to explain the current system.

## III. THE OPTICAL FIBRE AND CABLE VALUE CHAIN

### *A. Glass preforms: the upstream strategic bottleneck*

Optical fibre production begins with a glass preform: a carefully engineered cylindrical structure from which fibre is drawn. The preform stage concentrates demanding process knowledge, specialised equipment, quality control and capital investment. The consistency of refractive-index profiles, purity and geometry determines whether the drawn fibre can meet performance specifications. As a result, preform availability is not interchangeable with nominal fibre-drawing capacity. A producer may own drawing towers yet remain exposed if it cannot secure suitable preforms at the required volume, quality or price.

CRU's 2026 assessment describes preform tightness as a defining constraint in the early-2026 market. It notes that effective capacity can be materially lower than headline capacity when idle or mothballed facilities are excluded, and that restarting or adding preform production takes time [2]. This is a classic industrial bottleneck: capacity at a downstream stage cannot compensate immediately for a shortage at a technically specialised upstream stage. It also creates a strategic distinction between firms with integrated preform-to-fibre operations and firms dependent on external supply.

### *B. Fibre drawing, cable design and manufacturing*

After preform production, fibre is drawn into extremely fine strands and tested for attenuation, strength, geometry and reliability. Fibres are then assembled into cable designs suited to different environments: aerial, buried, duct, indoor, industrial and submarine applications. Submarine cables require additional engineering for water pressure, tensile loading, corrosion exposure, repeaters or branching units where relevant, and protection against seabed hazards. The commercial product is therefore not merely raw fibre; it is a system of materials, cable structures, connectors, terminal equipment, engineering and lifecycle services.

Demand is also changing the product mix. CRU's 2025 review points to increased interest in bend-insensitive A2 fibre, including data-centre and specialised applications, while its 2026 outlook identifies high-fibre-count cable solutions and emerging technologies such as hollow-core and multicore fibre as areas of strategic interest [1], [2]. These shifts matter because a shortage is not always a shortage of generic fibre-kilometres. It may instead be a shortage of a particular specification, qualification, supplier or delivery window.

### *C. System integration, landing stations and network operation*

Submarine connectivity depends on more than the wet plant placed on the seabed. A complete system includes shore-end works, landing stations, submarine line terminal equipment, power-feeding equipment, terrestrial backhaul, network management and agreements among owners and operators. The system integrator coordinates interfaces and performance across these elements. Buyers increasingly include telecommunications operators, consortia, cloud platforms and other large digital infrastructure firms. The growing role of hyperscalers changes procurement power: large technology companies can finance routes, reserve capacity and negotiate long-term supply, influencing which corridors are built and which manufacturers receive orders.

TeleGeography reports that planned submarine cable projects entering service during 2026–2029 represent more than US$16 billion in announced construction value, while noting that not every announced project will necessarily be completed [5]. This investment pipeline signals sustained demand, but announced expenditure should not be confused with completed capacity. Projects remain exposed to financing, permitting, manufacturing slots, vessel availability, landing rights and political approval.

## IV. THE 2025–2026 DEMAND AND SUPPLY REBALANCING

The renewed demand cycle reflects the convergence of several infrastructure programmes. AI training and inference require dense data-centre interconnection, high-capacity backbone links and resilient connections among cloud regions. Conventional broadband deployment, mobile backhaul, enterprise networks and national digital programmes continue to consume fibre. Submarine systems are also being planned to provide route diversity, connect underserved markets and reduce latency between major data centres. Demand growth is therefore multi-source, even though AI infrastructure has become a particularly visible driver.

CRU reports that fibre prices began recovering during 2025 after a prolonged period of weakness and then rose sharply in early 2026 as demand growth met constrained upstream supply. Its March 2026 reporting describes a synchronised increase across regions, linking the shift to preform constraints, changing fibre mix, data-centre investment and regional capacity conditions [6]. These figures should be understood as market-index observations from the named industry source, not as a single universal transaction price. TrendForce similarly reports that optical fibre spot prices rose severalfold during 2026 and expects data-centre-driven shortages to persist through 2028 [7].

The structural lesson is that the fibre market can move from apparent oversupply to tightness without a sudden collapse in the number of manufacturers. Inventory, utilisation, product mix and the time required to restart or expand preform capacity all influence effective supply. When customers anticipate shortages, they may reserve production slots or enter longer-term agreements. Such behaviour can improve visibility for manufacturers but can also disadvantage smaller operators and markets with weaker purchasing power.

Supply expansion is constrained by more than factory construction. New preform lines require specialised deposition equipment, process development, skilled technicians, qualification and customer approval. Fibre and cable plants also need dependable energy, chemicals, high-quality inputs and logistics. Even where investment is announced, a meaningful contribution to qualified commercial output may take months or years. This mismatch between fast demand signals and slow industrial adjustment helps explain price volatility and the strategic value of integrated supply.

## V. SHIPS, SEABEDS AND THE MARITIME BOTTLENECK

Submarine cable installation and repair require specialised vessels, trained crews, cable-handling equipment, route surveys, permits and coordinated work at sea. These vessels are not generic cargo ships. They are capital-intensive assets with specialised operating systems and schedules shaped by weather, port access, route length, seabed conditions and competing projects. Their availability therefore forms a separate constraint alongside glass and factory capacity.

Abels and Babic [4] describe installation and system delivery as highly concentrated, with only a small group of suppliers historically possessing integrated manufacturing and laying capabilities. The same research notes the limited size of the global cable-ship fleet and the cyclical nature of vessel demand. This concentration creates efficiency and accumulated expertise, but it also increases systemic exposure when several large projects compete for the same vessels or when geopolitical and insurance conditions restrict access to particular waters.

Repair capacity is as important as new-build installation. A cable fault can arise from fishing activity, anchoring, seabed movement, equipment failure or intentional interference. Once a fault is identified, repair may require fault localisation, permissions from coastal states, vessel mobilisation, weather windows, spare cable and coordination with cable owners. The ITU's 2025 Global Connectivity Report notes that repairs can take from around two weeks to several months depending on geography, weather and procedural hurdles [3]. The duration is not simply a technical measure: it reflects the institutional and logistical architecture surrounding the cable.

Maritime disruption can therefore have a multiplier effect. A vessel delayed by weather or restricted access may postpone repair on one route and reduce available capacity for another. Congested repair schedules can extend outages. Insurance premiums and security assessments may raise operating costs, while uncertainty about access to strategic waters may influence route design. A resilient system requires not only more cables, but also the ability to maintain them promptly.

## VI. WAR, GEOPOLITICAL COMPETITION AND CABLE SECURITY

### *A. Submarine cables as strategic infrastructure*

Submarine cables carry a substantial majority of international data traffic and connect financial markets, cloud services, government communications, research networks and everyday digital services [8]. Their strategic importance follows from their concentration in specific landing points and maritime corridors, the high cost of replacement, and the difficulty of repairing them quickly. A cable system may be privately financed and operated while remaining essential to national and regional security.

Geopolitical competition affects the sector through several channels: supplier restrictions, sanctions, export controls, investment screening, procurement rules, data-security requirements, route selection and diplomatic pressure. Security concerns can be legitimate, particularly where network ownership, terminal equipment or maintenance access creates opportunities for surveillance or disruption. However, broad restrictions can also reduce supplier choice, increase costs, delay projects and divide markets into politically defined technology blocs. The challenge is to distinguish evidence-based risk controls from measures that primarily serve industrial or geopolitical protection.

### *B. Physical vulnerability and attribution*

Cable damage is not synonymous with sabotage. Anchors, fishing gear, geological events and ordinary equipment failures remain important causes of faults [8]. In tense maritime environments, however, ambiguous incidents may trigger suspicion and diplomatic escalation before facts are established. The attribution problem is difficult because cables lie across large seabed areas, ownership and jurisdiction can be complex, and evidence may be dispersed among operators, vessels and coastal authorities.

Resilience policy should consequently separate three tasks: prevention, response and attribution. Prevention includes route surveys, burial or protection in high-risk areas, monitoring and navigational awareness. Response includes rapid fault reporting, repair-vessel access, spare cable and cross-border procedures. Attribution requires evidence preservation, transparent investigation and communication that avoids premature conclusions. Treating every fault as hostile risks politicising maintenance; treating every fault as routine risks overlooking deliberate interference.

### *C. The tension between security and interdependence*

Security-driven procurement may favour domestic or allied suppliers, while the technical and economic logic of submarine connectivity favours international collaboration. A cable may be manufactured in one country, financed in another, laid by a vessel registered elsewhere, land in several jurisdictions and be operated by a multinational consortium. This interdependence is not an accidental weakness; it is how global infrastructure is built. The policy objective should be to make dependencies visible and manageable rather than assume that complete national self-sufficiency is feasible or desirable.

## VII. A FIVE-LAYER STRUCTURAL FRAMEWORK

The preceding analysis suggests a five-layer model for assessing the resilience of the global optical fibre and cable system. Each layer has distinct assets and risks, but failure at one layer can constrain the others.

**Layer 1 — Materials and process capability:** high-purity inputs, preform production, specialised equipment, process knowledge and qualified suppliers. The key question is whether critical materials can be obtained at scale and within acceptable lead times.

**Layer 2 — Fibre and cable manufacturing:** drawing capacity, cable assembly, product specifications, testing, skilled labour, energy and industrial logistics. The key question is whether nominal capacity corresponds to available, qualified output in the required product mix.

**Layer 3 — Maritime deployment and repair:** cable ships, crews, route surveys, shore-end operations, spare cable, permits and insurance. The key question is whether installation and repair resources can reach the required location when needed.

**Layer 4 — Network ownership and governance:** consortia, hyperscalers, operators, landing stations, terminal equipment, data governance and cross-border agreements. The key question is whether investment and operational decisions support competition, interoperability and transparent access.

**Layer 5 — Geopolitical and environmental security:** conflict exposure, sanctions, export controls, sabotage risks, seabed hazards, extreme weather and regulatory fragmentation. The key question is whether the system can absorb disruption without prolonged loss of connectivity.

The framework highlights cumulative bottlenecks. A country may possess strong fibre-drawing capacity but lack preforms; a cable manufacturer may have orders but no available installation vessel; a new cable may be completed but delayed by landing permits; a region may have multiple cables but limited route diversity if they share the same vulnerable corridor. Resilience must therefore be assessed across the entire system, not by counting factories, cables or nominal bandwidth in isolation.

## VIII. POLICY AND INDUSTRY RECOMMENDATIONS

### *A. Diversify upstream capacity without duplicating everything*

Governments and industry should map dependencies in preforms, deposition equipment, specialty materials and qualified fibre types. Diversification can include multiple qualified suppliers, strategic partnerships, targeted research and development, and support for commercially viable regional production. The objective should not be autarky. Building every stage in every country would be costly and could create inefficient excess capacity. Instead, policy should identify single points of failure and create credible alternatives for the most critical inputs.

### *B. Improve market transparency and procurement discipline*

Large buyers should share credible demand forecasts and avoid unnecessary order concentration that leaves smaller operators exposed. Longer-term supply agreements can support investment, but contract design should include delivery milestones, allocation principles and contingency provisions. Public authorities should monitor market concentration and trade measures while avoiding simplistic assumptions that low prices necessarily indicate unfair competition or that high prices automatically justify protectionism.

### *C. Strengthen the cable-ship and repair ecosystem*

Operators, governments and development institutions should evaluate regional repair coverage, vessel utilisation, spare-cable depots, crew training and emergency mobilisation procedures. Where commercial incentives are insufficient, cooperative standby arrangements or shared regional repair capacity may be justified. Repair permissions and customs procedures should be pre-agreed where possible, while respecting coastal-state jurisdiction and environmental requirements. The ITU's emphasis on repair delays underlines that repair readiness is a core element of connectivity resilience, not a secondary maintenance issue.

### *D. Design route diversity into network planning*

New systems should be assessed for genuine geographic diversity, not merely additional cable count. Routes that share landing stations, narrow maritime passages or common terrestrial backhaul may fail together. Network planners should consider alternative landing points, terrestrial cross-border links, satellite backup for limited essential services, and regional interconnection. Redundancy should be tested against realistic compound scenarios, including a cable fault coinciding with severe weather or a regional security crisis.

***E. Establish proportionate security governance***

Security controls should be transparent, technically grounded and subject to review. Governments can require risk assessments, incident reporting, secure access controls, supply-chain disclosure and independent audits for critical components. Restrictions on suppliers or technologies should be evidence-based, proportionate and coordinated with partners where feasible. Clear rules reduce uncertainty for investors and prevent security policy from becoming an unpredictable source of project delay.

***F. Build regional cooperation and shared information***

Submarine cable resilience is inherently cross-border. Regional mechanisms should support incident notification, vessel access, repair coordination, information sharing, route planning and technical standards. Public-private cooperation is essential because much of the infrastructure is privately owned while the consequences of disruption are widely shared. Cooperation should include smaller coastal states and emerging digital markets, which may have less bargaining power but face significant consequences from a single cable outage.

## IX. DISCUSSION

The central finding is that the 2025–2026 optical fibre and cable environment is not adequately explained by a single market cycle or a single geopolitical rivalry. It is a structural adjustment in which demand is rising at the same time that upstream industrial flexibility, maritime capacity and political predictability remain limited. AI infrastructure makes the demand signal more urgent, but the physical network still depends on glass chemistry, factory processes, ship schedules, seabed access and cross-border governance.

The phrase 'glass, ships and war' is therefore best understood as a model of interdependence. Glass without ships cannot become a functioning submarine route. Ships without manufacturing slots cannot install cable. Cables without secure landing stations and reliable repair access cannot provide resilient connectivity. Geopolitical restrictions may protect certain assets but can also constrain the supply chain that keeps them operating. The most resilient strategy is neither unrestricted dependence nor complete national separation; it is managed interdependence supported by redundancy, transparency and credible contingency planning.

This analysis has limitations. It is a conceptual synthesis rather than a primary survey of manufacturers, vessel operators or regulators. Some industry data are proprietary, and reported price indices or investment pipelines may use different definitions and coverage. Public information about cable incidents can be incomplete, particularly while investigations are ongoing. Future empirical work could compare regional preform concentration, fibre pricing, vessel utilisation, repair duration and route diversity using consistent datasets. Interviews with manufacturers, cable owners, ship operators, insurers and coastal authorities would also help test the five-layer framework.

## X. CONCLUSION

The global optical fibre and cable sector in 2025–2026 is a strategic infrastructure industry whose resilience depends on the coordinated performance of materials, manufacturing, maritime deployment, network governance and security institutions. Renewed demand from AI data centres and high-capacity networks has exposed the importance of preform availability and qualified fibre supply. At the same time, submarine cable expansion depends on a specialised and relatively concentrated ecosystem of system integrators, installation vessels, repair ships, landing stations and regulatory approvals. Geopolitical competition intensifies these dependencies by shaping supplier access, investment decisions, route selection and the governance of critical infrastructure.

The paper's principal recommendation is to govern the sector as an integrated system. Policymakers should diversify critical upstream inputs, support repair readiness, promote real route diversity and adopt proportionate security rules. Industry participants should improve demand visibility, coordinate long-term procurement and invest in lifecycle resilience rather than focusing only on new-build capacity. Regional institutions should facilitate cross-border repair and incident response. The future of global connectivity will depend not only on how much fibre can be produced, but on whether the world can move, install, protect and repair it across an increasingly contested maritime environment.

## REFERENCES

[1] CRU Group, "Optical fibre and cable: Top ten industry shifts in 2025," 2025. Available: https://www.crugroup.com/en/communities/thought-leadership/2025/optical-fibre-and-cable-top-ten-industry-shifts-in-2025/

[2] CRU Group, "Optical fibre prices rise as preform availability tightens," 2026. Available: https://www.crugroup.com/en/communities/thought-leadership/2026/optical-fibre-prices-rise-as-preform-availability-tightens/

[3] International Telecommunication Union, Global Connectivity Report 2025. Geneva: ITU, 2025. Available: https://www.itu.int/dms_pub/itu-d/opb/ind/D-IND-ICT_MDD.GCR-2025-4-PDF-E.pdf

[4] J. Abels and M. Babic, "Cable wars? Mapping the political economy of submarine cables in an era of geoeconomic competition," Globalizations, 2026 (online first), doi: 10.1080/14747731.2025.2599691.

[5] TeleGeography, "Building tomorrow's internet: A 2026 update on cable investment," 2026. Available: https://resources.telegeography.com/building-tomorrows-internet-an-update-on-new-cable-investment

[6] CRU Group, "CRU introduces monthly optical fibre price reporting in response to market volatility," 2026. Available: https://www.crugroup.com/en/communities/thought-leadership/2026/cru-introduces-monthly-optical-fibre-price-reporting-in-response-to-market-volatility/

[7] TrendForce, "Optical fiber spot prices surge severalfold in 2026, with data center-driven supply shortages expected to persist through 2028," 19 October 2026. Available: https://www.trendforce.com/presscenter/news/20261019-13275.html

[8] International Cable Protection Committee, "Submarine cable protection and resilience resources," ICPC, 2022. Available: https://www.iscpc.org/