BIOEXPORT NAVIGATOR:
A Decision-Support Tool for U.S.-China AI-Biosecurity Trade Compliance[1]

[Track 3. AI Biosecurity Tools]

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Abstract

Biosecurity practitioners currently face a fragmented policy signal challenge: while AI-enabled biological design risks accelerate, the legal frameworks governing cross-border transfers—particularly between the U.S. and China—remain opaque and difficult to interpret. This complexity creates a "chilling effect" on legitimate research while leaving critical gaps for accidental misuse in an era of intense strategic competition. The *BioExport Navigator* is a prototype decision-support tool designed to bridge this gap. By mapping RAND 2025 technical uplift to U.S. BIS regulatory triggers, it provides a structured decision layer for cross-border compliance. The tool uniquely flags EAR § 744.6 "U.S. Person" liability and identifies "small-but-deadly" models that fall below standard compute thresholds but trigger presumption of denial for China-bound transfers. It moves biosecurity from reactive monitoring to proactive, informed decision-making in an era of intense strategic competition. It ensures that high-risk AI-Bio convergence is managed through standardized, cost-effective, real-world policy frameworks.

[1] Research conducted at the AIxBio Hackathon, April 2026

1. Introduction

The convergence of artificial intelligence and biotechnology has moved biosecurity from the physical laboratory to the digital cloud. However, the regulatory framework governing this convergence is fragmented. Current biosecurity export controls are a black box for the average researcher. U.S. export controls, specifically regarding China, have shifted from a "list-based" approach (tracking specific chemicals) to a "capability-based" approach (tracking AI compute and design uplift) (BIS, 2025). For the individual researcher, lab director, or policymaker, this has created a "chilling effect" (CSET, 2024). Legitimate collaboration comes with high legal costs and experiences stress/fear caused by accidental legal violations; while less-cautious actors may unknowingly cross "redlines" (NTI, 2024). There is no lightweight, middle-ground tool that translates technical AI-bio risk (like the RAND Index) into legal export categories (like ECCNs).

The *BioExport Navigator* fills this gap by helping researchers and labs navigate the legal dilemma: *"If I send this AI file to my partner in Beijing, do I go to jail?"*. It is a cross-border regulatory navigator (Origin *X* → Destination *Y*) that:

1. Addresses this decision-making bottleneck by providing a structured logic layer between technical AI-Bio risk and legal compliance. It collates the first unified 'Regulatory Navigator' for AI-Bio by aligning AI capabilities with policy.
2. The prototype methodology is replicable—established frameworks **(**RAND, Sandia, IBBIS**)** are mapped and extended to Export Control Classification Numbers (ECCNs) (e.g., 2E001).
3. As a specialized U.S.-China Biosecurity Export Control Navigator, it serves as a practical policy interface where AI-Bio regulations meet scientific practice while navigating global economic and technological competition.

2. Related Work

This tool does not invent risk categories from scratch; rather, it synthesizes three "gold-standard" frameworks:

- **Sandia National Laboratories' BioRAMs:** Offers the logic for laboratory-level biosecurity and biosafety risk assessment.
- **The RAND Global Risk Index for AI-Enabled Biological Tools (2025):** Provides the functional taxonomy of risks (e.g., pathogen enhancement, immune evasion).
- **IBBIS Common Mechanism (commec):** Defines the technical "Sequences of Concern" and the collaborative industry standards for DNA synthesis screening.

Additionally, the *BioExport Navigator* extends by aligning these with the **U.S. Export Administration Regulations (EAR)** and the **Bureau of Industry and Security (BIS) 2024-2025** interim final rules.

3. Methods

This tool is built as a relational decision tree constructing a structured decision layer that maps technical risk to legal reality. The methodology involved mapping risk-informed functional capabilities (RAND; SANDIA) and technical redlines (IBBIS Common Mechanism), and further aligning them with the legal redlines of U.S. Export Administration Regulations (EAR) and Export Control Classification Numbers (ECCNs). The methodology comprised four main stages:

Stage 1: Functional Risk Taxonomy (Technical Layer)
We utilized the RAND Global Risk Index (2025) and IBBIS Common Mechanism to define a taxonomy of "Capabilities of Concern." Rather than focusing on specific pathogens, the tool uses functional triggers:

- **Pathogen optimization.** Capabilities that enhance virulence, transmissibility, or environmental stability.
- **Access/Uplift.** Capabilities that lower the barrier for non-experts to execute complex protocols.
- **Evasion.** Capabilities specifically designed to obfuscate regulated sequences or bypass synthesis screening.

While the RAND Index identifies AI-specific design uplift, we utilize Sandia National Laboratories' BioRAMs (Biosecurity Risk Assessment Models) to provide the foundational risk context for the biological agents being

manipulated. By anchoring AI capabilities in Sandia's established biosafety and biosecurity weighting systems, the Navigator ensures that regulatory triggers are proportional to the underlying biological risk.

Stage 2: Regulatory Cross-Mapping (Policy Layer)
While Executive Order 14110 sets a 10^{23} FLOPS reporting threshold for domestic oversight, the *BioExport Navigator* identifies a critical regulatory gap in international transfers. While the new ECCN 4E091 restricts advanced model weights based on compute parameters, specialized low-compute models with high biological 'uplift' (e.g., novel pathogen design) may fall outside this specific control. The Navigator flags these 'small-but-deadly' models for China-bound transfers, noting that even if they fall below the 4E091 compute threshold, they may still trigger a license requirement under broader Catch-All provisions or Entity List restrictions.

Stage 3: Decision Logic Development (Navigator Core)
The prototype was built as a relational decision tree (*X* → *Y*+ Capability = Requirement).

1. **Input.** User selects Origin (USA) and Destination (China).
2. **Primary Screen (The "Entity List").** The engine first checks the recipient against the Consolidated Screening List (CSL). If the entity is restricted, a Red Alert is issued immediately, overriding ECCN classification.
3. **Process.** The tool determines if the transfer is a physical export, a digital transfer, or a "Deemed Export" (sharing controlled technology with a foreign national within the U.S. under EAR § 734.13).
4. **Filter:** User selects a functional capability from the RAND Index.
5. **Output.** The tool displays a "Compliance Status Card":
    - **Red (Entity List):** IMMEDIATE PROHIBITION. The recipient is on the BIS Entity List; all transfers require a license with a presumption of denial, regardless of ECCN.
    - **Green:** No license required for this destination AND recipient has passed Entity List screening.
    - **Yellow:** License Exception may apply; enhanced due diligence required for dual-use capabilities.
    - **Red (ECCN/Rule):** Presumption of Denial based on the specific AI-bio capability (e.g., ECCN 2E001) or destination (Country Group D:5).
    - **Prohibition (Support):** "U.S. Person" activity restriction (EAR § 744.6) for intangible technical assistance.

Stage 4: Validation and "Red-Teaming"
The mapping logic was cross-verified using a **Multi-LLM Consensus approach** (Gemini, ChatGPT, and Claude) to ensure accuracy. This stage identified "blind spots" in the mapping, specifically where AI model weights might fall under **General Prohibition 10** even if they lack a specific ECCN.

Figure 1 illustrates the tool's Minimum Viable Product (MVP) architecture. Figure 2 illustrates mapping of five high-priority "AI-Bio" capabilities.

Figure 1: BioExport Navigator MVP Architecture

Feature	Data Source	Practical Logic
Origin/Destination Pair	Custom List (USA ↔ China)	Surfaces the **Entity List** status of specific labs or universities. This is the **primary screen** for China-bound transfers.
Category Filter	**RAND Risk Index**	User selects "Protein Design Software" → Tool maps this to **ECCN 2E001** (Technology for the development of controlled biological items).
Compliance Trigger	**IBBIS commec**	User inputs a capability → Tool checks if it involves **"Sequences of Concern"** regulated by the **Australia Group**.
Strategic Insight	**EAR § 744.6 / BIS Rules**	Displays a warning if the activity involves restricted **"Support"** by a **U.S. person** for advanced Chinese biotech.

Figure 2: BioExport Navigator mapping of 5 high-priority "AI-Bio" capabilities

Core Mapping: Technical Capability to Regulatory Trigger

AI-Bio Capability (RAND/IBBIS)	U.S. Export Control Trigger (EAR/ECCN)	Compliance Decision Logic (USA → China)
1. Pathogen Functional Modification (e.g., AI used for *altered host range* or *immune evasion*)	**ECCN 2E001** (Technology) & **2D352** (Software)	**Presumption of Denial.** Software "specially designed" for the functional design of regulated pathogens (Country Group D:1/D:5) requires a license.
2. Adversarial "Decoy" Generation (AI used to obfuscate **Sequences of Concern** to evade screening)	**EAR General Prohibition 10** (Knowledge of Violation)	**Red Flag.** Exporting AI tools with the *explicit* function of circumventing synthesis screening violates "knowledge" provisions against illegal end-uses.
3. Advanced Frontier Model Weights (Closed-source models trained > integer/floating-point operations)	**New ECCN 4E091** (AI Model Weights)	**Strict License Required.** As of Jan 2025, exporting unpublished model weights above the compute threshold to China is restricted.
4. Digital Bench-to-Cloud Workflows (Technical data for automated lab protocols/remote labs)	**ECCN 3E069** (New Biotech Equipment Tech)	**Mandatory License.** New 2025 rules control "technology" for the development of advanced biotech tools like high-parameter flow cytometers for China.
5. Increased Environmental Stability (AI used to optimize pathogen survival outside hosts)	**"U.S. Person" Support (EAR § 744.6)**	**Restriction on Services.** U.S. persons are prohibited from providing "support" (even if no item is exported) for the enhancement of WMD-relevant pathogens in China.

Example Scenario: Cross-Border Transfer of a Specialized Biodesign Model

- **Input Capability.** "Autonomous sequence optimization for immune evasion" (A high-uplift capability identified under the RAND Global Risk Index).
- **Regulatory Hook.** ECCN 4E091 (Controls on Dual-Use AI Model Weights) and the January 2025 BIS Interim Final Rule on advanced computing exports to Country Group D:5.
- **The Result.** 🔴 RED ALERT. Mandatory Export License required; Presumption of Denial for China-based end-users. Additionally, EAR § 744.6 triggers a restriction on any "U.S. Person" providing technical support for the model's integration or fine-tuning.

4. Results

To test the "Logic Engine," we ran three "Stress Test" scenarios (see Figure 3: BioExport Navigator Use-Case Validation):

1. **The "Weights" Test:** Mapping the transfer of a 70B parameter bio-design model. The tool correctly flagged the January 2025 BIS rule requiring a license for "dual-use AI model weights" to China.
2. **The "Service" Test:** A U.S. citizen providing code for a Chinese cloud lab. The tool successfully triggered the EAR § 744.6 "U.S. Person" restriction, which is often missed by standard physical-item trackers.
3. **The "Evasion" Test:** An AI model designed to "decoy" sequences. The tool flagged General Prohibition 10, identifying the intent to circumvent screening as a criminal violation.

Figure 3: BioExport Navigator Use-Case Validation (Audit-Verified)

Scenario	User Input (Capability + Path)	Tool Result (The "Decision Layer")	Impact of Navigator Tool
A: The Academic	**Input:** Sharing a protein-folding AI model (weights) with a university in Shanghai.	🟡 **Yellow Alert. Weights below 10^{23} FLOPS, but ECCN 4E091 triggers for China (D:5). Action: Mandatory Entity List screening.**	**Closes "Small-Model" Loophole:** Captures high-uplift tools that fall below raw compute reporting lines.
B: The Developer	**Input:** Sending AI code designed to generate "decoy" sequences to bypass synthesis screening.	🔴 **Red Alert.** Triggers *Prohibited (Gen. Prohibition 10 / EAR99)**. Explicit intent to evade IBBIS mechanisms.	**Protects Infrastructure:** Flags tools designed to "break" the global DNA synthesis screening safety net.
C: The Lab Director	**Input:** U.S. person providing technical data to a Chinese national *inside the U.S.*	🔴 **Deemed Export Alert.** Sharing controlled tech (ECCN 2E001) with a foreign national in the U.S. triggers EAR § 734.13.	**Identifies "Intangible" Transfers:** Catches the most common real-world enforcement vector (Deemed Exports).

5. Discussion and Limitations

The *BioExport Navigator* proves that we can democratize biosecurity compliance. By moving from fragmented signals to a structured decision layer, we empower researchers to be the first line of defense in global biosecurity.

- **Industry Impact—cost effectiveness, informed compliance, enhanced collaboration.** The *BioExport Navigator* enables complex biosecurity policy compliance to become legible and affordable for non-lawyers, while also democratizing safety checks. Additionally, biosecurity researchers often avoid cross-border collaboration because they fear legal "export control" repercussions they don't understand. This tool moves biosecurity from 'fear-based avoidance' to 'informed compliance.'
- **Lightweight but structured**. It's an interactive logic tree (X → *Y* + Category = Requirement), not a complex AI simulation.
- **Feasibility, data alignment, and extension of established industry frameworks.** It grounds "Export Controls" (a trade/legal concept) in "Bio-AI Capabilities" (a technical risk concept):
  - **i)** **RAND Global Risk Index (Sep 2025)** provides the "Filter by Category" logic. It can map RAND's eight functional categories (e.g., protein design, viral optimization) to specific ECCNs (Export Control Classification Numbers) in the U.S. Commerce Control List (CCL).
  - **ii)** **Sandia BioRAMs** provides the "risk context." While BioRAMs are for lab officers, their logic—which weights an agent's properties against security practices—can help users understand *why* a certain transfer (e.g., an AI model for viral aerosolization protocols) is restricted.
  - **iii)** **IBBIS Common Mechanism (commec)** is the "technical data" anchor. Since commec flags sequences against international control lists (including China's), this tool can use its open-source databases to show users which specific sequences or software tools trigger a "red flag" in a cross-border transfer.
- **Strategic implications of EAR § 744.6 "U.S. Person" rule.** This law creates a unique friction point in the geopolitics of AI-Bio. A "hidden trap" of EAR § 744.6 is that it regulates 'people and services', not just physical items or software files. This is critical for a U.S.-China focus because it effectively creates a "personal travel ban" on specific types of technical assistance. Unlike most export laws that ask, *"Is this item on a list?"*, § 744.6 asks, *"Is this U.S. person helping a prohibited program?"*. For further analysis, see Appendix I.
- **Geopolitical Conflict Management.** The tool acknowledges and proactively responds to the complex, emerging realities of the U.S.-China trade and technology competition while preserving paths for low-risk, transparent scientific exchange. The tool focuses on the U.S. "AI Diffusion Framework" and recent 2024–2025 BIS updates:
  i) *U.S. AI Diffusion Export Control Rule (2025 Updates)*. The tool can use recent Bureau of Industry and Security (BIS) guidance that expanded the Foreign Direct Product Rule (FDPR) to AI model weights. It can flag if a model trained on U.S. chips (e.g., Nvidia H100s) is subject to "U.S. Persons" controls even if shared between non-U.S. entities.

ii) *China's "Unreliable Entities List" & Dual-Use Revamp (Jan 2025).* Counterbalances U.S. data with China's revamped dual-use regulations. This tool can show the $X \rightarrow Y$ and $Y \rightarrow X$ friction—for instance, China's restrictions on rare earth elements or specific biotech software in retaliation to U.S. chip bans.

Limitations & Dual-Use Considerations

1. Limitations & False Negatives

- **Regulatory lag.** The *BioExport Navigator* relies on static mapping of ECCNs and BIS rules. Because U.S. export controls and China's "Unreliable Entities List" evolve rapidly (often via weekly updates), the tool may suffer from temporal false negatives if a user does not cross-reference the date of the last database sync. The tool requires a "Last Updated" metadata tag to prevent reliance on stale data.
- **Interpretative ambiguity & legal nuance.** Export control law often hinges on "intent" and "knowledge" (e.g., EAR § 744.6). A lightweight tool cannot replace a legal "Due Diligence" review; it can identify explicit triggers but may miss nuanced prohibitions based on non-public end-user information. It provides "First-Tier Screening" but cannot account for non-public "Is Informed" letters sent by BIS to specific companies.
- **Entity List Latency.** While the *Navigator* tracks Country Groups, the BIS Entity List (specific banned institutions) updates more frequently than general ECCN categories. The tool currently requires a manual secondary check against the latest Consolidated Screening List (CSL) to ensure the specific recipient institution is not sanctioned.
- **Deemed Export Oversight.** The current prototype focusing on cross-border transfers does not fully automate the tracking of 'Deemed Exports' (EAR § 734.13), where sharing of controlled technology with a foreign national *within* the United States is legally equivalent to an export to their home country."
- **ITAR Jurisdiction.** This tool focuses on EAR/BIS regulations. It does not address jurisdiction under the International Traffic in Arms Regulations (ITAR) administered by the State Department, which may apply to specific weaponized pathogens or military-end-use applications.
- **Scalability constraints.** While the tool effectively maps high-level RAND risk categories, it does not yet support granular "Sequence of Concern" screening at the base-pair level, which would require integration with a live IBBIS commec API.

2. Dual-Use Risks

- **Gap identification (The "redline" problem).** The primary dual-use risk is that an adversary could use the *Navigator* to reverse-engineer regulatory blind spots. By testing various origin-destination-capability combinations, a bad actor could identify "pathways of least resistance"—jurisdictions or specific AI-bio capabilities that currently fall outside of strict license requirements.
- **Circumvention strategy.** The tool's "Strict Source Discipline" provides links to primary guidance. While meant for compliance, this also provides a centralized "how-to" for understanding exactly what thresholds (e.g., 10^{23} FLOPS) a model must stay under to avoid mandatory reporting to the Bureau of Industry and Security (BIS).
- **Mitigation.** The tool provides "Strict Source Discipline," meaning it only reflects publicly available laws. It does not contain "hidden" exploits or vulnerabilities.

3. Responsible Disclosure & Mitigation

- **"Not legal advice" disclaimer.** The tool must feature a persistent header stating that output is for educational and preliminary screening purposes only.
- **Tiered access suggestion.** Future iterations should consider TLP (Traffic Light Protocol) access. While the "Navigator" interface can be public, specific "Red-Teaming" insights into how AI models bypass screening should be restricted to verified biosecurity practitioners.
- **Anonymized query logs.** To prevent the tool itself from becoming a target for intelligence gathering, the platform should not store specific user IP addresses alongside their "Origin/Destination" queries.

4. Ethical Considerations

- **Scientific openness vs. security.** The tool acknowledges the ethical tension between "Open Science" (collaboration with Chinese institutions) and "National Security." By providing clarity, the tool aims to reduce the "chilling effect" on legitimate, safe research while strictly flagging high-risk activities.

- **Bias in attribution.** There is a risk of over-flagging legitimate researchers based on institutional affiliation rather than specific activity. The tool mitigates this by focusing on capability-based triggers rather than purely entity-based bans.
- **The "Chilling Effect".** We must ensure the tool does not become a *de facto* ban on all Chinese collaboration, but rather a guide for *safe* collaboration.
- **Equity.** The tool is designed to be lightweight and accessible to under-resourced institutions that cannot afford $1,000/hour legal/export counsel.

Future Work

- **Entity mapping.** Integrate the Bureau of Industry and Security (BIS) Entity List so users can select specific Chinese universities and see their specific restriction status (e.g., WMD end-user flags).
- **Live BIS RSS integration.** Connect the tool directly to the Federal Register API to reflect 2026's changing trade war landscape instantly.
- **LLM-powered querying.** Integrate a secure, "Air-Gapped" LLM to allow practitioners to ask plain-language questions about complex shipping manifests.

6. Conclusion

The *BioExport Navigator* addresses a critical gap in the current biosecurity landscape: the translation of technical AI-bio design uplift into actionable regulatory decisions. By synthesizing the functional risk frameworks of RAND, Sandia, and IBBIS with the legal rigor of the U.S. Export Administration Regulations (EAR), this prototype proves that complex compliance for frontier technologies can be made accessible to the non-expert practitioner. Our validation tests demonstrate that a capability-based decision layer successfully captures high-risk transfers—such as specialized AI model weights and intangible technical support—that often fall below standard domestic compute reporting thresholds or evade physical-item tracking.

The implications of this tool extend beyond mere compliance; the *BioExport Navigator* serves as a model for informed governance in an era of strategic de-risking. By providing clarity on redlines—particularly regarding the often-overlooked "U.S. Person" (EAR § 744.6) liability—the tool reduces the "chilling effect" on legitimate scientific exchange while strengthening the global biosecurity safety net against intentional evasion. As AI-Bio convergence continues to accelerate, the move from fragmented technical signals to structured, logic-driven decision layers will be the defining requirement for maintaining both national security and scientific openness.

Appendix

Appendix I: Note on strategic implications of EAR § 744.6 "U.S. Person" rule

- **What is a "U.S. Person"?** Under § 744.6, a 'U.S. Person' is defined by legal status rather than mere physical presence. This includes:
  - **U.S. Citizens** (regardless of global location);
  - **Permanent Residents** (Green Card holders);
  - **U.S. Entities** (including foreign branches of U.S. firms).
- **What is "Support"?** It is defined very broadly to include "servicing," "financing," "performing any contract," or even just "facilitating" a transfer.
- **The "Intangible" Export**: While a researcher might not be "exporting" a file, providing *remote technical troubleshooting* for a Chinese lab's AI bio-design tool can trigger a violation. *The BioExport* Navigator helps identify when *advice* becomes a *controlled service*.
- **The Knowledge Standard**: This rule applies if the U.S. person *knows* the activity will support a prohibited end-use. The *BioExport Navigator* is valuable because it provides that "knowledge"—alerting the user that their partner lab in China is on a restricted list (like the BIS Entity List). It uses U.S. Person Risk Assessment Checklist (EAR § 744.6) to alert users when a seemingly benign academic consultation triggers personal liability under the 'U.S. Person' support rule, a frequent blind spot in decentralized research collaborations.
- **The New 2025 "Military-Intelligence" Expansion**: Recent updates (January 2025) expanded these rules to prohibit U.S. persons from supporting military-intelligence end-users in China. Many researchers don't realize their partner university might have "Military-Civil Fusion" ties that trigger this personal liability.

Note: *While a foreign national's physical location in the U.S. is relevant for other export rules, it does not alone confer 'U.S. Person' status for the purposes of the § 744.6 support restrictions.*"

Appendix II: U.S. Person Risk Assessment Checklist (EAR § 744.6)

This checklist is designed as a practical application tool for testing the *BioExport Navigator*. It transforms complex legal requirements into a structured, scannable format that biosecurity practitioners can use to evaluate their personal liability under EAR § 744.6. This checklist assists individuals and institutions in identifying high-risk "support" activities related to AI-biosecurity collaboration in prohibited jurisdictions (e.g., China).

Part 1: Defining the "U.S. Person" (Personal Jurisdiction)

Check all that apply:

- Are you a **U.S. Citizen** (regardless of your current physical location)?
- Are you a **Permanent Resident** ("Green Card" holder)?
- Are you a **U.S. Entity** (incorporated in the U.S. or a foreign branch of a U.S. firm)?

If any box is checked, your personal activities are subject to § 744.6 restrictions.

Part 2: Identifying Prohibited "Support" Activities

Even if no physical items are exported, do you provide any of the following to a non-U.S. program?

- **Technical Assistance**: Troubleshooting, optimizing, or maintaining AI bio-design software.
- **Remote Data Services**: Providing cloud-based compute or model-training "support" via Infrastructure as a Service (IaaS).
- **Administrative/Financial Support**: Financing, contract negotiation, or facilitating transfers of biosecurity-relevant tools.
- **Employment/Consultancy**: Working for a Chinese biotech or AI firm that has ties to "Military-Intelligence" or "Military-Production" end-users.

Part 3: The "Knowledge" Trigger & End-User Screening

The § 744.6 rule applies if you "know" (or should know) the activity supports a prohibited end-use:

- Have you screened your partner institution against the BIS Entity List?
- Does your partner have known ties to the Military-Civil Fusion (MCF) strategy in China?
- Is the activity related to pathogen functional modification or adversarial obfuscation of regulated sequences?

Part 4: New 2025 "Red Flags" for AI-Bio Convergence

Pay special attention to these emerging triggers:

- **Compute Thresholds**: Is the model being supported trained on hardware exceeding 10^{23} FLOPS?
- **Evasion Tactics**: Does the request involve atypical specifications that might bypass IBBIS DNA synthesis screening?
- **Restricted Weights**: Does the collaboration involve sharing or optimizing advanced AI model weights for biological design?

Note: *Under EAR § 744.6, 'U.S. Person' status is defined by legal standing (citizenship, permanent residency, or U.S. incorporation), not mere physical presence. While physical location in the U.S. triggers other export definitions (e.g., § 734.13), it does not alone confer U.S. Person status for foreign nationals under the § 744.6 support restrictions.*

Code and Data

This project focuses on a policy-logic architecture rather than standalone software code. To ensure responsible disclosure and avoid creating a centralized "bypass manual" for export controls (an identified dual-use risk), the underlying logic is provided as a structured data artifact rather than a public repository.

- **Code repository:** N/A (Policy Logic Prototype)
- **Data/Datasets:** Included as an artifact: BioExport_Navigator_Logic_FINAL.csv. This dataset maps RAND and IBBIS technical benchmarks to U.S. BIS regulatory triggers. Data Artifact version FINAL reflects multiple post-audit refinements to ensure precision in ECCN classification and 'U.S. Person' jurisdictional definitions.
- **Other artifacts:** Supplemental Note on strategic implications of EAR § 744.6 "U.S. Person" rule (Appendix I) and U.S. Person Risk Assessment Checklist (Appendix II), and Regulatory Mapping Engine (Figures 1–3 in the main report).

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LLM Usage Statement

The *BioExport Navigator* was conceived and directed by the author, leveraging an 'Epistemic Ecosystem' of Large Language Models (Gemini, ChatGPT, and Claude) to assist in technical mapping and structural drafting.

Human-Led Synthesis. As the Lead Investigator, the author identified the core research problem—the fragmented regulatory signal in U.S.-China AI-Bio trade—and directed the models to cross-map the RAND, Sandia, and IBBIS frameworks against specific U.S. Bureau of Industry and Security (BIS) triggers.

Verification & Accountability. While LLMs assisted in generating the initial ECCN mapping tables and technical descriptions, all claims, regulatory citations (e.g., EAR § 744.6), and logical triggers were independently verified by the author through primary source review of the Federal Register and official BIS guidance. Regulatory triggers (ECCNs/EAR sections) were cross-referenced against the official eCFR and BIS.gov databases as of April 26, 2026. The final narrative, strategic positioning, and 'U.S. Person' risk assessment reflect the author's original policy analysis and historical context. All content has been edited and synthesized to ensure accuracy and professional alignment with biosecurity norms.

To ensure regulatory and technical rigor, the prototype's logic underwent a secondary 'Red Team' stress-test using Claude 3, which specifically audited the ECCN mappings and U.S. Person jurisdictional definitions to mitigate false-security risks and identify emerging regulatory gaps.