



AI4HRP: Designing a Modular, Feedback-Driven LLM-based System for Evidence-Grounded High-Risk Property (HRP) Classification

Tirthankar Ghosal (on behalf of ORNL AI for Operations Team – R&D, Procurement, ITSD)



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Rings of the Relativistic Heavy Ion Collider are shown here in the tunnel at Brookhaven National Laboratory on July 21, 2019. Brookhaven, located in Upton, N.Y., is among 10 of the national laboratories overseen by the Energy Department's Office of Science BIZ HERMAN FOR THE WASHINGTON POST VIA GETTY IMAGES

Management

National lab isn't properly tracking sensitive and high-risk property, OIG says

What are the issues with HRP identification in DOE?

- A **mission-critical task** for DOE
- **Substantial resources** required to perform the task
- Often **time-consuming** resulting in **backlogs**
- **Training of SMEs** with recent HRP policy updates, ever-changing policies
- **Tracking of HRP items**
- Classification becomes **outdated**



**Can we leverage recent
advances in Artificial Intelligence
to do HRP classification
efficiently?**

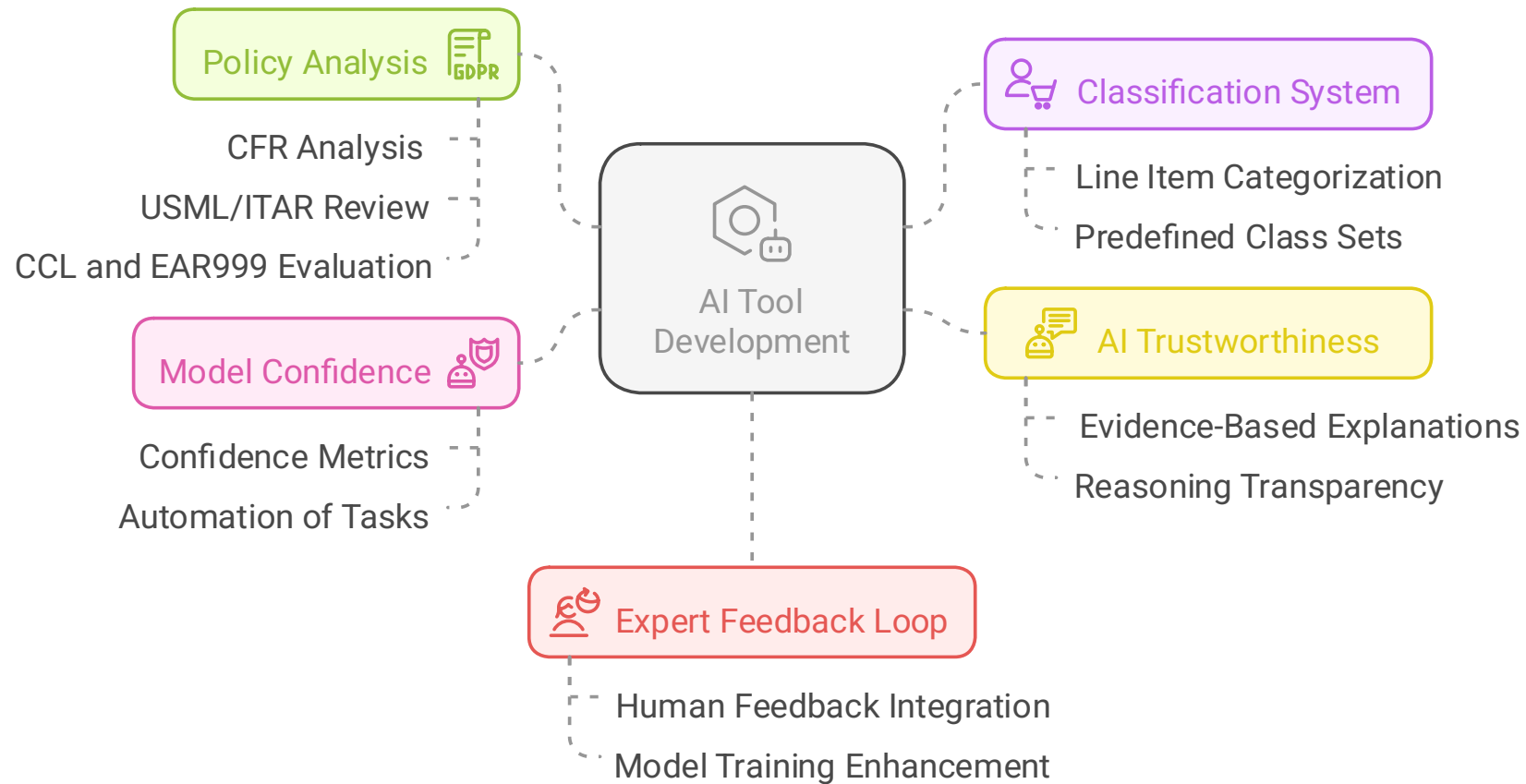
Solution Strategy

- Build an **AI-tool** leveraging LLMs to look into updated DOE policies (**CFR, USML/ITAR, CCL, EAR999**), analyze the **Purchase Request** from **Ariba**, and classify each **Line Item** into a set of predefined classes.
- Build a **trustworthy AI model** that gives correct explanation of the classification with **evidences** and **reasoning**
- Emphasize on the **confidence** of the model to automate the "low-hanging fruits"
- An **expert-in-the-loop infrastructure** to train the model on human feedback
- **Identification** at the request stage

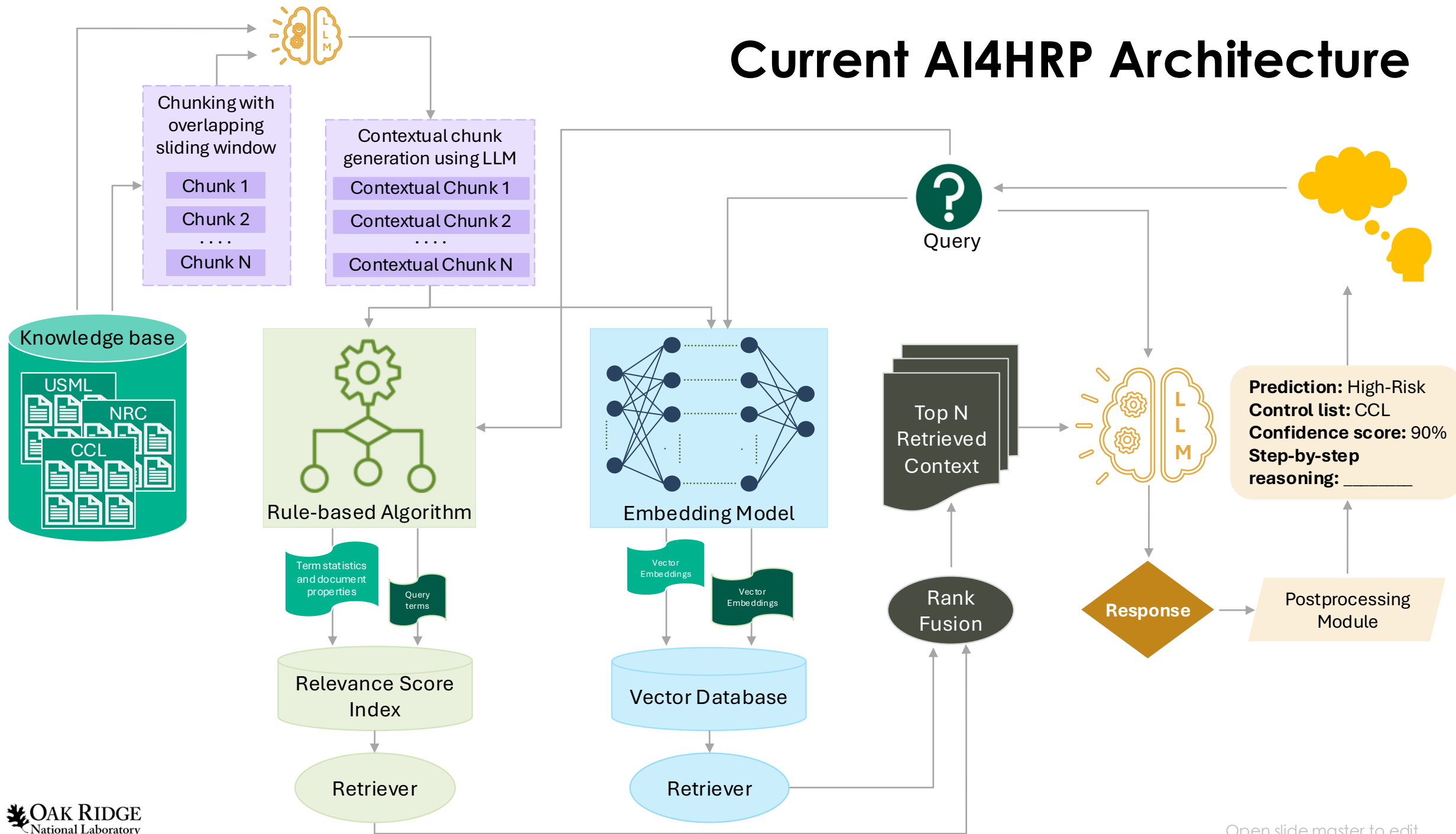
AI-Driven High-Risk Property Identification



AI4HRP Tool Development Components

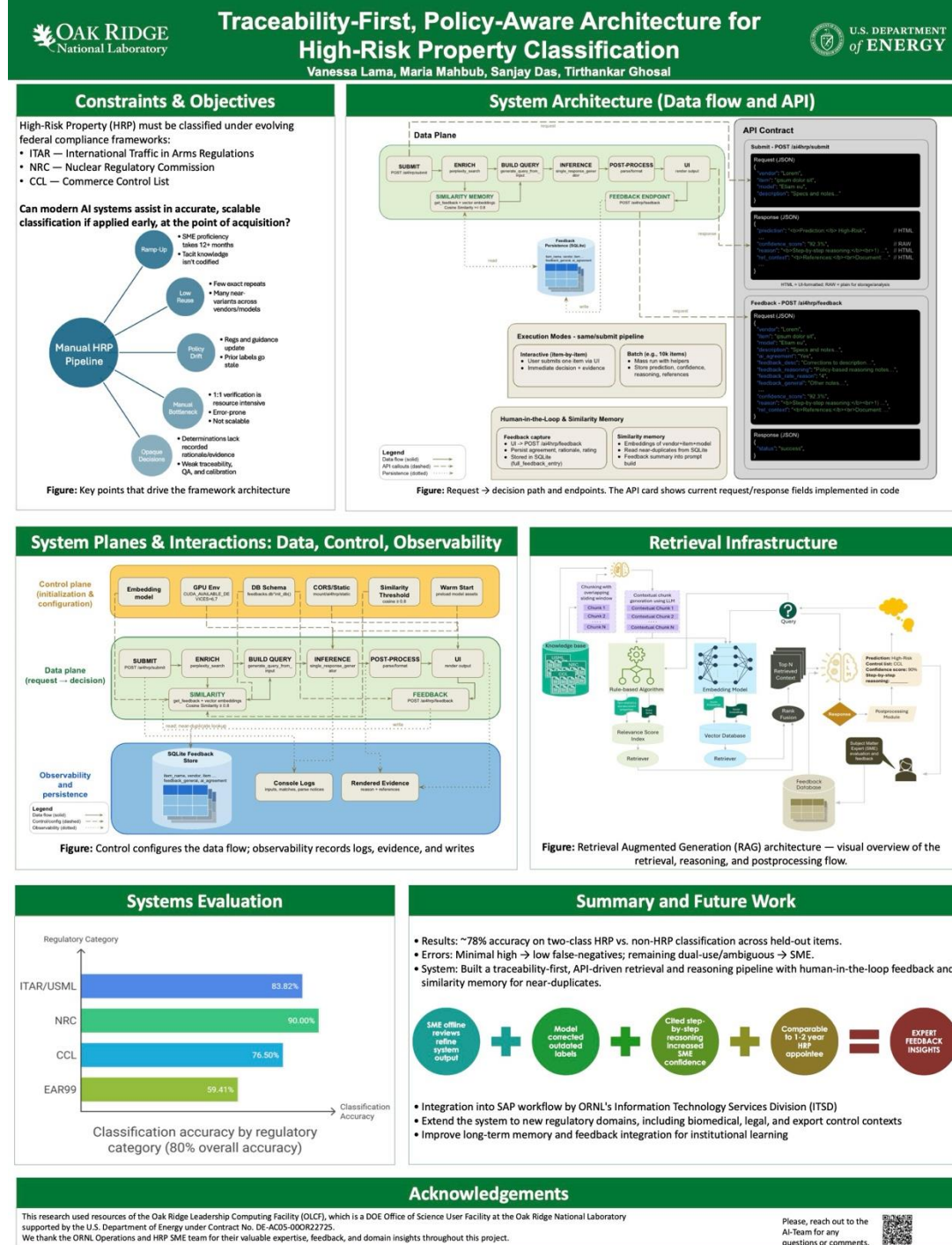


Current AI4HRP Architecture



Current Status

- At a **pilot stage** released to our alpha set of SME's for evaluation and feedback
- Integration with procurement workflow** going on
- Human-in-the-loop infrastructure to let the model learn over time (re-inforcement learning)
- Highly accurate on high-priority classes (ITAR/USML & NRC) – **rare miss** (sanitized 8k instances)
- Sometimes the model gets confused on dual-use items



Pilot UI for Evaluation and Testing

Vendor *

Accuracy International

Item Name *

50 caliber Rifle

Model no. *

AW50

Description *

The British military uses the AWM variant, which is a long range sniper rifle. Other users include Germany. The AW50 is in limited use with some special forces units. Variant AW50: Standard variant with a 27 inch barrel. AW50F: This variant fires the Raufoss NM140 MP and other .50 rounds. It is fitted with a fully adjustable bipod and buttstock heel rest. This is the most common variant. Users Australia, Germany, Indonesia, Ireland, Malaysia, Portugal, Slovakia, South Korea and Thailand. Images Standard variant of the AW50. Source: [https://www.foxnews.com/military/2014/07/24/aw50-sniper-rifle-variant-aw50f/](#)

Submit

Prediction: High-Risk

Control list: ITAR|USML

Confidence score: 99.75%

Step-by-step reasoning:

1. The AW50 is a .50 caliber rifle, which falls under the category of firearms described in the passages. Specifically, semi-automatic firearms of .50 caliber or less are controlled under ECCNs 0A506 and 0A507, and fully automatic firearms and related accessories are referred to USML Category I.

2. The AW50 is a sniper rifle used by military forces, indicating it is likely to be considered a defense article.

3. USML Category I covers firearms and related articles, including rifles of .50 caliber or less, which aligns with the AW50's specifications.

4. The AW50 is not related to nuclear materials or equipment, so NRC 10 CFR Part 110 does not apply.

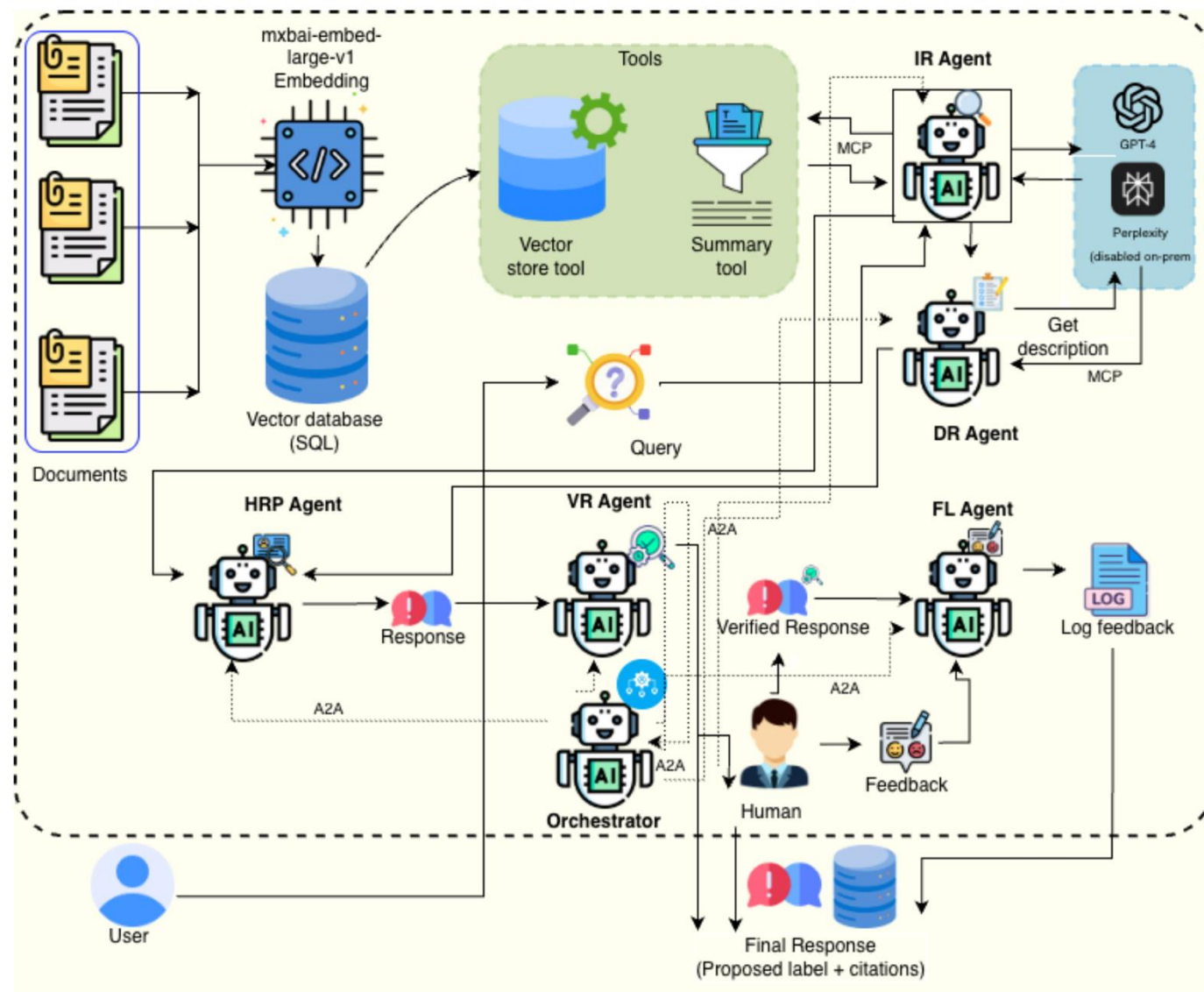
5. Given the AW50's classification under USML Category I, it does not fall under the Commerce Control List (CCL) or EAR99, which are typically for items not specifically designed for military use.

References:

Document Name	Page Number	Context
The Commerce Control List (section: eCFR __ 15 CFR Part 774)	17	The document outlines various types of sighting and aiming devices for firearms, including holographic sights, reflex or "red dot" sights, reticle sights, and other optical sighting devices. It specifies laser aiming devices or illuminators designed for firearms with operational wavelengths between 400 nm and 710 nm, excluding laser boresighting devices used for aligning firearm sights. Additionally, it covers lenses, optical elements, and adjustment mechanisms for these devices. Riflescopes not subject to the EAR as of March 8, 2020, and designed for firearms under ITAR control are also included. The definition of "specially designed" for these riflescopes is determined by paragraph (a)(1) of the definition in § 772.1 of the EAR. The document further mentions ammunition control requirements under various reasons such as NS, RS, FC, CC, UN, and AT.
The Commerce Control List		The document outlines the classification and control of various firearms and related components under the Export Administration Regulations (EAR). Specifically, ECCN 0A501 covers non-semi-automatic firearms, excluding 0A502 shotguns, and their related commodities. ECCN 0A502 pertains to non-automatic shotguns and certain parts for semi-automatic shotguns not controlled by 0A509. ECCN 0A504 and USML Category XII regulate optical sighting devices. The items listed include semi-automatic centerfire rifles of .50

Results and Agentic Approach (next stage)

- We achieved a 77% overall accuracy on HRP classification.
- 88% accuracy on controlled properties (ITAR/USML, NRC).
- We propose an agentic framework for improving the performance.



Few snapshots of the proposed tool-in-practice (Human-in-the-loop)



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Apply Filters

Clear Filters (2)



Queue Date	Escalated Date	Purchase Order Number	Escalated by	Items	High Risk Items	
Nov 5, 2024	Nov 20, 2024	PR-1234-5678	Isaac Washington	10	2	>
Nov 5, 2024	Nov 15, 2024	PR-4567-8912	Adam Bricker	10	4	>
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Work items with errors

PR-1234-5678

Work Items with Errors

Item	Description	HR Probability	Confidence	Risk Level	
Phenom ProX Scanning Electron Microscope	The Phenom Pro desktop SEM is optimized to be the ultimate all-in-one imaging system for any application.	64%	80%	⚪ Unsure	>
Microtool Sample Holder	Ideal for observing drill bits, milling tools, and injection needles, simply secure the sample with a non-destructive clamping mechanism and start imaging within minutes.	52%	72%	⚠ High	>
Charge Reduction Sample Holder	Effectively reduces electric charge buildup, minimizing the amount of preparation needed to analyze nonconductive samples.	98%	90%	⚠ High	>
Nebula Particle Dispenser	The Nebula is designed to assist in dispersing powder samples, facilitating their preparation for SEM analysis.	88%	78%	⚠ High	>
Ion Mill	Prepare artifact-free samples for high quality	20%	90%	⚪ Unsure	>





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Purchase Order

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Work Items with Errors

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Item	Risk	Review/Edit
Phenom ProX Scanning Electron Microscope The Phenom Pro desktop SEM is optimized to be the ultimate all-in-one imaging system for any application.	Unassigned	>
Microtool Sample Holder Ideal for observing drill bits, milling tools, and injection needles, simply secure the sample with a non-destructive clamping mechanism and start imaging within minutes.	Unsure	>
Charge Reduction Sample Holder Effectively reduces electric		

Property Status

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Phenom ProX Scanning Electron Microsc...

⚙️

The Phenom Pro desktop SEM is optimized to be the ultimate all-in-one imaging system for any application.

Assign risk for:
Phenom ProX Scanning Electron Microscope *

Select risk level...

▼

🔧

Reviewer Explanation *

Placeholder

💠

AI Explanation:

Eget ullamcorper odio tincidunt malesuada. Posuere orci id aliquam dignissim orci at convallis. Scelerisque imperdiet scelerisque lorem eget suspendisse mi nulla nunc tellus. Eget in ut pellentesque mauris quam donec. Viverra posuere gravida nisl neque. Feugiat eget cras at ipsum molestie.

Diam turpis purus eget neque senectus venenatis. Ultrices egestas nisl facilisi nulla purus ornare venenatis. Ornare mauris enim amet nullam ullamcorper.

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Work Items with Errors

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Item	Risk	Review/Edit
Phenom ProX Scanning Electron Microscope The Phenom Pro desktop SEM is optimized to be the ultimate all-in-one imaging system for any application.	✖ Unassigned	>
Microtool Sample Holder Ideal for observing drill bits, milling tools, and injection needles, simply secure the sample with a non-destructive clamping mechanism and start imaging within minutes.	🔍 Unsure	>
Charge Reduction Sample Holder Effectively reduces electric		

High Risk Property Status

✕

Phenom ProX Scanning Electron Microsc...

⚙️

The Phenom Pro desktop SEM is optimized to be the ultimate all-in-one imaging system for any application.

Assign risk for:
Phenom ProX Scanning Electron Microscope *

Select risk level...

▼

Low

High

Unsure

AI Explanation:
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Work items with errors

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Work Items with Errors

Item

Risk

Phenom ProX Scanning Electron Microscope

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Unassigned

Microtool Sample Holder

Ideal for observing drill bits, milling tools, and injection needles, simply secure the sample with a non-destructive clamping mechanism and start imaging within minutes.

Unsure

Charge Reduction Sample Holder

Effectively reduces electric

High Risk Property Status

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Phenom ProX Scanning Electron Microsc...

The Phenom Pro desktop SEM is optimized to be the ultimate all-in-one imaging system for any application.

Assign risk for:
Phenom ProX Scanning Electron Microscope *

Low

Reviewer Explanation *

Placeholder

Your explanation will help to train the AI

AI Explanation:

Eget ullamcorper odio tincidunt malesuada. Posuere orci id aliquam dignissim orci at convallis. Scelerisque imperdiet scelerisque lorem eget suspendisse mi nulla nunc tellus. Eget in ut pellentesque mauris quam donec. Viverra posuere gravida nisl neque. Feugiat eget cras at ipsum molestie.

Diam turpis purus eget neque senectus venenatis. Ultrices egestas nisl facilisi nulla purus ornare venenatis. Ornare mauris enim amet nullam ullamcorper.

Save Cancel

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Your changes have been saved

Approve

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Nebula Particle Dispenser	The Nebula is designed to assist in dispersing powder samples, facilitating their preparation for SEM analysis.	88%	78%	🔴 High	>
Ion Mills	Prepare artifact-free samples for high quality cross-sectional analysis.	30%	90%	🟢 Low	>



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PR-1234-5678 approved

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