Australian Government
Department of Defence
Science and Technology

Human Experimentation to Guide Requirements for Future Navy Maritime Tactical Uninhabited Aerial Systems (MTUAS)

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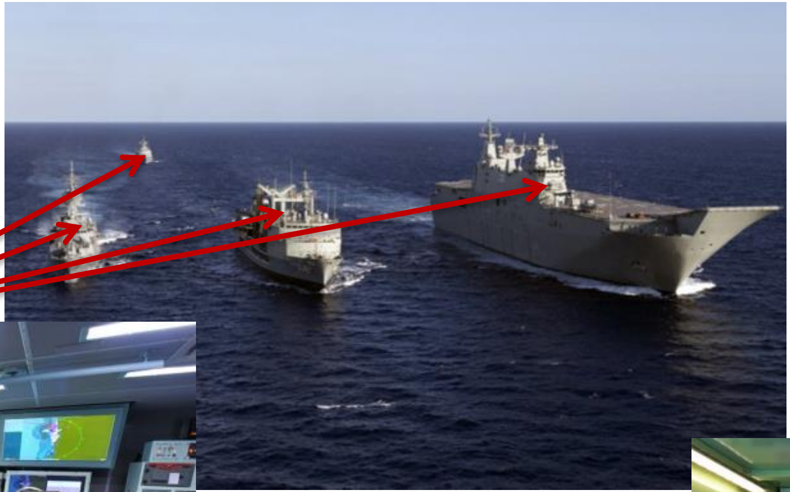
Background

- RAN is acquiring MTUAS capability for new and existing vessels
  - Focus on task-group operations

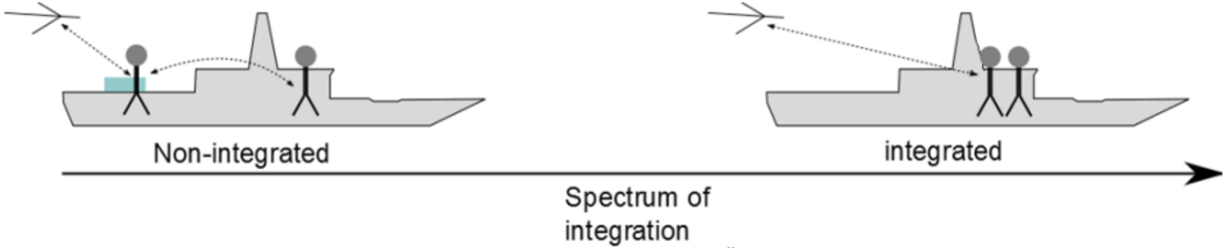


Ship Operations (Ops) Room and
Combat Management System (CMS)

MTUAS Ground Control
Station (GCS)

Background

- What level of integration should exist between a ship's Combat Management System (CMS) and the MTUAS?
  - More integration generally better, but where do the major gains lie?
- DST Group engaged to undertake human-in-the-loop studies on how to effectively integrate MTUAS into RAN ships
  - Study 1: Location of UAS crew relative to ship's command
  - Study 2: Integration of UAS data and control into CMS



Objectives

- Results to inform requirements for acquisition of future systems
- Need objective quantitative evidence that would stand up to the trade-offs and competing pressures of the acquisitions process
- Avoid brittle requirements
- Explore possible impacts of future systems on operator roles and tasking
  - Seed ideas and concepts for future exploration

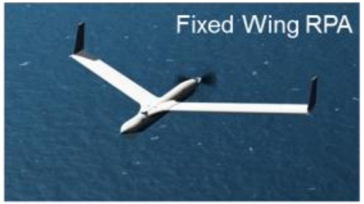
Considerations

- What MTUAS and CMS capabilities to consider?
  - Plausible near-future sensors, controls, crewing, and automation
- What type of study to conduct
  - Simulation-based experimental approach using Navy operators
- How to define integration ‘levels’?
  - Combined several existing taxonomies
- What to test?
  - Scenarios, tasks, crew configurations, measures
- Project deadlines
- **Frequent and iterative stakeholder involvement in these decisions**

MTUAS and CMS Capabilities

- Multiple Remotely Piloted Aircraft
  - 1 x fixed wing, 1 x rotary wing
- Multiple sensor payloads
  - Radar, Electronic signature (ES), and Electo-optic (EO) camera
- 'Moderate' level of automation and HMI functionality
  - Tracking Radar, not Inverse Synthetic Aperture Radar (ISAR)
  - ES system provided probabilistic recommendation of emitter identification
  - EO camera slewed to track, no auto-detection and cueing or auto image ID
  - System designed to meet operator information and control requirements

Remotely Piloted Aircraft (RPA)



Payload

Levels of Integration between MTUAS and CMS

	Level 1	Level 2	Level 3	Level 4
Location of MTUAS relative to CMS	MTUAS and CMS on separate ships	MTUAS and CMS on same ship	MTUAS and CMS on same ship	MTUAS and CMS on same ship
Communications circuits between MTUAS and CMS	External circuits	Internal circuits	Internal circuits	Internal circuits
RPA full motion video available in CMS	No	Yes	Yes	Yes
RPA metadata (sensor fields of view) available in CMS	No	Yes	Yes	Yes
Type of MTUAS tracks passed to CMS	Processed tracks	Processed tracks	Pending tracks	Pending tracks
Type of CMS tracks passed to MTUAS	Processed tracks	Processed tracks	Processed tracks	Pending tracks
Location of payload and flight control relative to CMS operators	Separate compartment	Separate compartment	Separate compartment	Same compartment

Scenarios and Crewing

Comprehensive tactical picture

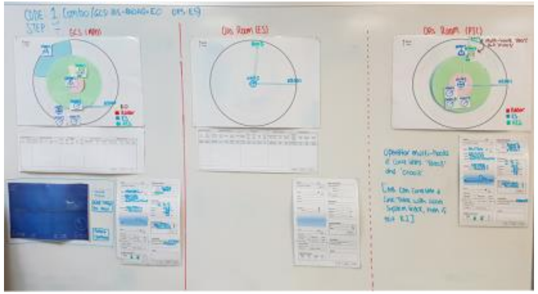
Protect the Oil Rig

- Range of possible scenarios
  - Picture compilation chosen
  - Two picture compilation tasks
    - Comprehensive tactical picture
    - Protect the oil rig
- Identified key operator roles
  - Ops Room: Principle Warfare Officer (PWO), Picture Compiler (PIC), Electronic Warfare Operator – Ops (EWO Ops)
  - GCS: Mission Payload Operator (MPO), Electronic Warfare Operator – GCS (EW GCS)
    - GCS operator roles different from current crewing paradigm
    - GCS roles changed over the course of study development

What to Measure?

- System performance
  - Number of identified tracks and how many sensors used in ID
- Inter - Operator verbal communication duration
- Operator workload
  - NASA TLX
- Support for task performance provided by each level of integration
- Likes, dislikes, issues. Individual and group debrief
- Preference ranking for each level of integration

The Implementation Process

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Integration of Maritime Tactical Uninhabited Aerial Systems into a Maritime Task Group Part 2: Integration of Sensor Data and Payload Control

Weapons and Combat Systems Division
Defence Science and Technology Group

ABSTRACT

RELEASE LIMITATION

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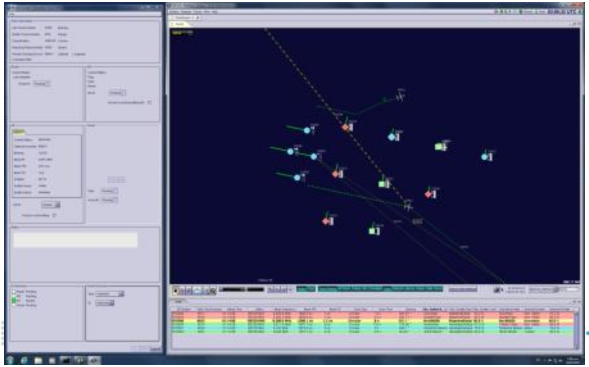
…keholder workshops	Specify Simulation Requirements	…mplement Simulation Requirements	…duct First Pilot Study	Conduct Second Pilot Study	Conduct Full Study	A…lyse, Brief, and Report
June 2017	October 2017	October 2018	October 2018	December 2018	March 2019	July 2019



Outcomes

Level Change	Experiment Change	Performance Change	Comms Change	Workload Change	Tasking Support Change	Implications for data integration, role allocation and location
Level 1 – 2	RPA sensor FOV and video visible in ops room. Internal voice comms	Nil significant	Lower PWO and EW talk time ☑	Nil change	Increased support for PWO, and MPO ☑	Support for FOV and EO video visibility in ops room. EO resolution issue? Internal comms increased shared awareness.
Level 2- 3	Pending GCS tracks visible to CMS operators. No EW GCS	More detections and traffic lights, faster ID times ☑	Lower EW talk time ☑	Reduced PWO workload, only small increase in EW workload ☑	Increased support for PWO, PIC, EW, MPO ☑	Support for common picture and single EW construct. Low-ish track numbers, persistent ES detections.
Level 3 - 4	Pending CMS tracks visible to MPO. MPO in ops room	Mostly nil significant, slower ES traffic light	Higher PIC and MPO talk time ☒	Nil change	Increased support for PIC ☑	Little quantitative support for system integration but operator preference for collocating MPO in ops room

Summary and Conclusions

- Multi-disciplinary team essential aspect of the work
- Very strong client engagement and support
  - Worked iteratively during study planning, design and reporting
  - Observed during data collection
  - Interested in results, translation into requirements
- Reasonably clear and strong results
  - Simulation-based experimentation provided evidence-based support for acquisition decisions
- Some results needed to be qualified
  - Live EO feed vs snapshot differential resolution issue
  - Simplification of ES operator tasks
  - Lack of tactical overlay
- Snapshot of automation capability
  - Interesting to explore higher levels of automation for Radar and EO identification capability