U.S. ARMY COMBAT CAPABILITIES
DEVELOPMENT COMMAND –
AVIATION & MISSILE CENTER

Manned-Unmanned Teaming
DSEI 2019 Strategic Conference: THE FUTURE OF MILITARY ROTORCRAFT

Matthew S. Whalley
Focus Area Lead for Autonomous and Unmanned Systems
Aviation Development Directorate (ADD)
Deliver collaborative and innovative aviation and missile capabilities for responsive and cost-effective research, development and life cycle engineering solutions.
Core Competencies

**Technical Domain:**
- Active and Passive Air Defense Sensor Technology (S&T)
- Aerial Autonomy
- Aerospace and Aerodynamics
- Capabilities Engineering
- Materials and Structures
- Fuzing, Guidance, Controls and Seekers
- Propulsion, Explosives, Energetics, Warheads

**Capabilities Engineering:**
- Software Engineering
- Weapons Assurance
- Modeling and Sim Design, Dev, VV&A
- Configuration Management
- Engineering Prototype Design and Dev
- Maintenance, Life Cycle Cost Reduction, and Logistics Engineering
- Manufacturing Tech and Production Support
- Multidiscipline Acquisition and Project Engineering
- Quality Engineering and Management
- Reliability, Availability, and Maintainability
- Sustainment, Industrial Base, and Obsolescence
- Systems Engineering, Integration, and Interoperability
- Test and Evaluation
- Air Defense Radar (Reimbursable)
- Airworthiness

~11,778
FY19 Strength

<table>
<thead>
<tr>
<th>2,957</th>
<th>22</th>
<th>8,799</th>
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<tbody>
<tr>
<td>Civilian</td>
<td>Military</td>
<td>Contractor</td>
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FY19 Funding

$3.5B

7%
Aviation S&T

7%
Missile S&T

62%
Army

24%
Other
#1: Readiness
Provide aviation and missile systems solutions to ensure victory on the battlefield today.

#2: Future Force
Develop and mature Science and Technology to provide technical capability to our Army’s (and nation’s) aviation and missile systems.

#3: Soldiers and People
Develop the engineering talent to support both Science and Technology and the aviation and missile materiel enterprise
MANNED-UNMANNED TEAMING

• Previous MUM-T Efforts
• Scaling up – Advanced Teaming
• Summary
PAST WORK

AMUST

HSKT ACTD

VUIT 2

SCORCH

SUMIT

L2MUM

BDRVT
SYNERGISTIC UNMANNED MANNED INTELLIGENT TEAMING (SUMIT)

- FORCE simulation environment (long-term simulation solution for development, assessment, and evaluation for Advanced Teaming)
- Autonomy/HMI evaluation guidelines that can be used in future R&D (e.g., Advanced Teaming live flight tests)
- Evaluation metrics, results, recommendations
- Open systems architecture guidelines (risk reduction for open systems standards)
- Complex scenarios fit for use in advanced teaming (e.g., Air Launched Effects, swarm assets, electronic warfare)
SCORCH – SUPERVISORY CONTROLLER FOR OPTIMAL ROLE ALLOCATION FOR CUEING OF HUMAN OPERATORS
Evolve a technical architecture to:

• Support advanced manned-unmanned teaming
• Identify and document the technology challenges that would impact capability implementation
• Document the systems engineering and platform integration issues
• Address the human factors impacts and pilot workload when operating in a manned/unmanned teaming environment
NATO SG-227, MANNED-UNMANNED TEAMING – OUTPUT

• Baseline MUM-T scenarios based on ATP-49, “Use of Helicopters in Land Operations Doctrine”

• Possible roles and effectiveness of, 1) Escort UAV, 2) Air Launched Effector UAV, and 3) Optionally Manned Rotorcraft (including Next Gen Rotorcraft).

• Need for improved human-machine interface

• Role and importance of Modular Open System Architecture (MOSA) for legacy and NGR platforms.

• Need to address cyber threat; low probability of detection/anti-jamming comms

• Need for MUM-T Training, Tactics, and Procedures (TTP) and Doctrine

• Need for advanced MUM-T NGR requirements

• Joint testing warranted to advance understanding
PAST WORK

AMUST

HSKT ACTD

VUIT 2

L2MUM

SCORCH

SUMIT

BDRVT
Good but ...

- Ownship-centric
- Dedicated operator (high-workload)
- Automation using scripted, synchronized maneuvering
- Teamed operations require near-continuous GPS & comms
- Numerous COTS UAS – wide range of standards
- Proprietary (closed) software & architectures
MANNED-UNMANNED TEAMING

• Previous MUM-T Efforts
• Scaling up – Advanced Teaming
• Summary
MOVING AHEAD

Manned-Unmanned Teaming

A Few to One  One to One  One to Many, One to Any  On Demand

UAV as a Pointman
- Sensor Guided Flight
- Reliable, Autonomous Flight
- Shared Airspace Flight
- Adaptable Tactical Behaviors

Advanced Teaming

UAV as a Wingman
- Close-Proximity Flight
- Tactical Perception
- Intuitive Interface
- Team Survivability & Lethality
- Weaponized

Increasing Autonomy
A-Team Features

• Mission command of team of manned-unmanned & air launched aircraft
• Autonomous cooperative RSTA by UAS team
• Common operating picture from distributed sensors; ATR/AiTR
• Autonomous planning for ALE UAS
• Operations in denied environment
• Air-ground payload control handover
• Autonomous FARP
• Last kilometer resupply
Products

• Flight test proven mission systems technologies
• Resilient Autonomy: datalink independence, fault detection, contingency management, and graceful degradation
• Shared situational awareness – relevant information to and from teammates, at the right time
• Intuitive, easy-to-use Human Systems Interfaces that support multi UAS control
• Data management, and simulation environments
• Simulation evaluation methodologies, technical metrics for autonomy, and evaluation results
ADVANCED TEAMING S&T (19-24)

Products

• Flight test proven mission systems technologies
• Resilient Autonomy: datalink independence, fault detection, contingency management, and graceful degradation
• Shared situational awareness – relevant information to and from teammates, at the right time
• Intuitive, easy-to-use Human Systems Interfaces that support multi-UAS control
• Open systems architecture systems, data management, and simulation environments; FACE and JCA aligned
• Simulation evaluation methodologies, technical metrics for autonomy, and evaluation results

Payoff

• Robust multi-UAS teamed operations in contested environments
• Survivability through shared situational awareness
• Increased aviation team lethality
SUMMARY

• Manned-unmanned teaming is evolving.
• Our ultimate goal is flexible on-demand coordinated teams that span a wide spectrum of platforms.
• Formidable challenges remain; e.g., TTP abstraction, distributed intelligence, human-machine interface, and resilience.
• Ongoing and planned efforts in advanced teaming are working to advance MUM-T across all of these fronts.
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