Human and technical performance aspects in RPAS integration trials in controlled airspace

The DEMORPAS Project

9th November 2016, SIDs, Delft
“DEMORPAS has been a demonstration project that aimed at demonstrating how to integrate RPAS into non-segregated airspace in a manned and unmanned multi-aircraft flight environment”

- Demonstration of the **feasibility** of introducing **RPAS in non-segregated airspace**
- Potential **solutions** in the areas where integration problems exist
- Performance of **real RPAS flights** in a mixed environment under air traffic control
- Assessment on the impact of RPAS integration with manned aircraft on **human actors**
- Assessment on the **reliability on RPAS trajectories** and their capability of flying standard procedures
SESAR Innovation Days 2016 - Delft

Consortium

- ISDEFE
- ENAIRE
- Isdefe
- CRIDA
- FADA-CATEC
- Spanish Air Force
- Spanish AESA
- INTA
Resources

- RPAS ALO
- STEMME S-15
- SINA position

### STEMME S-15

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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<tr>
<td>Wingspan</td>
<td>18 m</td>
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<tr>
<td>MOTW</td>
<td>1100 kg</td>
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<tr>
<td>Maximum Cruising Speed</td>
<td>113Kts (210 km/h)</td>
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<tr>
<td>Range</td>
<td>1100 km</td>
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<tr>
<td>Ceiling</td>
<td>16000 ft (4880 m)</td>
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<td>Operational endurance</td>
<td>6 hours</td>
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Emergency recovery system
Parachute
Exercises Execution

Exercises

- First Exercise
  - RPAS ALO
  - ATC
  - Remote Pilots and Air Traffic Controllers → get used to each other and to RPA behavior.

- Second Exercise
  - RPAS ALO
  - STEMME S-15
  - ATC
  - RPAS and Manned Aircraft sharing airspace → assess perception of the actors.
  - Conclusions about stress can be derived.
1st Exercise execution

- **Operational Scenario**
  - Execution of ad-hoc procedures.
  - RPA asks to modify its flight plan to perform a surveillance mission.

- **Emergency Scenario**
  - How RPAS emergencies can be handled by Air Traffic Controllers.
  - Simulated emergencies.
2nd Exercise execution

- Mixed Operational & Emergency Scenario
  - Execution of ad-hoc procedures.
  - RPA simulated loss of telemetry → trajectory change.
  - Conflict between both aircraft detected and solved by ATC.
Analysis of results

Qualitative and quantitative results

- Human Factor assessment
- Trajectory analysis

Remote Pilot

Manned aircraft Pilot

Air Traffic Controller

Flight Plan

Radar

Telemetry
Analysis of results

Human factors

- Remote pilots
  - Situational awareness – improved thanks to the ATC radar information (SINA position).
  - Workload – too many tasks assigned to the same person.
  - Communications and phraseology – Improved thanks to the training.

![Diagram showing communication similarity](chart.png)
Analysis of results

Human factors

- ATCOs
  - Feasibility to follow ATC instructions and procedures (e.g. Transference of control between ATC units).
  - Situational awareness – Good prediction of RPAS evolution.

![Graph showing how predictable the RPAS evolution was.](chart)
Analysis of results

Human factors

- **ATCOs**
  - Feasibility to follow ATC instructions and procedures (e.g. Transference of control between ATC units).
  - Situational awareness – Good prediction of RPAS evolution.
  - Workload – More demanding due to communications.
  - Latency:
    - Read back was appropriate.

![Diagram showing comparison of remote pilot read-back time](image)
Analysis of results

Human factors

- ATCOs
  - Feasibility to follow ATC instructions and procedures (e.g. Transference of control between ATC units).
  - Situational awareness – Good prediction of RPAS evolution.
  - Workload – More demanding due to communications.
  - Latency:
    - Read back was appropriate.
    - RPAS reaction time was similar to manned aircraft.

Compared to manned aircraft, how was the RPAS reaction time?

![Comparison chart](image)

- TWR
- ACC

Slightly lower: 33%
Equal: 67%
Slightly higher: 18%
Analysis of results

Human factors

- Manned aircraft pilots
  - RPAS take-off and landing procedures
  - RPAS emergency procedures

risk for VFR mainly

How would the integration of RPAS emergency impact on safety?

- Risk: 17% TWR, 57% ACC
- Risk for VFR: 17% TWR, 29% ACC
- No risk: 66% TWR, 14% ACC

Controllers
Quantitative Analysis

Trajectory Analysis

- Comparison of RADAR and Telemetry
  - Horizontal plane – Controllers considered acceptable the difference.

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Quantitative Analysis

Trajectory Analysis

- Comparison of RADAR and Telemetry
  - Vertical plane – ATC background is essential.

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<th>Average</th>
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Conclusions

Communications

Operational Procedures

Emergency procedures

Remote pilot workload