RESEARCH ON PILOT TRAINING METHODS USING FLIGHT SIMULATORS

Analysis of simulator training procedures for pilots

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The article addresses the basic outputs of the analysis conducted within the project of „Research of pilot training methods using flight simulators". It offers the results of the analysis regarding the statute of the art in the field adding hypotheses developed for the research part of the project. Focus is on identifying the key processes labelled as insufficient by current pilot training requirements in terms of their negative impact on air transport safety.

Keywords: pilot training methods, flight simulator, pilot performance, analogue cockpit, glass cockpit

1 INTRODUCTION

Flight crew preparation is one of the key factors affecting flight operation safety while posing high demands on financing. Inconsiderate cuts in funds for flight training result in degrading both the level of professional skills of pilots and that of the flight safety. Consequently, one has to be in constant search of new such flight training methods that would lessen financial burden without negative impacts on flight safety. Currently the world trend is about increased utilization of flight simulators in pilot training.

The signals above served as an initial stimulus for the Education Training & Consulting company, a.s.(j.s.c.), which in cooperation with the Faculty of Aeronautics TUKE started solving a project „Research of the training methods of pilots using flight simulators" with the ITMS code of the project 26220220161, co-financed by EU funds. Its strategic aim is to perform research for increasing safety of flight operations conducted by the ET&Cc, a.s. making full use of the research and development facility of the FA TUKE and a follow-up transfer its latest findings into business practices [1].

Air transportation safety is directly dependent on aircrew preparation. This gave the idea to perform an analysis into the current status of pilot training and preparation to identify deficiencies and suggest such new methods of flight training that would increase the level of safety. Simultaneously, it is aimed to reduce financial dementedness and verify the new procedures so as to make them applicable in practice.

The project is realized within the framework of two activities. The first one is focused on the analysing current simulator training procedures for pilots and suggesting new methods of simulation for pilot training for the research stage of the project. The second one is focused on scientific confirmation of the outputs obtained from the analytical part of the project and research, optimization of the newly–designed simulation methods of pilot training and their validation in practice.

2 METHODS APPLIED TO ANALYSE THE STATUS QUO

The analytical part of the project involved mapping of the current situation in terms of the procedures applied in the process of aircrew training and preparation with emphasis on the efficient use of flight simulators and contribution to assist in raising the level of flight operations safety.

Stage one of the analysis focused on investigation the legislative framework governing the entire process of aircrew preparation and training. Special focus was on training procedures in terms of the requirements applicable to flight simulator training of pilots.

The next stage was devoted to the stakeholders of the air transportation system in both domestic and international contexts also taking into account civil and military sectors. This activity made use of information directly from the subjects involved in air transportation obtained by way of discussions during the interview when visiting selected firms and institutions of the industry. Another source of information were the websites of companies not visited in person.

As a matter of fact, the key issue of the project is the of interest for several other institutions both domestic and international ones. Therefore, it was necessary to analyse similar research projects with the aim to define the state of the art in the field of research so as to find ways of tying up to their findings.

With human factor as admittedly the most important element in flight transportation safety, the analysis also involved the causes of aviation accidents that could be traced back to pilot training procedures.

The questionnaire-based survey became the principal tool for learning the opinions regarding the current status of pilot training procedures and utilization of flight simulators in pilot training. It entailed addressing airlines and institutions directly or indirectly involved in air transportation. The questionnaire was readily available for the wide public in via the www.formees.com/cz website application.

3 ANALYSING THE STATE OF THE ART

The fundamental aim of analysing the current status in pilot preparation and training was to indentify the insufficiencies in this area and obtain stimuli form the research part of the project. The following points will inform on the basic areas of interests of the analytical activities.

3.1 Legislative framework
The analysis of the air legislation directly specifying the requirements for pilot training and use of flight simulators as part of the aircrew training process with focus on the Slovak republic, an environment regulated by the European Aviation Safety Agency covering the entire area of Europe as well.

3.2 Stakeholders of aviation, involved directly in the process of preparing and training pilots both in domestic and international environment.

This stage of analysis was focused on the individual firms and institutions, representatives of all components of the air transportation system in the context of pilot preparation and training:
   – Airlines, holders of air operator´s certificates, the AOC, in commercial air transportation,
   – Flight training organizations, FTO/ATO,
   – General aviation,
   – Military aviation units,
   – Manufacturers of flight simulators,
   – Operators of flight simulators.

The information of interest were concerned with brief characteristics of the subject, its history, process of obtaining certificates, procedures applied in pilot training, and utilization of flight simulators in pilot training.

3.3 Identification and analysis of similar research projects. It involved analyses of the available information regarding:
   – Research projects focused on the procedures applied in pilot education and training,
   – Factors affecting pilot performance, i.e. flight transportation safety as well,
   – Methods of measuring pilot performance,
   – Utilization of flight simulators as part of pilot training also in terms of efficiency,
   – Wide spectrum of the issue of pilot education and training.

3.4 Causes of air accidents that resulted from pilot training procedures.
The analysis of the causes of aviation accidents was aimed to focus on accidents the causes of which were related to the educational and training procedures of pilots in order to identify insufficiencies in this area, all that in the light of real consequences.

3.5 Questionnaire-based survey on the status quo of pilot training procedures and utilization of flight simulation within the process of pilot training [2]
The survey enabled obtaining information in the following areas:
   – Identification of training procedures for pilots with most frequent use of flight simulators,
   – Utilization/Non-utilization of flight simulator to verify correctness/efficiency of the established flight procedures,
   – Identification of flight operational procedures , wherein the respondents are able to find inefficiencies, which could be the cause of changes in training procedures with the purpose of eliminating them,
   – Changes in flight information data presentation and their impact on pilot performance (e.g. changing from analogous to glass cockpit and vice-versa).

Graph 1 is expressing basic ideas of respondents within the identification of flight operation and training procedures, with him seeing faults because of which training procedures should be changed to eliminate the insufficiencies.
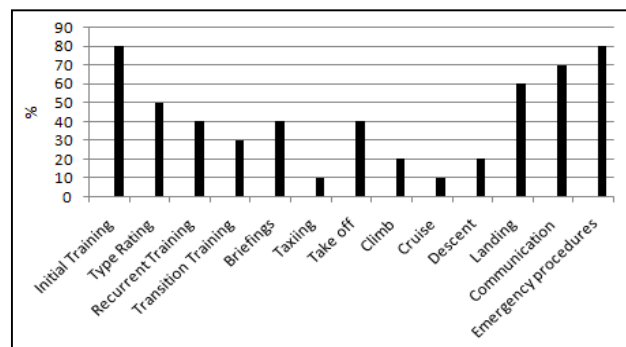
Graph 1 Areas of pilot training that deserve more attention

Graph 2 is expressing the basic ideas of the questionnaire-based survey respondents regarding the impact of changes of flight data presentation on pilot performance, when changing from analogous to glass cockpit form.
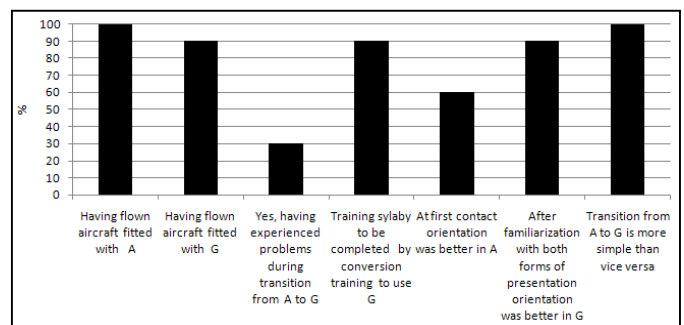
Graph 2 The issue of changing from analogue into glass-cockpit data presentation

4 OUTPUTS OF THE ANALYTICAL PART OF THE PROJECT

4.1 From the analysis of simulator-based training procedures for pilots it followed that the issue of changing the presentation of navigation and engine data on the aircraft cockpit panel does influence pilot performance regarding its piloting techniques reflected in deviation from the actual position of the aircraft and the actual trajectory of flight from the required flight and navigation parameters.

Current development in the field of presenting the basic flight data in the cockpit is taking place in favour of the replacement of classical analogue indicators for glass cockpit ones, which in some cases bring about principally different ways of presenting information necessary for aircraft piloting and navigation. We assume that the issue of data presentation is demonstrated differently at different categories of pilots, in terms of their training proficiency, number of hours flown, length of their pilot career etc. The highest impacts on pilot performance exerted by changes in presentation on pilot performance are assumed at the following combinations:

- Changes from analogue presentation to glass cockpit presentation for pilots, who have been flying on analogous data presentation so far,
- Changes from glass cockpit presentation to analogue one for pilots, who have been flying on glass-cockpit presentation so far,
- Changes in the presentation for pilots, who have been flying alternatively on both forms of presentation, whereas the change occurs after a relatively longer period of time.

On the basis of the finding of the analysis, for the purpose of research activities within the project, two hypotheses were developed, which could help in acquiring new knowledge in the field of study:

Hypothesis 1
Based on the findings of the analysis we assume that the changing presentation from analogue to glass cockpit one will affect negatively the performance of those pilots, who during their pilot career have previously flown only by analogue data presentation, or have flown only a smaller number of hours (up to 100 flight hours), or are absolute beginners with only the basics of instruments flying. This category of pilots will make up to Test sample of pilots No 1. We assume that if the change in presentation is preceded by a training based on flight simulators, the change in presentation will affect pilot performance less negatively [3].

Hypothesis 2
Based on the findings of the analysis, we assume that the impact of changing the presentation from analogous to glass cockpit or vice versa is more felt at pilots having flown for a longer period of time by one of the ways of presentations for a longer time. Or, when they have flown

a larger number of flights by the second way of presentation before changing for the other form of presentation. In view of the actual status of aircraft in operation with both ways of presentation, these pilots are currently confronted with changing ways of presentation, some even within a shorter period of time (even during a day) and some after longer periods of time. The Testing sample of pilots No. 2 will be made up of this type of experienced pilots. We assume that if the change is preceded by a new education and training method, the change in presentation will affect pilot performance less negatively [3].

4.2 The analyses of simulation-based training procedures lead to the conclusion that failure of the artificial horizon does affect the performance of the pilot resorting to the use of stand-by instruments. It is demonstrated by deviations of the actual position of aircraft and the actual trajectory of flight from the required flight and navigation parameters. At current status of presenting flight and navigation data, the following basic situations may set in:

- During instrument flight on analogue presentation, turning off the artificial horizon and the need to fly on substitute flight instruments such as the turn and bank indicator with a relative bank indicator (the „ball") and a vertical speed indicator, or by way of a stand-by artificial horizon located directly in front of the pilot (it came to the breach of the usual checks for flight and navigation information). The stand-by horizon is of smaller size, so it is unable to provide as correct information as the main artificial horizon. Such a situation does affect piloting in terms of maintaining the required bank and pitch of the aircraft but usually does not considerably influences navigation procedures.
- During instrument flying by glass cockpit presentation, with the display failing to present digital information and the need to perform piloting on stand-by flight instruments such as the airspeed indicator, altimeter, stand-by artificial horizon and the simple, magnetic ball compass, mostly available in analogue finish. The stand-by horizon is not installed in front of the pilot (this is the cause of breaking the habitual procedures of scanning flight and navigational indicators) as a rule. The stand-by artificial horizon is of smaller by design, i.e. it does not provide as precise information as the main one. This situation does affect piloting in terms of maintaining bank and pitch angle of the aircraft and the navigation procedures as well.

Hypothesis 3
Based on the findings of the analysis, we assume that the effect of main artificial horizon failure and the need to perform flying by stand-by flight instruments is more felt on the performance of those pilots, who have not gone

through training in instrument flying by stand-by instruments on a flight simulator, or an aircraft. This category of experienced pilots will make up the Test group of pilots No. 3. We assume that if flying by stand-by flight instruments is preceded by a new preparation and training method, flying on stand-by flight instruments will then affect pilot performances less negatively [3].

5 CONCLUSION

Use of simulators enable training of border-line situations, which cannot be performed during regular training flights. Applying new training methods can help reduce the financial burden of flight training without degrading the quality of air training and that of the flight safety. Even further, these new training methods may contribute to air traffic safety. Shifting the main share of training from real aircraft towards modern flight simulators will also bring direct financial savings in terms of the costs of fuel and wear of aviation equipment thereby bringing appreciable contributions to the living environment.

BIBLIOGRAPHY

[1]   GAZDA, J.: Výskum tréningových metód pilotov s využitím leteckých simulátorov – Opis projektu, 2011

[2]   KIMLIČKOVÁ, M..: Výskum tréningových metód pilotov s využitím leteckých simulátorov – Dotazníkový prieskum, 2014

[3]   KAĽAVSKÝ, P.: Výskum tréningových metód pilotov s využitím leteckých simulátorov – Analýza simulačných tréningových postupov pre pilotov, 2013

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