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Innovative use of AI to increase aircraft availability in the Fleet Air Arm.

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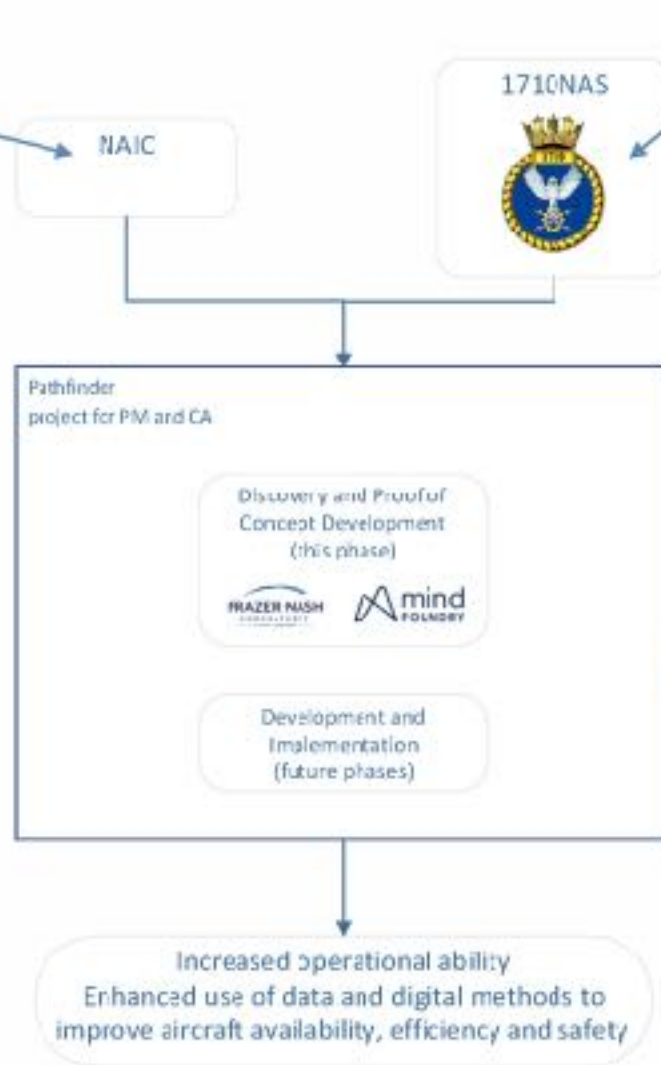
Plan

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- ▶ Task background – Why? What?
- ▶ What we achieved – Use cases
- ▶ AI Roadmap for development
- ▶ Developing Proof of concept modelling tool development
- ▶ Recommendations and Benefits
 - ▶ Specific for 1710 NAS
 - ▶ And for wider Defence
 - ▶ And for industry



Task background – Why?



Purpose

Demonstrate that AI and Machine Learning (ML) can have mission impact in a prioritised use case of predictive maintenance and condition assessment for 1710 NAS

Aims

- ▶ A description of the potential use cases and capabilities for the fusion of maintenance data and imagery for PM/CA for 1710 NAS.
- ▶ To produce a proof-of concept demonstrator showing how a proposed AI solution for PM/CA could benefit 1710 NAS.
- ▶ To provide an initial deployment roadmap for a specific PM/CA AI solution, with defined next steps for 1710 NAS.

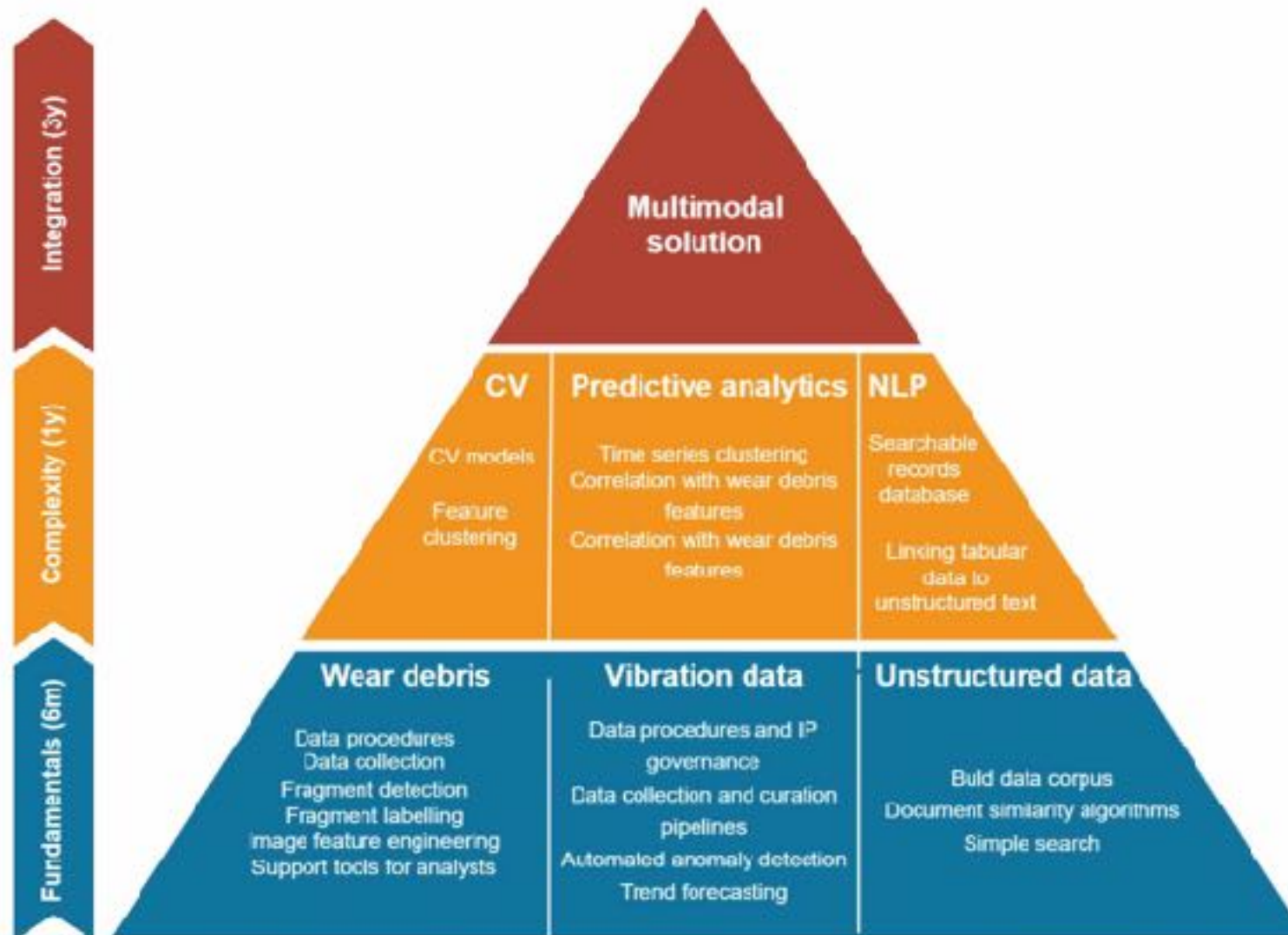
Collaboration



- ▶ Navy SME
- ▶ Digital SME
- ▶ AI SME

AI Roadmap

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Task background – What we did

AI for 1710NAS: Guiding principles

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User centric

- Make Use Cases as relevant to end users as possible.

Focus on availability

- How can the use cases support increasing aircraft availability

Operational efficiency

- Ensure use cases increase operational efficiency, freeing SME time and enhancing the overall decision-making process.

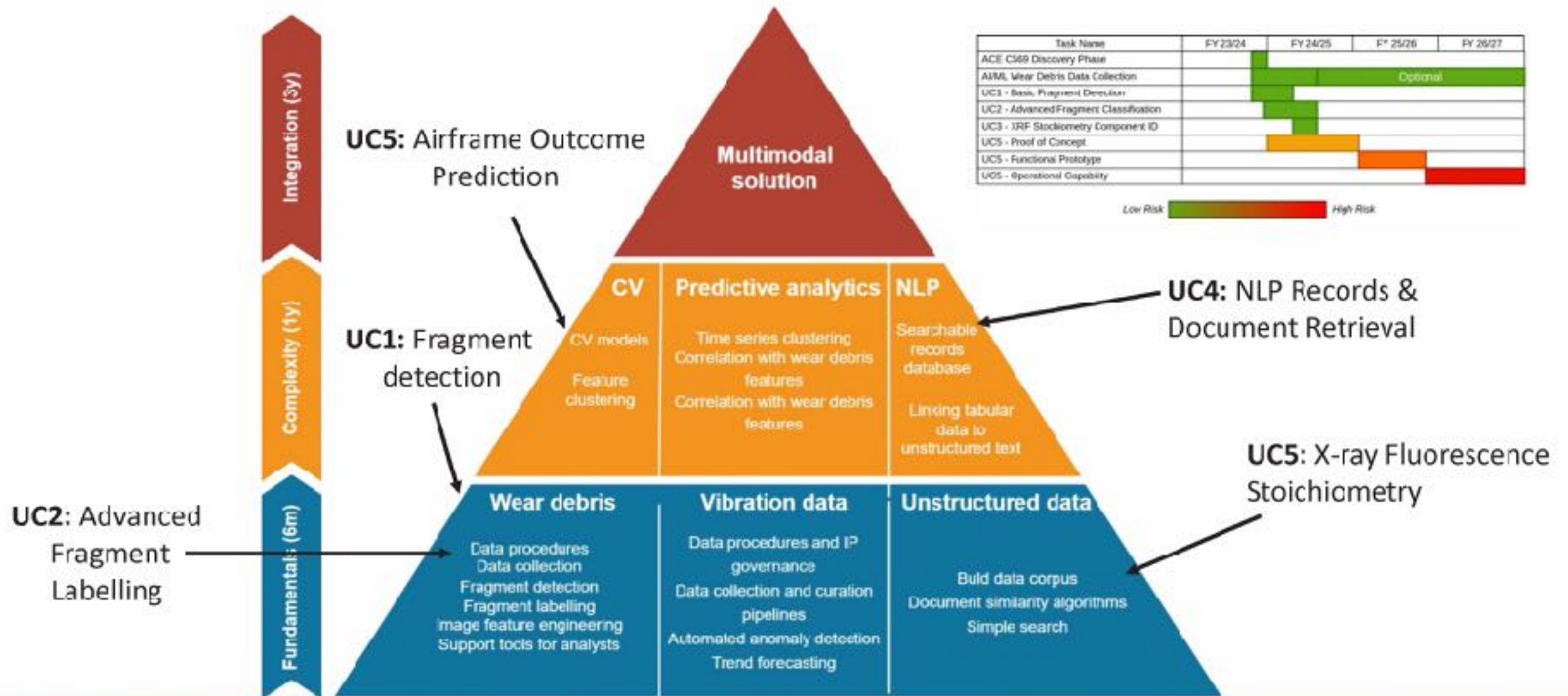
Understand the whole picture

- Ensure any developments are cognisant of a wider goal to exploit data, AI and ML within 1710 NAS and can translate to the wider Fleet Air Arm.

Start simple

- Identify the use cases which are achievable and show rapidly how benefit can be realised by 1710 NAS and the Fleet Air Arm

AI Roadmap



Task Name	FY 23/24	FY 24/25	FY 25/26	FY 26/27
ACE C569 Discovery Phase				
AIML Wear Debris Data Collection			Optional	
UC1 - Basic Fragment Detection				
UC2 - Advanced Fragment Classification				
UC3 - XRF Stoichiometry Component ID				
UC5 - Proof of Concept				
UC5 - Functional Prototype				
UC5 - Operational Capability				

Low Risk High Risk

What we achieved – Use Cases

The following use cases were identified:

▶ UC1 – Fragment Detection

Wear debris fragment detection and measurement by automatically identifying fragments in magnetic plug sample images and annotating them with their size.

▶ UC2 – Advanced Fragment Labelling

Automatic advanced classification of optical debris imagery.

▶ UC3 – X-ray Fluorescence Stoichiometry

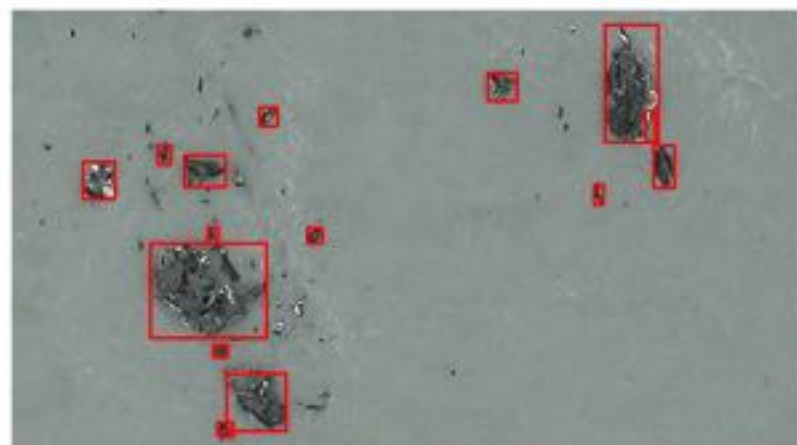
X-ray fluorescence fragment component matching.

▶ UC4 – NLP Document and Records Retrieval

Access and interrogation of existing policies and historical records with natural text-based language.

▶ UC5 – Airframe Outcome / Fragment Origin Prediction

Wear Debris Computer Vision. A set of AI/ML models which can make useful predictions of a rframe condition/a rwork:hiness and fragment origin based on magnetic plug debris sample images.



Fragment Bounding Box Detection



Fragment Geometry Detection

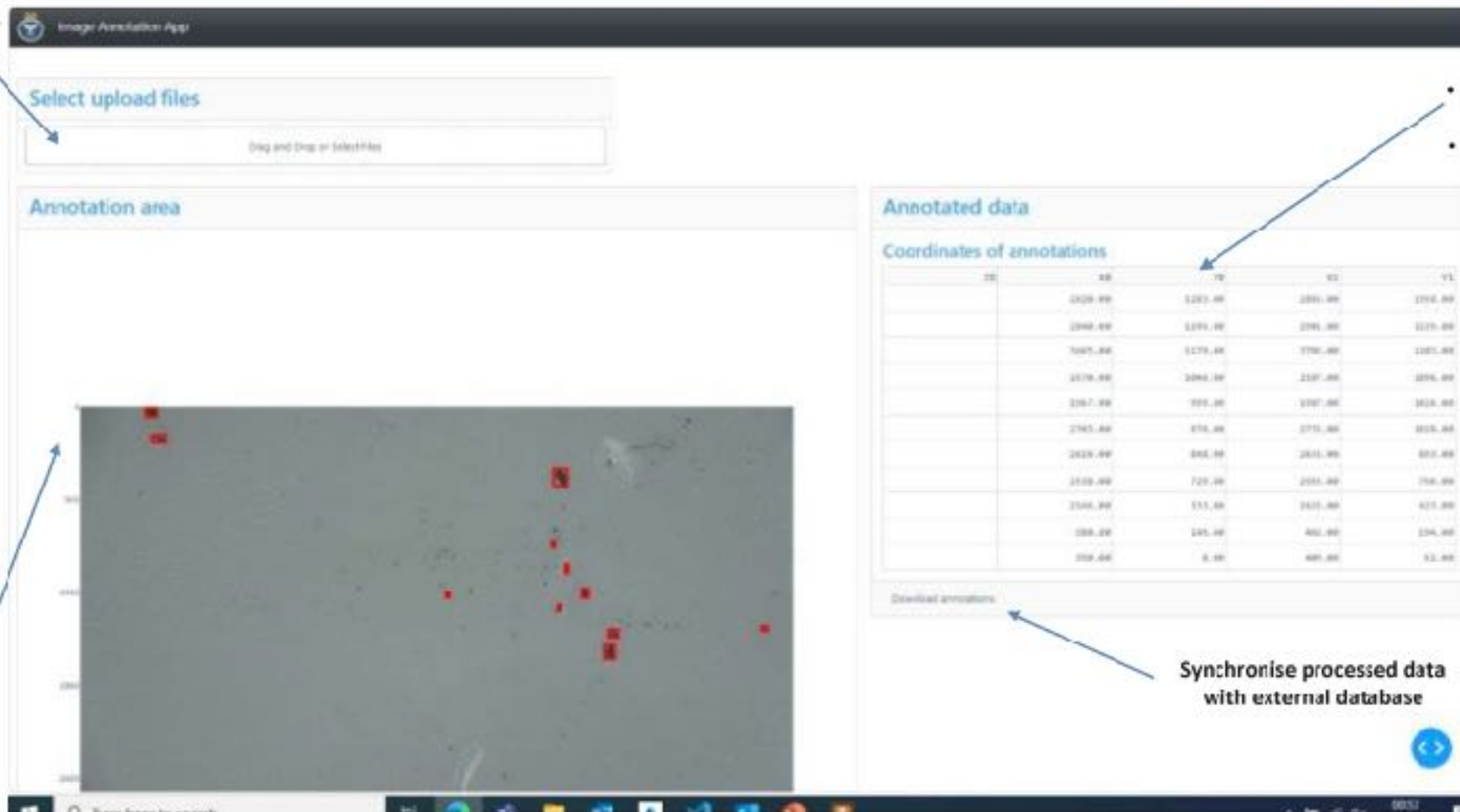
Proof of Concept tool development

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User selects images to process (from new file or database)



Select upload files

Drag and Drop or Select Files

Annotation area

Annotated data

Coordinates of annotations

ID	XX	YY	W	H	VL
	2028.00	1283.00	2893.00	1710.00	
	2049.00	1299.00	2893.00	1275.00	
	1645.00	1179.00	1760.00	1281.00	
	2176.00	3096.00	2327.00	2893.00	
	1267.00	1997.00	1397.00	3023.00	
	2765.00	876.00	2711.00	3023.00	
	2029.00	846.00	2611.00	3023.00	
	2100.00	720.00	2553.00	790.00	
	2146.00	113.00	2411.00	423.00	
	188.00	195.00	462.00	124.00	
	209.00	0.00	460.00	12.00	

Download annotations

Synchronise processed data with external database

Details of:

- Individual fragments (including size)
- Image level features Displayed to user

Fragment detection results displayed to user automatically. User can edit, remove or add additional fragments to override (and potentially retrain algorithm)

Benefits

- ▶ **Tangible clear benefits for 1710**
 - ▶ UC1 will provide reductions in processing time for Wear Debris Analysis team of up to 45%
 - ▶ UC2 may allow significant training benefit but with cost of analyst time to create machine learning dataset
 - ▶ Mitigate gapping of key resources and skill fade
 - ▶ Increase Operational aviation readiness and availability
- ▶ Ensure the procedures and data storage in place to “future proof” against using all data for advanced techniques later.
- ▶ Investigate using more advanced measurement methods for time savings (e.g. x-ray tomography).
- ▶ How can analysis be pushed forwards more effectively to remote labs on the front line?
- ▶ Applicable to wider Defence equipment with rotating machinery
- ▶ Applicable to other industries eg wind turbines

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Thank you

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