RPAS-ATM Integration Demonstration

Final Workshop

Human Performance Objectives and Results

Capua - June 21th 2016

Human Performance Objectives

Human Roles:

- To assess the impact of the new concept on the operating methods
- To assess the impact of the new concept on ATCO and pilots' task performance.

Human and System:

- To assess the impact of the new concept on the pilots' interaction with the system (consistency, workload and trust in the system).
- To assess accuracy and timeliness of system information.
- To assess the impact of the new GS HMI on the pilots' interaction with the system.

Human Performance Objectives

Team structure and communication:

- To assess the impact of the new concept on
  - communication modalities and means
  - communication load
  - team situational awareness between the controller and the remote pilot

Implementation Impediments:

- To assess ATCO and pilots' acceptance of the new concept
- To assess the impact of the new concept on the needs related to skills, experience, knowledge and training for both ATCOs and the pilots.

Human Performance Indicators

- Trust and acceptability of the new concept
- Situational awareness
- Error propensity
- Workload
- Actions' timeliness
- Consistency with automation principles
- Accuracy, effectiveness and timeliness of the information
- HMI usability and suitability
- Communication load

Human Performance Methodology

- **Observations**: Observers in Ground Station and ATC facilities
- **Debriefing**: Used to discuss further what happened during the runs and to understand if there were different opinions from different actors.
- **Questionnaires**: The questionnaires were applied to 2 pilots and 3 controllers allowing a structured collection of their individual feedback

Impact of the new concept on operating methods

Objective

To assess the impact of the new concept on the operating methods by identifying the changes imposed on the existing ones, feasibility of these changes and their compliance and consistency within the overall context (normal, abnormal and degraded conditions).

Success Criteria

The changes of operating methods and procedures emerging from the introduction of the RPAS are feasible and consistent within the overall context.

Results summary

The RPA piloting task is more passive compared to on-board piloting and relies more on monitoring and managing tasks (visual information).

Remote pilots and ATCOs considered RPAS operations feasible and consistent within the existent operational context.

NOTAM is very important for safety reasons in the experimentation of a new concept.

Impact of the new concept on task performance

Objective	Success Criteria	Results summary
To assess the impact of the new concept on the controllers' and pilots' task performance.	The introduction of the RPAS has no negative impact on the pilots' and controllers' task performance.	No negative impacts on pilot's performance (both in auto-pilot and manual mode). Good ATCos' performance during RPAS operations. In degraded conditions (spoofing and jamming) the ATCO might experience increased workload, especially if he needs to vector the RPA to a specific point and provide separation from other air traffic.

Impact of the new concept on pilot/system interaction

Objective	Success Criteria	Results summary
To assess the impact of the new concept on the pilots' interaction with the system (system's consistency with automation principles, pilots' workload and the trust in the system).	The changes in the task allocation will not have a negative impact on interaction between the pilot and the system.	The remote pilot was able to maintain a good level of workload and situation awareness. During datalink jamming and spoofing and in the presence of an intruder workload was slightly increased, because he had to coordinate/communicate more with the ATCO and also because he had less time to take decisions.

Accuracy and timeliness of information (DAA & C2L)

Objective	Success Criteria	Results summary
To assess the performance of the technical systems in use (DAA and C2L) in terms of accuracy and timeliness of system information.	The accuracy and timeliness of information of the assessed technologies (C2L and DAA) is sufficient to support pilot's task performance.	The DAA system manoeuvres generation gave the remote pilot adequate time margins to decide and to implement the intended actions. TSA volume should not be infringed by DAA manoeuvres. C2L had a minimal delay between the remote pilot command and the action. In case of BRLOS operations it may increase.

Interaction with HMI

Objective	Success Criteria	Results summary
To assess the impact of the new concept on the users' interaction with the existing system (more specifically HMI).	The introduction of the RPAS in managed airspace does not require major modifications of the existing HMI (both for the controller and the remote pilot).	Interaction with the ground station was considered adequate and positive to fly the RPA, especially in nominal scenarios. The interaction got a bit degraded when critical actions in a limited amount of time are needed (e.g. self-separating the RPA from an intruder). Most of the interaction problems related to the usability of the GCS' HMI.

Interaction with HMI

Objective

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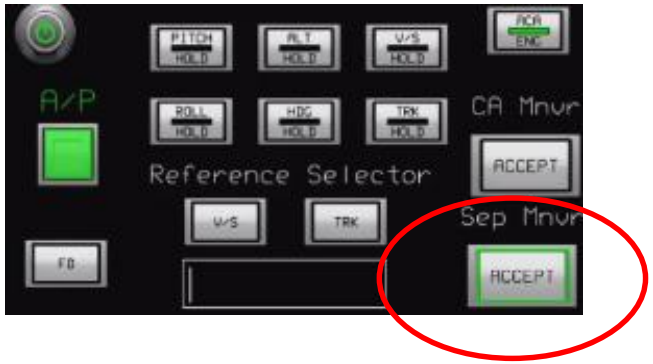

Results summary

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The interaction got a bit degraded when critical actions in a limited amount of time are needed (e.g. self-separating the RPA from an intruder).
Most of the interaction problems related to the usability of the GCS' HMI.

Impact of the new concept on communication

Objective	Success Criteria	Results summary
To assess the impact of the new concept on the communication modalities and means, communication load and team situational awareness between the controller and the remote pilot.	The introduction of the RPAS has no negative impact on the pilots' and controllers' communication.	The communication load was acceptable either in nominal and emergency situations. In the scenarios of manned and unmanned intruders the pilot and ATCO needed more information in the most efficient way, in the future specific phraseology will probably improve their communication.

ATCos and pilots' Acceptance

Objective	Success Criteria	Results summary
To assess the controllers' and pilots' acceptance of the new concept and the changes it brings to the current way of working.	The new concept and changes it brings to the current way of working are considered acceptable by involved human actors (pilots and controllers).	The overall RPAS concept acceptability was considered positive for both remote pilots and ATCos.

Impact on skills and training needs

Objective	Success Criteria	Results summary
To assess the impact of the new concept on the needs related to skills, experience, knowledge and training for both the controllers and the pilots.	The introduction of the RPAS will imply the need for additional training, skills and expertise.	The introduction of RPAS will imply additional training and skills mainly for the remote pilot since the piloting tasks change. The CGS HMI recalls the on-board cockpit, so a good transfer of skills might be achieved in a short time frame. The ATCos' skills and operations will not be significantly impacted by RPAS operations. Training is always required to maintain good performance levels, especially in degraded conditions.

Human Performance conclusions

- The overall concept (introduction of RPAS in operations) is acceptable for both pilots and controllers
- Degraded conditions (e.g. C2L lost or bad) can be adequately managed: well clear contingency procedures are needed
- DAA can be successfully integrated in the system, usable and suitable HMI is a main enabler
- 'Transparency' requirement may be achieved. Recommendations:
  - Adequate phraseology;
  - Ad hoc training for both ATCos and pilots;
  - Availability of adequate information (e.g. performance limitations of the RPAS).