Applying artificial intelligence on electronic flight bag for single pilot operations

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SUMMARY

Single pilot operations (SPO) is an operational concept which commercial aviation industry is considering. Artificial Intelligence (AI) hosted on Electronic Flight Bag (EFB) has a potential to become a buddy for pilot in SPO. This short paper presents an operational concept of SPO with EFB/AI and further discussion based on empirical exploration to achieve the objective on integration AI with EFB design.

KEYWORDS

Single pilot operations (SPO), Electronic Flight Bag (EFB), Artificial Intelligence (AI), Aviation

Introduction

EFB is an emerging and popular device which provides operational information to pilots. In current regulation the EFB usage is limited compared to its technical capability. SPO is perceived as a future operational concept among commercial aviation industry. There are several challenges on SPO especially how one pilot in cockpit can manage so many advanced automation systems under time-limited urgent situations. SPO may be achieved by expanding today's operations with EFB to embrace with AI. By reviewing the literatures and regulatory documents to the present, this short paper describes how today's flight operation adopts EFB, the operational concept of SPO with EFB/AI, and areas where further research required for future applications.

Application and limitation of EFB in current operation

EFB can host varieties of applications and can "be connected to the ground via the Wi-Fi which opens up a whole host of information" (Hint, 2019). Note that application status largely varies on operators (airlines), so not all operators utilize full capabilities. Currently, EFB can host only applications whose failure condition classifications are considered minor or less (FAA, 2017). Because of this restriction, EFB is still regarded as a "supplementary" information device.

Concept of SPO and requirement for EFB/AI

AI (together with machine leaning) is regarded as one of possible enablers for SPO (EASA, 2020). Because EFB can host variety of applications, AI may be integrated with EFB. From author's experience as EFB administrative role in one airline, the SPO with EFB/AI would be feasible even today, in "normal" flight. Obviously, the challenges are in non-normal situations.

Figure 1 shows current flight operation with two pilots (pilot-flying and pilot-monitoring) and EFB, and how EFB/AI can work in SPO. EFB/AI should communicate continuously with aircraft and ground, to get real-time information regarding operation, to analyse it, and to provide pilot with "the right information at the right time and automatically" (Hint, 2019). EFB/AI also need to communicate with ground to help remote control of aircraft which may be needed in case when

pilot onboard loss operational capacity or situation awareness. In extremely remote case of lost communication and pilot incapacitation, EFB/AI may need to land the aircraft autonomously.

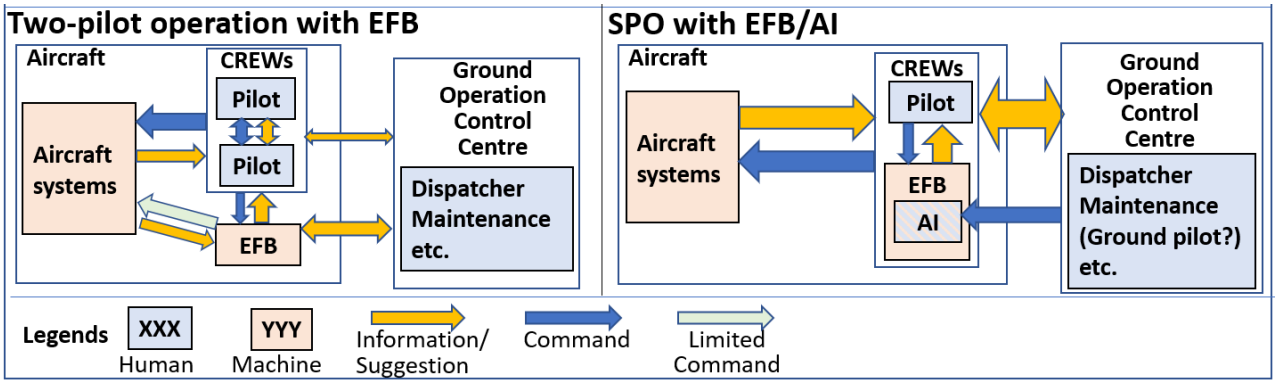

Figure 1: Comparison of operation concept (Two-pilot operation with EFB vs SPO with EFB/AI)

Further research on EFB/AI for SPO

By comparing current EFB with proposed EFB/AI for future SPO, it is easy to identify further research areas to achieve the research objective. To deal with all possible (including time-limited) non-normal situations, EFB/AI should be capable to conduct autonomous troubleshooting activities. Besides a lot of technical challenges (remote control, cybersecurity, etc.) from Human Factors perspective, as already pointed out on many literatures, one of biggest challenges is how to keep pilot's situational awareness (SA) or avoid "Out-of-the-loop syndrome" (Endsley, 2004) in the increasing complexity of automation systems. "Explainability of AI" (EASA, 2020) is crucial, and it should be capable to deal with non-normal situations, like two pilots are currently dealing with. Single pilot, ground staffs and EFB/AI should establish "team SA" (Endsley, 2004) or "Distributed SA" (Stanton, 2016) even in separated locations, beyond the border between human and AI.

Conclusion

Many concepts for SPO have been proposed so far and there is not yet a definitive answer. The concept proposed in this paper is one of them developed from author's EFB admin experience and review on recent literatures. Disruptive technologies are needed to achieve new innovative concept, but too much disruption is not always welcomed nor accepted by users. Considering the current popularity of EFB among operators, it may be a realistic strategy to approach how the EFB can be expanded to EFB/AI as a trusted "buddy" for a lonely pilot in SPO.

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