

Lessons from Designing Controller-Pilot Data Link Communication for UAVs. Berglund, A., Andersson, R., & Ekström, H.; Saab Aerosystems.

Introduction

Integration of Unmanned Air Vehicles (UAVs) into civil airspace faces many challenges. One of the challenges is the increased workload for the pilot that may also affect the safety. During descent and approach, the workload level is high since the pilot works with briefings, goes through checklists, and communicates with Air Traffic Control (ATC) (Sarter et al., 1997). Talk has been considered essential for safety in aviation (Hawkins and Orlady, 1993; Cushing, 1995). Thus, one way to help the pilot is to introduce Controller-Pilot Data Link Communication (CPDLC) which is an application where data link messages are shown as short text messages for both the pilot and the air traffic controller. CPDLC has been tested in aviation for the purpose to exchange routine, noontime critical ATC related instructions, clearances and requests (ICAO, 1999). Previous study shows that a positive effect of the introduction of CPDLC technology is that the communication loop between the pilot and the controller is strengthened and guarded against misunderstandings, reception problems, and language barriers (Goteman and Dekker, 2005).

Design Requirements

Thus, the increased workload for the UAV pilot may be reduced with the introduction of CPDLC application. Saab is developing technology according to usability requirements aimed at enabling pilot and controller communication. The CPDLC application (see Figure 1) has been used for real time communication with ATC during UAV simulation tests. The pilot could switch to radio communication when it was needed. The user interface was designed according to the following usability requirements: - *Traceable*: Make the communication sequence traceable. All communication during the flight is stored and shown for the pilot. Example, if the pilot needs to see the height ATC requested to climb to for 10 minutes ago, he can trace back in the history list and see the request sent 10 minutes ago. - *Notifying*: Alert the pilot when messages are arrived. It is more important when ATC initiates a request, thus the system alerts the pilot by sound and visual notifications. Example, when ATC requests to climb to a new level, a voice message: "ATC calling" is played. - *Feedback*: Give each action an immediate and obvious effect. Example, how long time it takes to send a message is informed for the pilot since this varies depending on the data link traffic and a timeout functionality. Therefore, a clear presentation of how long time it is left is shown with a progress bar. - *Visibility*: Make relevant parts visible. Errors can be prevented with good visibility. Example, actual labels, requests, and units are always visible. - *Efficiency*: Minimize the workload for the pilot by connecting the CPDLC application with the rest of the UAV system. Example, when the pilot receives a climbing clearance, the requested altitude is automatically shown in the application where the altitude sets. However, the system does not set the actual value automatically. It is very important that the pilot is in charge of the system.

Conclusions

The purpose of introducing new technology is to help the pilot performing the tasks since the increased workload. Therefore, the design of the user interface is central and affects the workload. More usability tests of the CPDLC application is needed to verify the benefits of the technology from the human factors perspectives.