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Safety and Suitability Assurance of Sovereign Loitering Munitions Deployed from Existing UAS

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Agenda

- Introduction
- Concept Overview
- Types of Regulatory Challenges
- EO Safety Considerations
- System Safety Considerations
- Airworthiness Considerations
- Summary

Introduction

Background & Context

- Ukraine-Russia and Middle Eastern theatres feature extensive use of UAS's.
- Air dropped munition UAS boast greater features than conventional guided weapons and loitering munitions.
- Promotes an array of benefits including EO integration and logistics and mission customisability.
- Smaller air dropped munitions are becoming increasingly favourable over larger munitions and kamikaze drones.

Objectives

Further investigate and explore regulatory, safety and systems assurance considerations surrounding the integration of air dropped munition on pre-existing UAS.

LM Concept Overview

Air Launched Loitering Munition

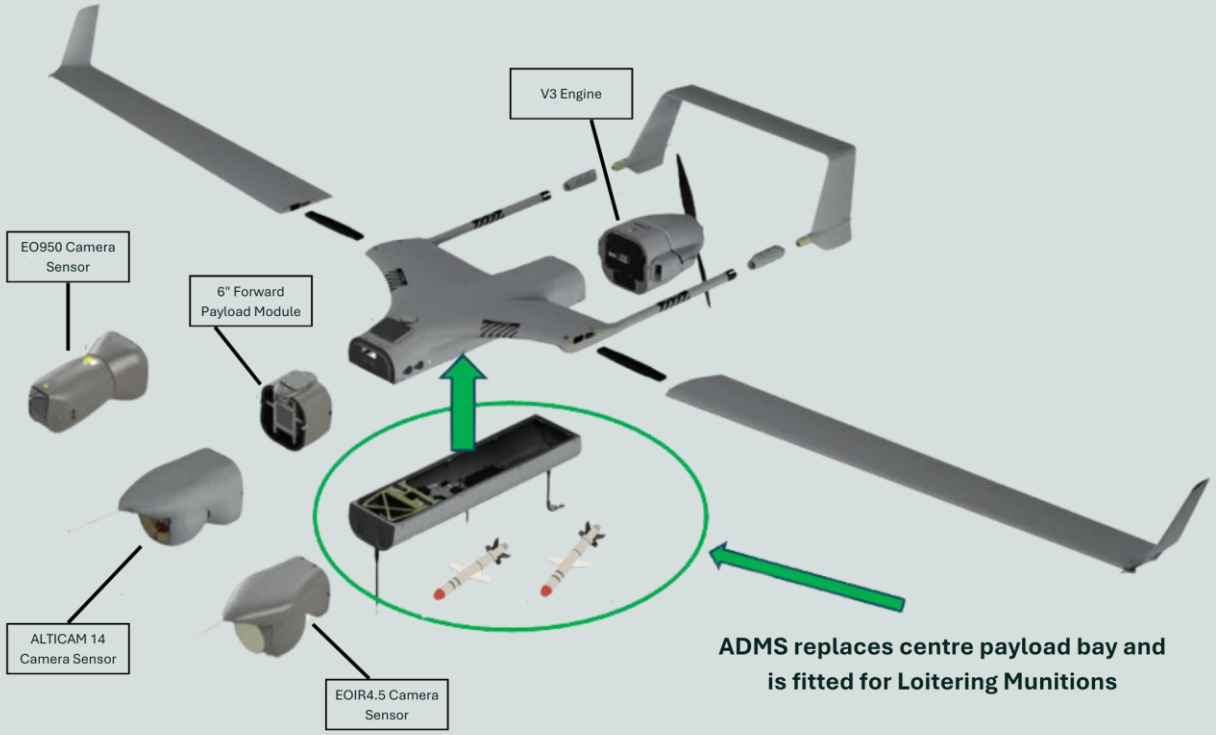
- Released from Small UAS carriage platform
- Based on COTS UAS technologies – Low cost
- LM mass < 2 kg
- Integrates as a modular retrofit UAS payload module < 15 kg
- Laser or INS/GPS guided with warhead
- Sovereign capability

Carriage sUAS

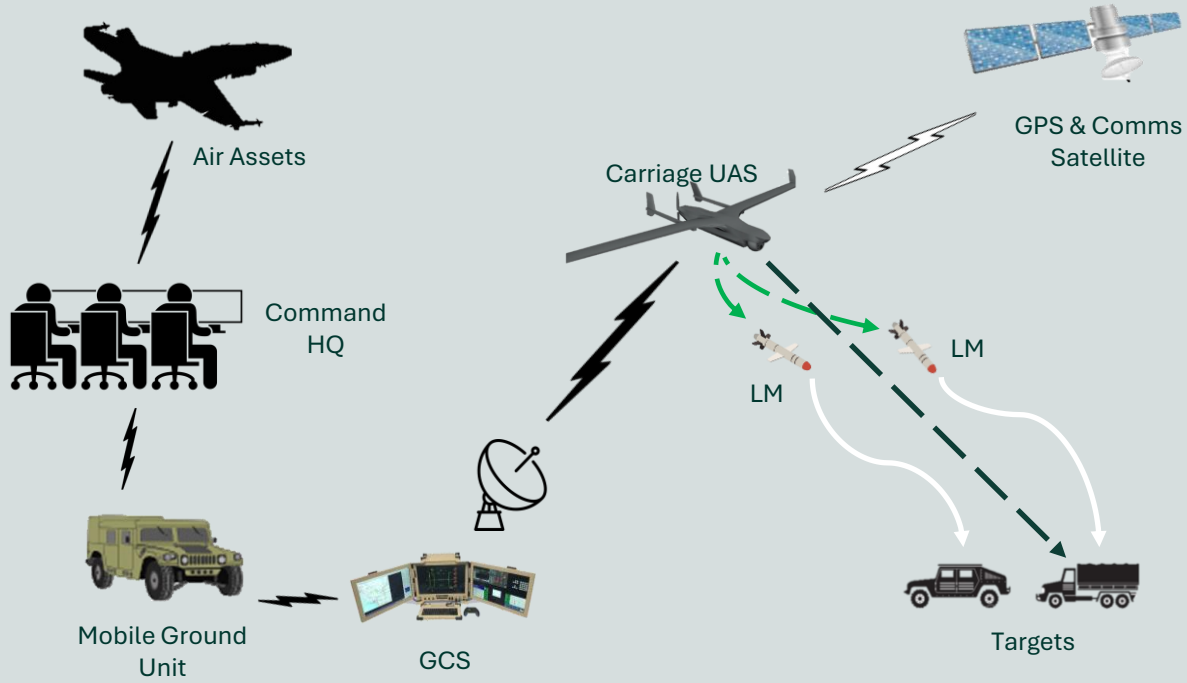
- Existing platform
- Range – 50 to 100 km
- UAS onboard ISR sensors used for targeting and designation

LM Concept Overview

Representative UAS Integration



Operational View



Types of Regulatory Challenges

EO Safety & Suitability

- Ensure EO payload is compatible with the UAS/external interfaces, meets performance requirements while maintaining user safety

Systems Safety & Assurance Impacts

- Develop a robust System Safety approach that accounts for EO-specific hazards and regulatory requirements

Airworthiness Considerations

- UAS airworthiness
- UAS stores compatibility

EO Safety Considerations

- When not installed/loaded will have the safety considerations as other EO
- Similar safety issues to other air carried EO when installed/loaded
  - DOS Explosive Safety Advisory Circular (ESAC) 2023/001
  - Arming switches / S&A devices:
    - Require combination of electric with other means depending upon size & complexity
  - Rendering safe post-flight
    - Visual and electronic confirmation
    - Identification and management of damaged, misfired or hung store
  - Electro Explosive Hazards (HERO / RADHAZ, ESD)
    - Inadvertent arming/disarming
    - Dudding of EEDs
    - Logic state disruption / memory effect of S&A devices with repeated flights
  - Weapon danger areas
  - Proximity to lithium batteries (storage concerns & when charging)

Systems Safety Considerations

- When integrating EO onto a pre-existing UAS platform, there are some inherent risks that are exacerbated and some new risks introduced

- Assessing system assurance through a Risk Based methodology:
  - DASA Advisory Circular 001/2018 Risk Controls for UAS Operations

- Software considerations due to integrated EO:
  - Certification of air dropped munitions software featuring machine learning
  - Siloed software to bypass all safety protocol to provide redundancy feature

- Trials, Test & Evaluation Safety Impacts:
  - Imposed airspace policies impact on realistic training, development and T&E

- Power source and system protections

Airworthiness Considerations

- DASA Regulations - DASR UAS.50 - UAS Weaponisation and Carriage of Passenger states
  - "Integration of weapons onto Defence UAS must require approval by the Authority"
- Guidance states that the purpose of Regulation is to provide additional safety assurance as to airworthiness and operational considerations of a weaponised UAS
  - Does not prescribe any limitations on a Commander's decision of when or how to employ those weapons once approved by the Authority
  - May only operate under a Certified or Specific Type A category UAS
  - Guidance states that applications may consider approaches for mitigation of weaponisation risks
  - More generally, risk-based approach informed by Systems Safety and EO Safety
  - AC 001/2018 - Risk Controls for UAS Operations

Considerations Under DASR UAS.50

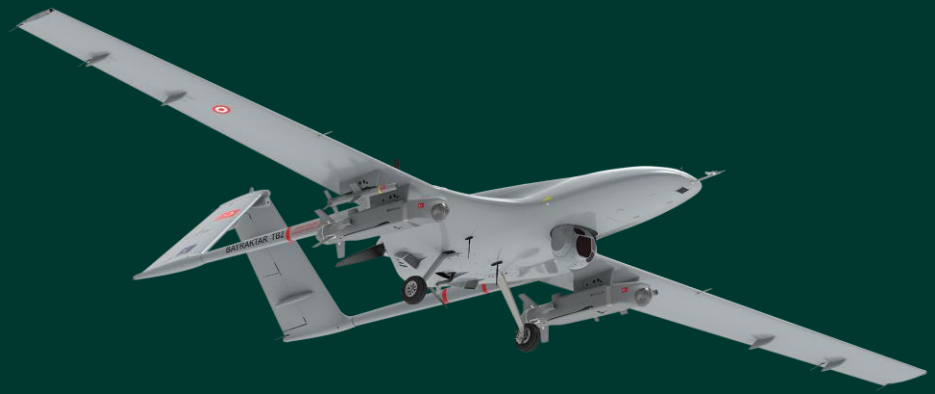
Mitigation of Risks outlined in UAS.50 Guidance must address:

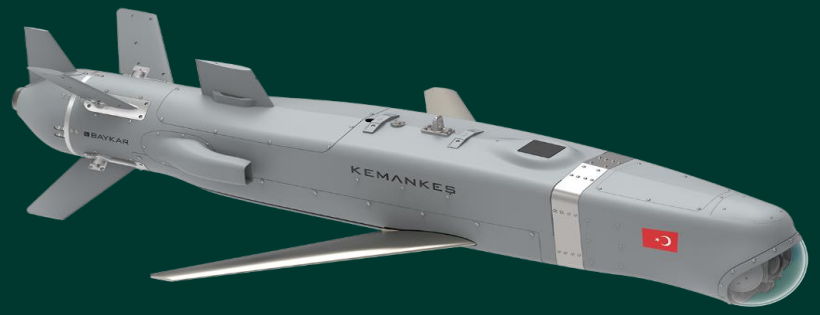
- Exposure of MEP or the GP to hazards
  - Adoption of RCC 321-23 and 323-18 Common Risk Criteria Standards for air weapons and UAS operations on test ranges respectively
  - Conduct of RHA → Weapon danger areas and templates for munitions
- Impacts to airworthiness of the platform - weapon release and/or separation
  - Tailoring of crewed ASC standards and approaches – e.g. MIL-HDBK-1763 and others
- Hazards - launch/recovery and/or flight loads of the UAS/weapon combination
  - Tailoring of crewed ASC standards and approaches – standardisation of suspension equipment and electrical interconnections

Considerations Under DASR UAS.50

Mitigation of Risks outlined in UAS.50 Guidance notes must address:

- Accuracy, integrity, availability and continuity of targeting applications upon the deploying of the weapon system - including latency of the C2 link
  - Usage of existing assured UAS ISR sensors and standard electrical interfaces
- Sufficient coverage within OIP of the likely risk profiles associated with the application and/or intended mission of the UAS to aid the RP
  - Provision of ASC like OIP tailored for UAS operations of munition
- Safety of any laser technology
  - Usage of ISR laser output on existing UAS





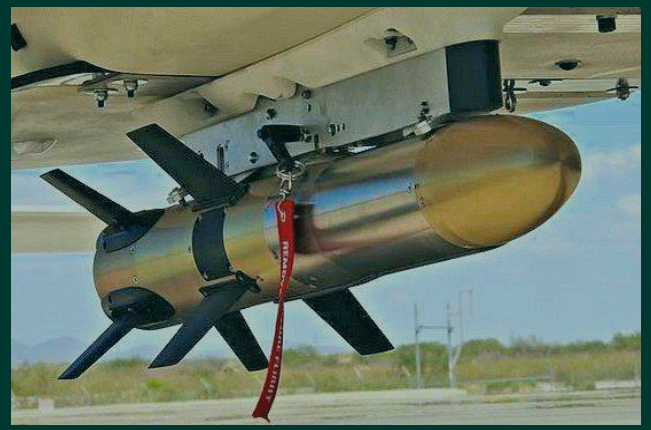
UAS Store Compatibility Considerations

Crewed Aircraft – Military standards and Handbooks used as references

- Address compatibility and certification of air weapons and missiles, some examples
  - MIL-HDBK-1763, Aircraft/Stores Compatibility: Systems Engineering Data Requirements and Test Procedures
  - MIL-STD-8591, Airborne Stores Suspension Equipment
  - MIL-HDBK-244A, Guide to Aircraft/Stores Compatibility
  - MIL-STD-1760D, Aircraft/Store Electrical Interconnection System

Dedicated standards and standardisation for UAS-based stores

- To adopt a tailored approach using existing Standards and Handbooks
  - Utilise existing stores compatibility methods – MIL-HDBK-1763
  - Informed by DASA Factsheet for ALS
- No standardisation of suspension equipment/electrical interconnection
  - Tailored to scale and size of munition – Small LM may adopt or define
  - Requires further consultation



Summary

Conclusion / findings

- Continuing to gravitate to one internationally recognised regulation for UAS munition systems
- Continuation in the approach for SUAS to risk-based assessments to safety and airworthiness to better enable development of unique systems

Recommendations

- Adoption of certification planning approach to UAS weaponisation outlining:
  - Systems safety case
  - EO safety & suitability
  - Weapon danger areas and safety templates IAW with RCC standards
  - Stores compatibility IAW tailored MIL-HDBK-1763

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Questions?

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