17. FHP-Symposium – „Automation and Manual Flying Skills“

Working Group 3 – Basic Human Factors

Written report of the results of the working group of September 16th, 2014

Introduction

Working group 3 (WG3) Basic Human Factors was comprised of eight members (one active airline pilot, three retired airline pilots, one neuro-scientist, one aviation-psychologist, one flight-engineer, one representative of a civil aviation authority and one facilitator (active airline pilot).

All members have additional qualifications – e.g. instructors/lecturers, aviation experts, certified aircraft accident investigators or representatives of professional associations. Seven of the members have flight experience.

All members agreed relatively quickly on the fact that, concerning the theoretical basics of human factors in civil aviation, there are already very many good summaries available in the common subject literature [e.g. "*Human Factors im Cockpit*" of the German Cockpit Association (*Vereinigung Cockpit* – Scheiderer/Ebermann, 2011), "Human Factors in Aviation" (Wiener/Nagel, 1988) or "Human Factors in Flight" (Hawkins, 2006)].

Areas surrounding "basic" human factors which, according to WG3, have not been adequately covered in the standard literature are new insights from the neuro-sciences. Several articles addressed these areas during the last FHP-Symposia (e.g. Teuchert-Noodt FHP 2012 and 2013). One recommendation of WG3 was to integrate these insights into the theoretical basic-training of human factors.

WG3 did, however, conclude that the theoretical base-knowledge surrounding basic human factors is generally well covered by the common standard literature. Any deficits in basic-, recurrent-, and further education are to be found rather in the way the theoretical basic-knowledge is translated into practical training.

Within this context several main areas of discussion resulted in WG3:

1 – How important is an advance selection of flight-students and instructors?

2 – Which special skills/competencies must teachers in the broadest sense (i.e. instructors, trainers, coaches or facilitators) possess in the area of human factors?

3 – How can basic human factors be conveyed in a transparent, controllable and reproducible manner and how to measure the transfer of knowledge objectively?

In the limited time available to WG3 the above questions could only be discussed on a basic level:

Ad 1 – Selection of Flight Students/Instructors

Within WG3 the opinions concerning selection of flight students/instructors were divided. Generally, the members of AG3 agreed that certain character-traits are advantageous for flight-students, and in particular for flight-instructors, but these character-traits can only be determined with relatively high effort through preliminary screenings and still remain difficult to detect.

Several members of WG3 did not find this effort commensurate to the potential benefits – especially, since many of the required abilities could also be "learned". A clear distinction must be made among the respective Flight- and Training-Organizations. It makes more sense for a large airline to conduct an extensive selection process than for a small airline or a small flight-school.

Additionally, there is already a shortage of flight-instructors. Additional "selection-hurdles" could exacerbate this situation. The proponents of an extensive selection rebutted this argument in that this problem should be solved through improvements in the working-conditions of flight-instructors (in the widest sense also through an improvement of the status) and not through compromises in the selection.

Due to the limited time available, WG3 was not able to discuss the above controversy in depth. The discussion was then moved towards the question of which skills/competencies in the area of human factors instructors actually do need.

Ad 2 – Specific Skills/Competencies of Teachers in the Area of Human Factors

WG3 regarded "personality" and "authenticity" as core-elements of basic human factors per se. Consequently, teachers of human factors should have specific skills/competencies in this area.

All members of WG3 regarded it as important that a solid theoretical basic-training (based upon one of the common literature mentioned above) must precede any teaching-activities. Ideally, (flight-) instructors possess a minimum (flight-) experience into which the human factors elements can then be integrated. In this context it is essential for the instructors to authentically incorporate their own personality traits and to also emphasize the respective traits of the (flight-) students.

WG3 is of the opinion that in the area of human factors there is a significantly larger spectrum of possible "correct" behaviors than in other areas of flight-training. For example, in strictly manual flying the parameters for acceptable performance are relatively clear-cut and insufficient transfer can thus be relatively easily determined (e.g. deviations from the intended flight-path).

An acceptable level of performance in human factors is, on the other hand, much more difficult to determine. First of all, the teacher must somehow be able to observe (measure) and evaluate the performance, which often is only based upon the personal experience of the teacher. Objective metrics (e.g. pulse-rate, eye-tracking of skin-conductivity) are generally only rarely used in training. Video-recording is also not routinely used. WG3 thus also concluded that these tools should be utilized significantly more; however, the teachers must then also be trained in the application and evaluation of these accordingly.

Additionally, WG3 felt it is essential that teachers convey a "coherent overall picture" of human factors and exemplify this in an authentic fashion.

Generally, it always advantageous if the teacher can personally demonstrate curriculum content;

but, depending on the content, not always necessary – for example, a good flight-instructor must not necessarily demo-fly an ILS-approach him or herself to teach this type of an approach to the student.

In the area of human factors, however, it is difficult to ensure adequate transfer if the teachers do not exemplify their own teachings – in other words: A "do as I tell and not as I do" is unacceptable in the realm of human factors.

The practical implementation of the above is often difficult and this was the third main area of discussion of WG3:

Ad 3 – Systematic, Transparent, Controllable and Reproducible Transfer of Basic Human Factors, as well as Objective Measurement of Knowledge-Transfer

There was consensus in WG3 that a central element of basic human factors is awareness-training and the best way to achieve this is via the personal experience of self-awareness.

As such personal experience of self-awareness is generally a very individual matter and, thus may differ from student to student; it is difficult to integrate such training into a tight curriculum. WG3 sees this as the reason why a lot of training programs currently conduct human factors training in a relatively non-systemic, non-transparent and inadequately controlled manner.

The matter is further aggravated by the fact that the legal requirements concerning human factors training are also rather vague. The theoretical basics are known and have been formulated (see introduction above), but concrete specifications on how these basics should be taught and how the transfer should be objectively measured are scarce.

At present, the learning success depends to a very high degree on the teacher. Good (flight-) instructors recognize, based upon their experience, if and how human factors are of importance in certain situations and can then address these specifically. Ideally, the teachers are able to draw references to common base-knowledge with the students. WG3 therefore recommends that at the beginning of the training the students are provided with one of standard works (see introduction) and that the instructors get specific training on the same to ensure a common knowledge-base.

Although a common knowledge-base will bring significant improvements, WG3 sees several other potential problems with the current basic human factors training:

1 - The situations which carry a human factors learning effect can only partially be planned ahead of time – thus there is a lack of a systematic approach to this training.

2 - The recognition of a teaching-opportunity and the implementation of the same depend, as already mentioned, to a very high degree on the experience and qualification of the teacher. These qualifications have not really been specified (see Ad 2) and, in addition, a massive generational change is about to happen, as worldwide the "baby-boomer"-generation will reach retirement-age and a new generation of (flight-) instructors, with relatively little experience will take over the training.

To ensure that the successful transfer of human factors will not solely depend on whether certain situations present themselves during training and, in addition, one has to be lucky and have an experienced teacher, who recognizes these situations and incorporates them accordingly, WG3

recommends additional training scenarios. Within these scenarios human factors should be specifically addressed.

WG3 regards it essential to conduct these scenarios in "variable comfort-zones". To develop a personal awareness the students must experience the entire spectrum from very comfortable (carrying the risk of complacency) all the way to very uncomfortable (→ high stress). This will help the students to make the personal experiences in self-awareness mentioned above.

Training-media must be kept variable and adapted to the respective training-goals. For certain things synthetic training-media (e.g. simulators) are suitable, but other human factors elements can only be represented adequately in a real flight-environment (e.g. flying and radio-telecommunication).

Of particular importance in this context is independent learning. There was general consensus within WG3 that within basic human factors training there has to be a certain amount of independent learning (e.g. Solo- and Team-Flights); however, this must always be accompanied by an instructor in the background to ensure pointed feedback. There was no consensus within WG3 on the exact measure of independent learning – again there was insufficient time to discuss the matter in depth.

Finally, WG3 saw potential for improvements in acquiring objective and reproducible data. Modern measuring-devices (e.g. pulse, eye-tracking – see also Ad 2) have reached a level of sophistication that they can be employed with relatively little effort.

Additionally, more experiments with collection of other data (e.g. brain-currents/-waves or order-perception measurements to determine cognitive deficiencies) should be conducted.

Data gained in the above manner help teachers to more rapidly recognize certain behaviors and students to better understand the above mentioned self-awareness. It is vital that these measurements are incorporated into specific phases during training. The measurements must not become some sort of "control monitoring", as this might result in a negative attitude of the students. Additionally, it must be ensured that the data obtained is not abused (e.g. for disciplinary action). Ideally, the measurements will be understood as a tool (analogous to video-recording in line-oriented flight training) to optimize training and to be able to give individual support.

Summary:

- Certain personality- and character-traits are advantageous for pilots and thus are of importance in the training of basic human factors – for both, flight-students as well as flight-instructors

- A preliminary selection prior to training may have some advantages; however, the cost-benefit analysis depends to a large extent on the type of flight-activity sought (professional pilot versus leisure-pilot) and on the size of the flight-organization, respectively the size of the training-organization

- The existing literature (see introduction and bibliography) provides a solid theoretical basis of basic human factors

    - Areas which should be incorporated into this literature are modern

insights from neuro-sciences to enable better self-awareness training and to improve learning-techniques

- (flight-) students should receive a copy of one of the standard works at the beginning of their training and they should be given a brief introduction (e.g. a one-day seminar) into Human Factors

- (flight-) instructors should be issued the same reference literature as the (flight-) students and, in addition, should receive an comprehensive (about one-week seminar) covering the theoretical elements of human factors more in-depth, but also addressing didactics and utilization of training-media, as well as measuring-devices (including data-analysis)

- Problems/deficits in basic human factors training can be found in the practical implementation rather than in the theoretical basics

- (Flight-) instructors need certain skills/competencies to teach human factors

  - Of fundamental importance in this context is personality and authenticity of the instructors

  - Experience to recognize human factors elements during flight-training and to incorporate these in a meaningful fashion are also desirable

- To make human factors training more systemic, transparent, controllable and reproducible WG3 recommends

  - Scenario-based training in variable comfort-zones, employing various different training-media

  - a certain amount of independent learning/training is useful if accompanying feedback by the instructors can be ensured

  - Modern measuring-devices to gather certain data/parameters (e.g. pulse, eye-movement, brain-waves or order-perception measurements) should be utilized significantly more to provide the instructors more objective data and to improve the students self-awareness experience

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