Application of Mission Level System Engineering Concepts in the Support of Major Acquisition Programs

Helene Anderson
DASN(RDTE)CHSENG
Helene.Anderson@navy.mil

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Mission Engineering at CHSENG

- DASN (RDTE) applies approximately $4M a year directly to the implementation of Mission Engineering.
- Nearly all of this money goes to the various Warfare Centers to support Mission Thread development using the DoDAF framework.
- We ensure we are congruent with the efforts of the Joint Mission Thread team, the DoN EA team, and with M&S initiatives as funded by Navy Modeling and Simulation office.
Key Elements of the MCP Planning Process

Since 2001, CHSENG has been trying to implement the Mission Capability Package Planning Process.
UXS CFT Mission Thread for Trident Warrior 11
Functional Decomposition

Manned

1. Interrogate ID
   Systems: AIS / DFT etc...

2. Hall (voice) Request ID intentions

3. Conduct VID
   3.1 Collect / Record Image
   3.2 Compare Image to DB (structure recognition) * Unlikely *
   3.3 Relay Image in CoC (manual interpretation)

Un-Manned

1. Interrogate cooperative ID
   Systems
   1.1 Interrogate response
   1.2 Fuse response
   1.3 Repeat response

2. Hall (voice) Request Intentions

3. Conduct VID
   3.1 Collect / Record Image
   3.2 Compare image to DB (structure recognition) * Unlikely *
   3.3 Relay image to CoC (manual interpretation)
## Metrics to Support Data Collection

### Capability Evolution of AMN in Trident Warrior (TW)

<table>
<thead>
<tr>
<th>TW 09</th>
<th>TW 10</th>
<th>TW 11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single USV autonomy</td>
<td>Two USVs - Cooperative autonomy</td>
<td>Two USVs – Cooperative and Sliding autonomy</td>
</tr>
<tr>
<td>Preset mission behaviors</td>
<td>Preset mission behaviors</td>
<td>Preset mission behaviors with operator interface to allow “on the fly” mission modifications</td>
</tr>
<tr>
<td>UNCLAS COP MDA DS COI (publish and subscribe)</td>
<td>UNCLAS COP – APAN (coalition) Classified Tactical Picture – Link 16</td>
<td>Link 16 classified CTP</td>
</tr>
<tr>
<td>Special built USV</td>
<td>Converted Fleet 11M RHIB to autonomous USV</td>
<td>Any mix of USVs</td>
</tr>
<tr>
<td>C2: operational level, MOC</td>
<td>C2: tactical level, expeditionary C2</td>
<td>C2: tactical level, expeditionary C2</td>
</tr>
<tr>
<td>Comms: cell phone modem</td>
<td>Comms: Navy tactical LOS mesh radios</td>
<td>Comms: Navy tactical LOS mesh radios with extended range using UAS comms relay</td>
</tr>
<tr>
<td>AIS receive only on USV</td>
<td>AIS transceiver; extend AIS as AIS relay for ships at sea</td>
<td>AIS transceiver; extend AIS and EO for Combat ID</td>
</tr>
<tr>
<td>No common controller</td>
<td>No common controller</td>
<td>Common Payload Controller and Vehicle Controller</td>
</tr>
</tbody>
</table>

### METRICS

- **percent of cooperative unmanned vehicle communications that resulted in intended vehicle actions**
- **percent of successful USV maneuvers to unplanned waypoint after receiving the on the fly message**
- **number of packets sent vs number of packets received intact**
- **All of the above metrics**
- **percent of units are in communication with commander throughout planning and execution.**
- **Number of Friendly branches/sequels formerly closed (not feasible or acceptable) become feasible or acceptable due to friendly nonlethal engagements.**
- **range of comms via UAS relay**
- **number of AIS packets sent vs number of packets received intact**
- **ratio: number of launches executed/number of launches requested**
TW 11 Mission Thread

- Potential to provide earlier threat alert 24/7
- Unmanned vehicles likely need a lethal weapon to provide a continuum of timely responses
- Significant impact to current Rules of Engagement and Tactics, Techniques, Procedures
- USV Self-protect and anti-tamper considerations
- We need NTA’s (Universal Naval Task List) written specifically for unmanned vehicles because the manned vehicles NTA’s didn’t provide the right metrics
### Operational Nodes - A View Across UAS

<table>
<thead>
<tr>
<th>Generic</th>
<th>Ground Control Station (GCS)</th>
<th>Launch and Recovery element (LRE)</th>
<th>Unmanned Aircraft</th>
<th>Operation Center</th>
<th>Intelligence Cell</th>
<th>Airspace Control Authority</th>
<th>Air Traffic Control</th>
<th>Weather Cell</th>
<th>Supported Combat Unit</th>
<th>GPS Network</th>
<th>Air COP Users</th>
<th>Ground COP Users</th>
<th>GIG Unanticipated Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>USAF Global Hawk</td>
<td>Global Hawk MCE</td>
<td>Global Hawk LRE</td>
<td>Global Hawk Aircraft</td>
<td>Global Hawk Operations Center</td>
<td>DCGS-AF</td>
<td>GHOCS/CAOC</td>
<td>Air Traffic Control</td>
<td>Weather Cell</td>
<td>Supported Combat Unit</td>
<td>GPS Network</td>
<td>Air COP Users</td>
<td>Ground COP Users</td>
<td>GIG Unanticipated Users</td>
</tr>
<tr>
<td>USAF Reaper</td>
<td>Reaper GCS</td>
<td>Reaper LRE</td>
<td>Reaper Aircraft</td>
<td>Squadron Operations Center</td>
<td>DCGS-AF</td>
<td>SOC/CAOC</td>
<td>Air Traffic Control</td>
<td>Weather Cell</td>
<td>Supported Combat Unit</td>
<td>GPS Network</td>
<td>Air COP Users</td>
<td>Ground COP Users</td>
<td>GIG Unanticipated Users</td>
</tr>
<tr>
<td>USAF Predator</td>
<td>Predator GCS</td>
<td>Predator LRE</td>
<td>Predator Aircraft</td>
<td>Squadron Operations Center</td>
<td>DCGS-AF</td>
<td>SOC/CAOC</td>
<td>Air Traffic Control</td>
<td>Weather Cell</td>
<td>Supported Combat Unit</td>
<td>GPS Network</td>
<td>Air COP Users</td>
<td>Ground COP Users</td>
<td>GIG Unanticipated Users</td>
</tr>
<tr>
<td>USN Fire Scout</td>
<td>Fire Scout GCS</td>
<td>Fire Scout LRE</td>
<td>Fire Scout Aircraft</td>
<td>Combat Info Center</td>
<td>DCGS-AF</td>
<td>AC2 Cell</td>
<td>Air Traffic Control</td>
<td>Weather Cell</td>
<td>Supported Combat Unit</td>
<td>GPS Network</td>
<td>Air COP Users</td>
<td>Ground COP Users</td>
<td>GIG Unanticipated Users</td>
</tr>
<tr>
<td>USA Gray Eagle</td>
<td>Gray Eagle GCS</td>
<td>Gray Eagle LRE</td>
<td>Gray Eagle Aircraft</td>
<td>Division Tactical Operations Center</td>
<td>DCGS-AF</td>
<td>ADAM/BAE Cell</td>
<td>Air Traffic Control</td>
<td>Weather Cell</td>
<td>Supported Combat Unit</td>
<td>GPS Network</td>
<td>Air COP Users</td>
<td>Ground COP Users</td>
<td>GIG Unanticipated Users</td>
</tr>
<tr>
<td>USA Shadow</td>
<td>Shadow GCS</td>
<td>Shadow LRE</td>
<td>Shadow Aircraft</td>
<td>Brigade Tactical Operations Center</td>
<td>DCGS-AF</td>
<td>Brigade S-2</td>
<td>Air Traffic Control</td>
<td>Weather Cell</td>
<td>Supported Combat Unit</td>
<td>GPS Network</td>
<td>Air COP Users</td>
<td>Ground COP Users</td>
<td>GIG Unanticipated Users</td>
</tr>
<tr>
<td>USMC Shadow</td>
<td>Shadow GCS</td>
<td>Shadow LRE</td>
<td>Shadow Aircraft</td>
<td>Combat Operations Center</td>
<td>?</td>
<td>Combat Operations Center</td>
<td>Air Traffic Control</td>
<td>Weather Cell</td>
<td>Supported Combat Unit</td>
<td>GPS Network</td>
<td>Air COP Users</td>
<td>Ground COP Users</td>
<td>GIG Unanticipated Users</td>
</tr>
<tr>
<td>USMC Raven</td>
<td>Handheld GCS</td>
<td>Raven GCS</td>
<td>Raven Aircraft</td>
<td>Platoon/Company HQ</td>
<td>?</td>
<td>Cell/COC</td>
<td>Air Traffic Control</td>
<td>Weather Cell</td>
<td>Supported Combat Unit</td>
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Note: The diagram illustrates the operational nodes for various unmanned aerial systems (UAS) used by different branches of the U.S. military. Each node represents a specific system or subsystem involved in the operation of an unmanned aircraft, highlighting the integration of various roles such as ground control stations, operations centers, and data processing units. The diagram is color-coded to indicate different branches of the military and their respective roles in the UAS ecosystem.
OV-5B for Generic UAS Operations
Lead functional gap assessment, provide independent view
• Assess the DOT_LP gaps in current capability
• Assess whether changes to DOT_LP will achieve mission success

Assess whether any of our organic weapons will succeed against the new threats. Define the solution.

Assess FFC’s prioritized Integrated Capability Packages and provide funding

• Identify prioritized capability need to the other stakeholders
• Submit prioritized solution (Integrated Capability) package to VCNO

Fleet Forces Command

CNO I&I EFFORT

COMOPTEVFOR

SYSCOM Warfare Centers

Warfare Centers Of Excellence

ASN(RDA) CHSENG
Reducing the Babel

- Mission threads should be able to be utilized by the Systems Engineering community to define performance requirements, the T&E community to create test procedures, the training community to evaluate sailor performance, and the SoS community to define the synergy of the SoS.

- A very important element for achieving this utility is the use of common syntax and semantics.

- Threads are being developed right now that are not using common syntax and semantics, which is resulting in the inability to interface these threads with other threads.

- Common syntax and semantics is available on the DoN EA wiki site https://www.intelink.gov/wiki/DONEA
  - Common Operational Activity List
  - Joint Common System Function List
  - Common System List
  - Common Performer List
  - Universal Naval Task List
  - Universal Joint Task List