Consolidating the Revolution: Optimizing the Potential of Remotely Piloted Aircraft

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AGENDA

- Background
- Demand and Challenges
- RPA/UAV/Drone Future
- Recommendations
- Discussion
Why The Study Now?

- 16 years of surge in RPA to meet combat demands resulted in strained developments: time for an optimized enterprise approach to fully exploit RPA
- Continued growth in mission need paired with budget pressures will demand smarter investments and concepts to meet our security challenges—requires a reset to optimize capability and capacity
- Technology advances yet to be implemented are readily available to enhance RPA operations
- Organizational reform can yield significant RPA leverage
- Optimal investment requires thoughtful ends, ways, and means
Attributes of Remotely Piloted Aircraft (RPA)

- Persistence - allows time to observe, evaluate, and act very quickly, or to take all the time necessary to be sure of a particular action; communications gateways/key nodes in combat cloud...

- Projects power without projecting vulnerability - Can operate remotely; fewer personnel in combat zones

- Undetected penetration / operation

- Facilitates operations in dangerous environments

- Integrates “find, fix, finish” sensor and shooter capabilities on one platform—yields unparalleled flexibility to adapt to changing priorities and targets of opportunity
Remotely Piloted Aircraft: MQ-1/MQ-9 Orbit ~200 Total Personnel

<table>
<thead>
<tr>
<th>Mission Control</th>
<th>Launch &amp; Recovery</th>
<th>Processing Exploitation Dissemination (PED)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft</td>
<td>0</td>
<td>Aircraft</td>
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<tr>
<td>Personnel</td>
<td>54</td>
<td>Personnel</td>
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<tr>
<td>Pilots</td>
<td>10</td>
<td>Pilots</td>
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<tr>
<td>Sensors</td>
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<td>Sensors</td>
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<tr>
<td>Maintenance</td>
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<tr>
<td>Msn Coordinator</td>
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<tr>
<td>Leadership</td>
<td>16</td>
<td></td>
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<tr>
<td>Ground Station</td>
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<td>Ground Station</td>
</tr>
</tbody>
</table>

Leadership 16
FMV Crew 30
SIGINT 12
Maintenance 14
Weapons/tactics 16
Leadership 23
Growth in Remotely Piloted Aircraft (RPA) Use

Growth in RPA Orbits/CAPs/Lines

- 2004 = 5
- 2005 = 8
- 2006 = 11
- 2007 = 18
- 2008 = 33
- 2009 = 39
- 2011 = 60
- 2012 = 57
- 2013 = 62
- 2014 = 65
- 2015 = 65
- 2016 = 60*

* 5 GOCO Orbits added in 2016; 10 in 2017; Army to provide 20 additional for total of 90...

Insatiable demand with no defined end state
Why “CAPs/Orbits/lines” Should be Evolved as a Measure of Merit/Sufficiency

Output is What the Warriors Value—Not Numbers of CAPs/Orbits/Lines
Tenets of RPA Evolution

- RPA compelling where the human is a limitation to mission success
- Seamless manned and unmanned systems integration
- Automation
- “Integrated Systems” approach
- Modularity = Flexibility
- Robust, agile, redundant C2 enables supervisory control (“man on the loop”)
- Linked and synchronized connectivity
- Survivable in contested airspace
MQ-9 Sorties with 1 or More Strikes

CAO: 9 June 2017

Prior to 2010 less than 2 % of total MQ-1 and MQ-9 sorties employed weapons

<table>
<thead>
<tr>
<th>Year</th>
<th># of Sorties w/ &gt;1 Wpn Employed</th>
<th>Strike Sortie as % of Tot Sorties</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>126</td>
<td>6.19%</td>
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<tr>
<td>2011</td>
<td>74</td>
<td>3.45%</td>
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<tr>
<td>2012</td>
<td>92</td>
<td>5.91%</td>
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<tr>
<td>2013</td>
<td>192</td>
<td>7.42%</td>
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<tr>
<td>2014</td>
<td>582</td>
<td>14.71%</td>
</tr>
<tr>
<td>2015</td>
<td>769</td>
<td>14.00%</td>
</tr>
<tr>
<td>2016</td>
<td>1925</td>
<td>26.80%</td>
</tr>
<tr>
<td>2017</td>
<td>926</td>
<td>31.12%</td>
</tr>
</tbody>
</table>
AF RPA Flight Plan: Vision for an unmanned future

An Air Force with...

- Remotely piloted aircraft fully integrated across the full range of operations
- Automated control and modular “plug-and-play” payloads
- Joint RPA solutions and teaming
- An informed industry and academia – knowing where we are going and what technologies to invest in....

Capabilities-based Air Force RPA vision thru 2047: Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities
AF RPA Flight Plan DOTMLPF-P

**Near-term FY09-10**
- CCDR allocation
- J2/J3

**Mid-term FY10-15**
- Hypersonic
- Auto Tgt Engage

**Long-term FY15-25**
- Autonomous Fight

**Far-term FY25-47**

**Doctrine**
- UAS SPO
- MAC Ops Sqdn
- MAC Logistics Sqdn
- TF RSO Basing
- Auto Ops Sqdn

**Organization**
- UAS SPO
- MAC Ops Sqdn
- MAC Logistics Sqdn
- TF RSO Basing
- Auto Ops Sqdn

**Training**
- 100% Sim Training
- Mech/Tech MX
- UAS AFSC
- UAS AAR
- Auto Flight

**Materiel**
- MAC STD interface
- Hi-Fi Sim
- Assured Comm
- ECSS Auto TPED
- Sense & Avoid
- Modular Payloads
- Loyal Wingman
- Autonomous Fight
- Swarming
- Alt Energy
- Auto MX
- Auto Tgt Engage

**Leadership**
- CC’s PR Campaign
- PME
- Career Pyramids
- Command of Autonomy
- Bldg the “New” AF Leader

**Personnel**
- Rated? SUAS Pilot?
- UAS LNOs
- Recruiting Focus
- Teaming w/ Schools
- Force Structure Reform

**Facilities**
- C2 Facility
- CFACC Facility
- Auto MX Facilities

**Policy**
- NAS ILAs Acq Excellence MAC-in-NAS
- Treaties Autonomy Auto Tgt Engage
AF 2009 RPA Flight Plan:
Potential Mission Sets for RPA

Current Capability Shortfalls

**Small**
- WASP III
- Raven
- Scan Eagle

**Medium**
- MQ-1B
- MQ-9
- MQ-X/Next Gen RPA

**Large**
- EO/IR/SAR
- RQ-4 Blk 10/20
- RQ-4 Blk 30
- +ASIP

**Special RPA**
- Interoperable RPA C2
- High Altitude Long Endurance
- Low Observable
- Hypersonic

**Today**

**NANO/MICRO**
- WASP III

**Fighter Recap**
- Family of Transformers
- NextGen – Multi-Mission
- Tier II STUAS
- Air-Launched SUAS

Indoor recon, indoor lethal/non-lethal, indoor comm, cyber attack, Swarming

**Counterair, Missile Defense**

Personal ISR, Lethal, SIGINT, Cyber/EW, Counter RPA, Auto-sentry

ISR, Comm Relay, Lethal/Non-lethal, Cyber/EW, SEAD, SIGINT, Low Altitude Pseudo-Sets

ISR, Comm Relay, Lethal, SIGINT

Close-in ISR, Lethal, SIGINT/DF

EA/ISR/CAS
- MQ-Ma
- MQ-Mb
- MQ-Mc

SEAD/AAR-T

Counterair, Missle Defense

RQ-4 Blk 40

Large Aircraft Recap

EA/GAP
- Nano
- Family of Transformers

Potential Mission sets for RPA
Air Force Vision for RPA in 2014 USAF RPA Vector

• Seamless integration of RPA into operations across all domains and levels of warfare.

• Widespread use of autonomous systems and processes to provide time efficiencies and operational advantages.

• Increasingly interoperable systems through application of open architecture, standards, and modularity.

• Teaming across departments and agencies, coalition partners, academia, and industry.
Small Unmanned Aircraft Systems (SUAS) Flight Plan: 2016-2036

Bridging the Gap Between Tactical and Strategic
Advanced ISR Capabilities

Open architecture allowing modular sensors to be integrated quickly and inexpensively

Open Sensor Bus
- WAAS
- LADAR
- Hyperspectral
- SIGINT
- SAR
- DAS

Situational Awareness

Hyperspectral

Multi-stream Wide Area Sensor

DAS Provides All Functions Simultaneously
Common Airframe with Modular Mission Bays

Tactical Transport

Cost effective, multi-mission solution
- Transformable to optimize force mix per phase of conflict
- Simpler common/modular design
- One aircraft design effort
- Lower average production cost
- Lower life cycle costs

Potential Savings - 25% in total aircraft inventory
# RPA Modularity = Agility

<table>
<thead>
<tr>
<th>Day 1, Phase 0</th>
<th>Day 5, Phase II</th>
<th>Day 7, Phase III</th>
<th>Day 12, Phase IV</th>
<th>Day 30, Phase V</th>
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</thead>
<tbody>
<tr>
<td>Deploys with cargo</td>
<td>Electronic Attack</td>
<td>Refueling and Electronic Attack</td>
<td>Armed ISR CAPS</td>
<td>ISR support of Irregular Warfare</td>
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<tr>
<td>Reconfigures with</td>
<td>Suppression of</td>
<td>“Loyal Wingman”</td>
<td>Theater comm relays</td>
<td></td>
</tr>
<tr>
<td>SIGINT / IMINT</td>
<td>Enemy Air Defense and ISR</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>“CAS”</td>
<td>Palletized Cargo</td>
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<tr>
<td></td>
<td></td>
<td>“Interdiction”</td>
<td>Movements</td>
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Modularity enables optimized RPA mission reconfiguration in the field
Modularity, automation, and interoperability will multiply the effectiveness and efficiency of acquisition, operations, and maintenance.

<table>
<thead>
<tr>
<th></th>
<th>WWII</th>
<th>Vietnam</th>
<th>Gulf War</th>
<th>Today</th>
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<tbody>
<tr>
<td>Planes</td>
<td>1,000 (B-17)</td>
<td>30 (F-4)</td>
<td>1 (F-117)</td>
<td>1 (B-2)</td>
</tr>
<tr>
<td>Crews</td>
<td>10,000</td>
<td>60</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Targets</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>80</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>Mass Aircraft</th>
<th>Tactical</th>
<th>Laser</th>
<th>GPS</th>
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<tbody>
<tr>
<td>In-the-Loop</td>
<td>In-the-Loop</td>
<td>In-the-Loop</td>
<td>In-the-Loop</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>2012 (MAC)</th>
<th>2022 (MAC + 50% auto)</th>
<th>Distant Future</th>
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<tbody>
<tr>
<td>Planes</td>
<td>4 planes</td>
<td>Loyal Wingman (Semi-autonomous)</td>
<td>Swarm (Autonomous RPA)</td>
</tr>
<tr>
<td>Crews</td>
<td>1 crew</td>
<td>Mission Commander</td>
<td>Mission Director</td>
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<tr>
<td>Targets</td>
<td>32 Targets</td>
<td>More Targets</td>
<td>??? Targets</td>
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<tr>
<td>MAC</td>
<td>Linked</td>
<td>Collaboration</td>
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<tr>
<td>On-the-Loop</td>
<td>Collaborative</td>
<td>Directing</td>
<td></td>
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Autonomy – Multi-Aircraft Control

Manpower Savings in an Era of Limited Resources

2011

- 50 CAPs
  - 50 MQ-9 CAPs
  - + 7 aircraft in constant transit
- 10 pilots per CAP
  - 500 pilots required
  - + 70 pilots to transit aircraft

570 Total Pilots

TBD (MAC)

- 50 CAPs
  - 50 MQ-9 CAPs
  - 2 CAPs per MAC GCS
  - 1 transit per MAC GCS
- 5 pilots per CAP
  - 250 Pilots required
  - + 0 to transit aircraft

250 Total Pilots

56% Manpower Savings

MAC = 1 pilot can fly up to 4 aircraft

TBD (MAC + 50% auto)

- 50 CAPs
  - 50 MQ-9 CAPs on orbit
- 25 CAPs automated
- 25 CAPs in MAC (5 pilots/CAP)
  - 125 Pilots required
  - + 25 auto-msn monitor pilots
  - + 0 to transit aircraft

150 Total Pilots

64% Manpower Savings

Surge Capacity

Auto

Transit

MAC = 1 pilot can fly up to 4 a/c
RPAs: Automated Partners/Loyal Wingman
Virtually perpetual RPA fully integrated with systems in every domain integral to enabling a "combat cloud" across the full range of military operations.
Swarming UAVs to Achieve Desired Effects
Technology Challenge Areas

Advanced Control Segment and Mission Management

Operations
- Sense and Avoid
- Air Refueling
- Terminal Operations
- Multi-ship Cooperative Teaming
- Distributed Operations
- Manned-unmanned Teaming

Flexible, Interoperable, Growth-Capable C2 & Information Architectures

Standard & Open Payload Interfaces

Payloads as Services
Multifunctional Apertures

Mission & CONOPS Dependent Displays & C2
Communicating Across Threat Environments

BLOS C2 / Data between RPAs / CAOC via Wideband SATCOM; Bandwidth / Transmissions restricted in AOR

Relayed SATCOM and LOS to Forward platforms via RPAs, E-3, Airborne Gateway, etc

LOS C2 / Data via Directional LPI Links to Anti-Access Platforms

Communicating Across Threat Environments
**Integrity - Service - Excellence**

**LOS C2 / Data via Directional LPI Links to Anti-Access Platforms**

**Tanker / RPA Local Network**

Relayed SATCOM and LOS to Forward platforms via RPAs, E-3, Airborne Gateway, etc

**BLOS C2 / Data between RPAs / CAOC via Wideband SATCOM; Bandwidth / Transmissions restricted in AOR**

**Aerial Refueling**

**Mission Control Element**

**Carrier Strike Group**

**JFACC/CAOC**

**Carrier Strike Group**

**JFACC/CAOC**

**Aerial Refueling**

**Mission Control Element**

**Permissive**

**Contested**

**Anti-Access**

**LOS C2 / Data via Directional LPI Links to Anti-Access Platforms**

**F-35**

**AWACS / E-8**

**BAMS**

**JASS**

**USAF deep attack forces**

**Ground Forces/SOF**

**Communicating Across Threat Environments**
Recommendations: Technology

- Prioritize technologies that are able to reduce manpower requirements, boost mission efficiency, and rapidly seize new opportunities:
  - Build to open mission standards to facilitate modular plug-and-play integration between aircraft, sensors, other payloads
  - Pursue integrated, collaborative partnering between RPA and other weapons systems (e.g. loyal wingman; manned/unmanned teaming)
  - Automate key functions including landing; multiple aircraft control; sense-and-avoid; and ISR data analysis
**Recommendations: Acquisition**

- Streamline the acquisition process to facilitate buying modern RPA technology in an agile, responsive fashion:
  - Develop common operating standards
  - Acquire aircraft, sensors, and weapons in a decoupled, modular fashion through an open mission systems approach
  - RPA as an early adopter of better buying power initiatives
  - Establish a fast-track technology acquisition pilot program for RPA
  - Streamline foreign military sales so that US allies, partners and friends can access American technologies so the US can benefit from amortizing development costs
**Recommendations: Organization**

- Optimize DOD RPA efforts to net greater capability by aligning the RPA enterprise in a more efficient and effective fashion:
  - Establish a DOD executive agent to coordinate M/HALE RPA
  - Ensure all M/HALE RPA are under the direction of an appropriate joint force air component commander (JFACC) that can optimize employment across geographic COCOMs
  - Integrate RPA into US airspace for training and domestic support missions
  - Rethink traditional mission identification nomenclature for RPAs that better reflect output capability and capacity
Optimizing the DOD RPA Vision: Why An Executive Agency?

Coordination of separate service-specific M/HALE RPA will:

- Reduce or eliminate acquisition duplication of effort
- Reduce RDT&E funds and timelines by leveraging existing investments
- Reduce logistics and sustainment funding requirements by eliminating redundancies
- Increase interdependency and interoperability
- Build joint solutions—not service-specific solutions
- Provide more capability sooner

Get the most out of RPA to increase joint warfighting capability, while promoting service interdependency and the wisest use of tax dollars
THE FUTURE OF UNMANNED AIR POWER: IMPLICATIONS FOR POLICY & STRATEGY

- Ethical implications of RPA use
  - Allow for more “ethical” oversight than any other use of force
  - In future will become a significant issue with greater autonomy

- Cultural implications
  - Common perceptions out of sync with reality…
  - RPA technology enthusiastically embraced inside the Air Force…

- Accuracy/collateral damage
  - Are the most precise means of employing force at a distance in a way that reduces collateral damage, and minimizes casualties
  - Taliban/ISIS number one cause of civilian casualties in Mid-East

- Are RPA subject to excessive exuberance?
  - While introducing enormous capability and concept advantages, RPA are not a panacea for air warfare nor replacement for manned aviation
  - Vulnerability of RPA in contested/denied airspace is significant