PHD PROPOSAL

The effects of active monitoring on pilot procedural skill retention during long haul operations on flight decks with a high reliability of flight path management automation: adaptive flight deck automation and training in metacognition for flight crews.

1 ABSTRACT

The author of this PhD proposal listed some recommendations for the improvement of flight path monitoring during the Viva for his Master thesis in Summer 2015:

1. Teaching flight crew members in metacognition during Crew Resource Management (CRM) Courses, Line Observation Safety Audits (LOSA) and simulator training sessions. This enables them to understand the threat of low arousal and the resulting possible slow cognitive reasoning in procedural skill retention when monitoring a highly reliable cockpit automation system.
2. Implementation of an adapting flight path management system which understands the limits of its human operator when experiencing a startle moment under situations of low cognitive arousal.

Recent studies support those arguments and note that human cognition have their limits in monitoring highly reliable automated systems which seldom fails. They suggest further studies in the field of information processing under low cognitive arousal (Dismukes et. al., 2007; Casner & Schooler, 2014). Additionally, the Netherlands Aerospace Center (NLR, 2013) published some suggestions for cockpit display information during rare automation anomalies.

The study will research the effect of startle following a prolonged state of low cognitive arousal during long haul flight and the deep structure of pilot's procedural skill retention to prevent a Loss of Control in Flight (LOC-I). In a further step, the topic of metacognition and its implementation into simulator sessions, Crew Resource Management (CRM) courses and Line Observation Safety Audits (LOSA) will be analysed by evaluate possible effectiveness of the proposed mitigations. In the opinion of the author, pilots should clearly understand the presence of mind wandering and boredom when monitoring a highly reliable system that seldom fails (see also Casner & Schooler, 2014, p. 1515).

Beside psychology and human factors, the author is also interested in aeronautical engineering. To build a bridge between them, a further analysis about adaptive flight deck automation on a full motion flight simulator will be conducted.

Therefore, human factor research in the field of procedural skill retention in an environment of low sense stimulations will become more important in the future in order to understand the deep structure of flight path monitoring.

2 RESEARCH OBJECTIVES

The research will analyse and discuss the deep structure of cognitive information processing and procedural retention when monitoring a highly reliable cockpit automation system under situations of low arousal on long haul flights. Casner and Schooler (2014, p. 1515) note in their research paper an accumulating evidence of the difficulty in maintaining one's thoughts focused on the activities of an automated system that seldom fails. They recommend the need for a study in the field of procedural skill retention influence on active monitoring under low arousal. Supporting this argument, Reason (1990) suggests that Knowledge-Based reactions to unfamiliar situations requiring rapid response are slow and conscious compared to well-familiar Skill-Based automated behaviours.

Christopher Wickens (2002) demonstrated in his research that repetitive and similar outcomes to a certain cognitive stimulus may enforce the working memory to an extend where the efficiency in assessing unexpected situations by attention resources and the activation of required procedural skills is hampered. Automated flight path systems can be beneficial to ease the workload management of the pilots. However, monotonous tasks like monitoring an automated flight path over a long period of time during long-haul operations create new flight path management problems when experiencing a sudden degradation in automation level to an extend where a precise manual control input is required to prevent an undesired aircraft state.

Based on those three researches, the PhD thesis aims to find new hypotheses by applying and implementing the conclusions into flight crew training and a design proposal for an adaptive flight deck automation.

3 Proposed Research Methodology

As a former train driver in Switzerland and an active airline pilot for Cathay Pacific Airways in Hong Kong, the author possess advanced knowledge in the domain of has the possibility to approach subject matter experts from the field of human factors, psychology and engineering. The membership at Royal Aeronautical Society, Flight Safety Foundation and The Honourable Company of Air Pilots and Navigators – former GAPAN – will allow the author to take part in conferences, accessing specialised publications and get in touch with high level experts. Mentioned literature will be analysed in deep and compared with journals, publications and transcripts from personal interviews the author is planning to conduct. A scientific blog established by the authors and publications on LinkedIn will aim to facilitate exchange of information and data amongst interested participants and readers.

With the advance in the research process, it is planned to conduct a real experiment in procedural retention under low arousal on a flight simulator with active airline pilots as subjects. An extensive survey using Qualtrics software will have the goal to compare the data gained in the research and to get further insights from active airline pilots.

During the entire research process, the author will work as an airline pilot for Cathay Pacific Airways and therefore mainly be based in Hong Kong. Most of the exchanges will be conducted either by email or Skype. Interviews however will be held in person in order to gain maximum benefit in the discussions with experts. As the roster permits, the author plans to visit frequently the School of Mathematics, Computer Science & Engineering at City University London to facilitate a good exchange of information with the supervisors and Professors.

4 Literature

- Casner, S. M., Geven, R. W., Recker, M. P., & Schooler, J. W. (2014). The retention of manual flying skills in the automated cockpit. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 0018720814535628.
- Dismukes, R. K., Berman, B. A., & Loukopoulos, L. D. (2007). The Limits of Expertise. *Hampshire, England: Ashgate Publishing Limited*.
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- National Aerospace Laboratory. NLR. (2013). *Angle-of-Attack information in civil aircraft*. Amsterdam: National Aerospace Laboratory.
- Pinet, J. (2015). *Facing the Unexpected in Flight: Human Limitations and Interaction with Technology in the Cockpit*. CRC Press.
- Reason, J. T. (1990). *Human error*. Cambridge: University Press.
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5 Current Understanding and Knowledge

As mentioned in Chapter 3 of this proposal, the author is an active airline pilot at Cathay Pacific Airways in Hong Kong and a former train driver at Swiss Federal Railways. In summer 2015, he completed the Master of Science degree in Air Safety Management at City University London, which was awarded with 'Distinction'. Together with various professional experience in complex and highly automated working environments, the research for the thesis will be both scientific and practically orientated, making it a valuable contribution to the safety of aviation. High level experts are at his disposal during the research to share knowledge and expertise.

6 Contribution to the Discipline

The application of scientific data about cognitive information processing monitoring of a highly reliable automation into flight crew training and future flight deck designs creates an essential bridge between research and flight operations. It ensures that the organisation is robust and resilient to the external and internal influencing factors. Real value to the business of commercial air transportation is added to make activities at every organisation level safe and sustainable. Improvement in training of flight crews is achieved through a better understanding of the deep structure in flight path monitoring by all involved stakeholders such as the team from Flight Crew Training, Fatigue Risk Management System (FRMS) and Flight Crew Scheduling, but also the members of the management board, the State's Aviation Authority and the Air Accident Investigation Branch (AAIB). This will enable the flight crew to apply effective threat and error management methods on flight deck when facing the risk of LOC-I through startle following an unexpected degradation in flight path automation under situations of low arousal.

On the proactive site of risk management, by implementing this knowledge into training courses for airline pilots and into future flight deck designs, a safe and resilient flight operation system is created. EASA's ED Decision 2015/022/R, which mandates CRM training on, amongst others, startle and resilience. This Decision means that Operators will have to find acceptable means to implement these aspects in their approved training programs. Any results from this research may be of interest to EASA or individual operators. As for the reactive part, air accident investigation methods could benefit from appropriate and meaningful analyses of accident and incident investigation data, enabling results to be effectively communicated to all stakeholders.

Additionally, by using the human factor evidences obtained in the flight crew training, the organisation remains a learning system.

7 Work Plan

January 2016	Submission of the PhD proposal to City University London.
Spring 2016	Expected registration as a PhD student and commencement of the research by analysing and reviewing the mentioned literature towards the research objective.
Winter 2016	Interviews with safety matter experts from the field of psychology, human factors and engineering.
Spring 2017	Practical experiments on a full motion or scientific flight simulator with active airline pilots as subjects, testing procedural skill retention under low arousal and adaptive automation.
Winter 2018	Based on the results obtained during the simulator experiment, creation of a Qualtrics survey, which will be send to numerous airline pilots worldwide.
Spring 2018	Expected first draft to be submitted to the supervisor at City University London.
Summer 2018 onwards	Open for further researches and amendments.