Using STAMP to Address Causes and Preventive Measures of Mid-Air Collisions in Visual Flight

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Safety Risks in Visual Flight

• Loss of separation is one of the **key safety risk areas** in aviation (EASA, 2015)

• Mid-air collisions are among the **top ten leading causes of fatal accidents** in the General Aviation (FAA, 2015)
„See & Avoid“ in Visual Flight
Accident: mid-air collision
Hazard: loss of separation
Safety assumption: the pilots will “see and avoid” each other in time

Pilots’ responsibilities for vehicle separation in visual flight:
• maneuver the air vehicle according to the rules
• search for traffic information and
• provide position information
## Unsafe control actions (CA) identified with STPA

<table>
<thead>
<tr>
<th>Control Action (CA)</th>
<th>CA causes hazard</th>
<th>Lack of CA causes hazard</th>
<th>CA too early/too late/wrong sequence causes hazard</th>
<th>CA too long or too short causes hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilots' Avoidance Maneuver</td>
<td>Moves in wrong direction (violates rules)</td>
<td>Does not maneuver when required by rules</td>
<td>Doesn't maneuver in time to avoid hazard when required by rules</td>
<td>Moves so far that causes loss of separation to another air vehicle</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Stops too early</td>
</tr>
<tr>
<td>Pilots' Scan of Airspace</td>
<td>Distraction</td>
<td>Does not maintain awareness of air vehicles in vicinity</td>
<td>Scans too infrequently</td>
<td>Does not scan the entire surrounding area</td>
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<tr>
<td></td>
<td>Does not scan for additional air vehicles</td>
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</tr>
<tr>
<td>Pilots' Provision of Position Information</td>
<td>Provides incorrect position information</td>
<td>Does not provide required position information</td>
<td>Provides required information too late</td>
<td></td>
</tr>
<tr>
<td>ATC/ FIS Provision of Traffic Information</td>
<td>Provides incorrect traffic information</td>
<td>Does not provide traffic information</td>
<td>Provides traffic information too late</td>
<td></td>
</tr>
</tbody>
</table>
Multiple controller hazards
(Adapted from Ishimatsu, Leveson et al., 2011)

- Only one pilot provides a required avoidance action
- None of the pilots provides a required avoidance action
- The pilots provide both safe and unsafe avoidance actions
- Both pilots provide only unsafe avoidance actions
Pilots’ process model and feedback

- Knowledge of the national and international regulations (ICAO, 2005)

- Knowledge of relative kinematics

- **Feedback** to update the process model:
  - Separation or incident/accident
  - No systematic practical training
The hierarchical control structure

Legislature

Government, Regulatory Agencies, Associations, Unions

Aeroclub
Glider, UL, Experimental, Hang Glider, Parachutist, Paraglider, Balloon Driver

Records
Operation Reports

Standards
Licensing
Certification
Penalties

Examiner

National CAA
PPL, CPL, ATPL

Regulations
Standards
Licensing
Certification
Legal penalties

Training
Record
Operations
and Change
Reports

FTO

Pilot 1

ATC/FIS

Pilot 2

Relative Air Vehicle Separation

Information
Control Action

Information
Control Action

Tests, Checks
Accident and Incident Reports

Written/Trained Procedures
Standards Licensing
Preventive Measures

Improving pilots’ capability:

• To detect and process traffic information (Koglbauer, 2015)
• To correctly perform required collision avoidance actions (Koglbauer, 2015)
• To provide the required position information

Actions at the higher control hierarchy:

• Provide **standards and requirements for practical** training on collision avoidance to the FTOs and clubs
• Collect reports on candidates’ collision avoidance performance as a part of the **initial and recurrent examination** and licensing process
• Facilitate the introduction of **simple and affordable equipment** (e.g. traffic advisory systems, generic flight simulators) to the training facilities and to the pilots
Conclusion

- **STAMP** is a powerful model which enables the assessment of the collision avoidance process from different perspectives of the aviation system.

- **Control flaws at different levels of the control hierarchy** can be identified and addressed by specific mitigation strategies.

- The national and **international standards and procedures for pilots training, testing and licensing can be improved** to include not only theoretical knowledge, but also practical performance and evaluation of collision avoidance actions in simulated and real flight.
Thank you for your attention!
References


