The Evolution of the UAS Operational Environment and Its Effect on Future Training

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Abstract — Many of the issues that need to be considered when employing UAS are the same or very similar to those of manned assets. However, there are some significant differences that determine how UAS can and should be employed. This presentation will describe the different areas of change and suggest topics that should be analysed, elaborated, and integrated in future civil and military training pipelines. This presentation highlights various evolutions in technology, regulations, threats, and operation of UAS that is relevant to present and future training of UAS personnel. Trends and issues for training are elaborated. Issues addressed by the presentation include supporting technology and methods to bring about change in training delivery across a variety of programs.

1 Introduction

Military Unmanned Aircraft System (UAS) training has often emerged as an answer to the training needs brought about by non-program of record procurement. Unmanned Aircraft (UA) is defined as an aircraft operated without the possibility of direct human intervention from within or on the aircraft. In this paper the term UAS will include the specifics of Remote Piloted Aircraft Systems (RPAS), Unmanned Aircraft Vehicle (UAV) and drone. In previous years, personnel were often temporarily recruited from manned platforms (without an established career track in unmanned systems) to fulfil the increasing demand for qualified UAS pilots and sensor operators. Due to this non-traditional procurement process, several UAS training paths developed over time.

In parallel, the civil/commercial interest and respective UAS technological advances evolved much faster than the required regulations to manage safe operations. Not having operations, training, maintenance, and support plans or associated employment concepts for both areas (military/civil) caused limited integration with existing systems.

Many of the issues that need to be considered when employing UAS are the same or very similar to those of manned assets. However, there are some significant differences that determine how UAS can and should be employed. This presentation will describe the different areas of change and suggest topics that should be analysed, elaborated, and integrated in future civil and military training pipelines.

The presentation covers proposed advancements in the following areas:

• **Training Processes**: Although over time differences in training for manned and unmanned systems have been identified and included in the training curriculum for UAS operators, it has taken a long time to establish an acceptable training process that can be considered mature and well thought-out.

• **Training for Operational Safety**: For example, training for UAS has reached higher levels of safety by including a dedicated career path and training UAS specific topics while maintaining typical pilot skills and leads to successful system operation.

• **Training Requirements**: Recruiting, manning, and training are all long-lead issues, especially regarding funding to provide appropriate training opportunities to meet the requirements. Therefore, early recognition of a change in training requirements is mandatory.

• **Stressors on Training Modernization**: Present and future developments in system technology (autonomy), modern training delivery (simulation), civil use of UAS and their regulation requirements, best practices in other system training (Mission Readiness Training) and additional risks of operation like cyber-attacks, all have an influence on the training approach. It is advisable to examine these topics and their possible impact on training relevant content and how to integrate relevant content into future-oriented UAS training.

2 Discussion

A main area of UAS technical development is increased automation of onboard systems. This frees the operator from simple flight management tasks and allows concentrating on mission-oriented tasks. Additionally, it prepares the way to operate several UAS by one operator.

The level of automation that can be built into UAs has increased significantly (Figure 1). Many tasks can be performed autonomously deeming even direct human supervision unnecessary. Enabled by the decrease in cost and size of sensors, actuators and most important processors in the last decades and supported by research in system automation more and more functionalities are taken over by technical applications e.g. auto pilot, navigation, mission and payload management and health monitoring systems [1].

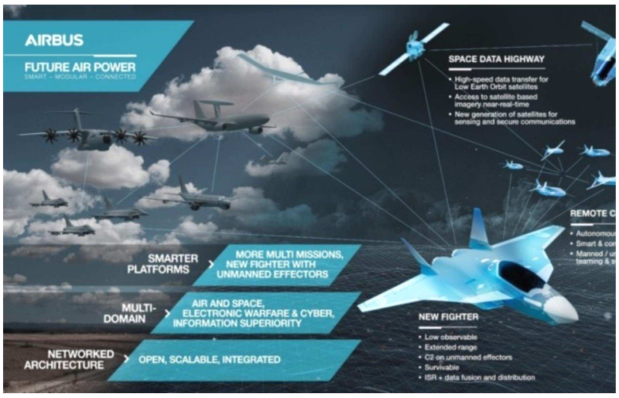

Fig. 1. AIRBUS Future Air Power[a]

So far machines are limited to actions that fall within the rules in their programming and are unable to make a deliberate and conscious decision. However, current technology that can learn or adapt its functioning in response to changing circumstances in the environment obviously exceeds the boundaries of pure automation, resulting in the proliferated but actually incorrect use of the terms 'Autonomy' and 'Decision Making' for such systems. The presentation accompanying this extended abstract clarifies these definitions.

Human factors are a critical challenge for attaining acceptable UAS reliability and readiness. Human factors remain a leading cause of unmanned aircraft mishaps. Currently, approximately one-third of all UAS mishaps are due to direct human oversight, errors caused while dealing with a mechanical failure, or a design issue that did not sufficiently account for the man-in-the loop.

In ninety-five Predator mishaps and safety incidents reported to the US Air Force over an eight-year period, 57 % of crewmember-related mishaps were consistent with situational awareness errors associated with reduced perception of the environment [2].

As increased automation shifts controllers into system management positions, monotony, loss of vigilance and boredom are more likely to occur. With recent advances in automation, it is not uncommon for an UAS operator in search and reconnaissance missions to spend most of the mission merely waiting for a system anomaly to occur and to only interact with the system occasionally. This reduced need for interaction can result in a lack of sustained attention, which can have a negative impact on the mission. Moreover, boredom may be a factor that induces complacency, which is also a significant concern in supervisory control systems.

3 Conclusions

The overarching element is the human in the loop with its human factor who is partly operator/manager/supervisor depending on system design capabilities and mission profile and bears total responsibility for operation.

Training for UAS operation initially lagged due to the fast introduction into service. It took some time before there was an opportunity to catch up and use the experience gained to establish a mature training pipeline based on existing regulation and considering UAS specific characteristics.

Legacy training systems need now to be reviewed under consideration of the upcoming developments and adapted to provide the training necessary for continuous safe operation. The human element with its various roles and human factors influencing the outcome of actions require special attention in training efforts.

As main training tool the simulator can be a targeted fidelity simulator reflecting precisely the training needs. The need however can justify a high fidelity Full Mission Simulator with realistic system behaviour for system analysis and special training. The simulator has to be networkable to allow interactive mission training.

The concept of Mission Readiness Training (MRT) introduces experiences from previous missions analysing influencing factors that resulted in bad decisions or dangerous situations. These way human factors are included in generating missions that create training situations in which the human is likely to make mistakes. UAS training could benefit from this concept.

The logical enhancement of networked scenarios with simulators is the application of Live, Virtual Constructive LVC) assets in a complex mission.

The presented training options are suitable to provide the required training to accommodate the upcoming challenges in UAS developments. Based on the most recent knowledge about development of UAS and their mission scenarios extending past 2025 far more complex scenarios with shorter development cycles can be expected. These dynamic trends will challenge UAS operators and all training related activities and resources.

References

[1] JAPCC, Future Unmanned System Technologies, November (2016)

[2] A. P. Tvaryanas, W.T. Thompson, "*Recurrent Error Pathways in HFACS Data: Analysis of 95 Mishaps with Remotely Piloted Aircraft*", Aviation, Space, and Environmental Medicine Vol. 79, No. 5, May (2008)

Author/Speaker Biography

Enrico Mollenhauer served as a Fighter Bomber and Instructor Pilot in the German Air Force and at Euro NATO Joint Jet Pilot Training (ENJJPT) held in the USA. He earned his degree in aerospace engineering at the Armed Forces University of the Bundeswehr and in business administration at the LMU Munich School of Management. After his military career he joined Airbus Defence and Space, a division of Airbus Group, as a project manager responsible for aircrew training solutions. Presently he leads the Ops Factor team for UAS Mission and Tactics Simulation.

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[a] https://www.youtube.com/watch?v=qCL1e1MJtSw