UAM AAM Human Factors Issues

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Advanced Air Mobility (AAM) formerly known as Urban Air Mobility (UAM)
AAM Characteristics

• Low-altitude
• Vertical flight
• Very high-density operations
• New electric or hybrid vehicles
• Highly automated
Analogous to Helicopter Flights/taxi

- Vertical take-off and landing
- Low altitude
- VFR
  - No ATC separation
- Obstacles
- Terrain
- Weather
<table>
<thead>
<tr>
<th>Year</th>
<th>Total accident rate per 100,000 flight hours</th>
<th>Fatal accident rate per 100,000 flight hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>3.62</td>
<td>0.72</td>
</tr>
<tr>
<td>2017</td>
<td>3.7</td>
<td>0.6</td>
</tr>
<tr>
<td>2016</td>
<td>3.48</td>
<td>0.54</td>
</tr>
<tr>
<td>2015</td>
<td>3.67</td>
<td>0.52</td>
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Commercial airline suffer one fatal accident for every 3 million flights.

https://qz.com/1791791/helicopter-crashes-like-kobe-bryants-have-become-more-common/
According to recent NASA-commissioned market studies, by 2030 as many as 500 million flights a year for package delivery services and 750 million flights a year for air metro services.

2018 Helo accident rates @ 500 Million flights –
3,600 Fatal Accidents per year

Roughly TEN PER DAY !!!
New Vehicles

- vTOL
- Electric
- Hybrid
- Multi-rotor
10 year moving average accident rate per million flights

*Below 10 years of operation, the moving average is based on the number of years of operation.

Feary, 2018
“Potential” Issues?

- Take high risk environment with a demonstrated poor safety record.
- Increase the rate of flights dramatically.
- Fly with all new vehicles.

What could go wrong?
How to address?

Automation

1. Remove pilot – Automate completely
2. Remote pilot – RPAS
3. Pilot on board – simplified vehicle operations
Problems with Automation

- Automation for automation’s sake
  - Lack of underlying methodology/process
- Britteness
- Mode Awareness
- Trust (over/under)
- Automation paradox
• The *Paradox of Automation* says that the more efficient the automated system, the more crucial the human contribution of the operators. Humans are less involved, but their involvement becomes more critical.

• If an automated system has an error, it will multiply that error until it’s fixed or shut down. This is where human operators come in.

• Efficient [Automation](https://personalmba.com/paradox-of-automation/#:~:text=The%20Paradox%20of%20Automation%20says,it%27s%20fixed%20or%20shut%20down.) makes humans more important, not less.
Human Autonomy Teaming

• Analysis of future issues/gaps/barriers not current for general aviation or helicopters

• Intelligently determine what *should* be automated to help the human (not what *can* be automated to help throughput)

• Implement automation smartly - HAT

• *SVO with experienced highly-trained pilots*
HAT Model

Alerts
Context
Responses to Queries
- Alternatives
- Transparency info
- Predicted Outcomes
- Reasoning
- Confidence level

Context
- Time Pressure
- User Info
- more

HAT Agent

Plays
- Goals
- Risks to achieving goals
- Mitigations

Transparency Info
Authority Info
Scratch Pad

Interface

Etiquette Rules/Contextual Sensitivity

Display Audio Visual

Operator

Queries/Requests
- A v. B
- Why?
- What If?

Automation

Requests Polling for Risks
Automation Design “Checklist”

• Stakeholders
• Tech readiness
  – Automation failure rates
• Why
  – Workload
  – Scalability
  – Training
• Transparency
• Two-way communication
• Clear operating modes
• Reversion modes (for the inevitable automation failure)
• Operational envelope
• Enunciation
• Inherit all of design questions:

• Do users know what it does, when and why?
• Does the user (and other stakeholders) trust the automation appropriately?
• Failure rates match design?
• Unintended uses/issues?
• Does it address design goal?
• Can revolutionize aviation! (or not)

• Must be implemented intelligently

• Human Autonomy Teaming is critical