Simulator-Based Assessment of Flight-Specific Aptitudes in German Armed Forces' Aircrew Selection

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This paper outlines German Armed Forces' (GAF) approach to predict future success in flight training of applicants for becoming aircrew member. GAF's aircrew selection procedure consists of three phases. Phase I and II include the assessment of basic aptitudes and the aviation-medical examination. Phase III (fixed wing) is more complex. It consists of one week simulator-based screening in a typical training scenario: Candidates prove their skills both in 4 simulator-flight missions with increasing workload and in academic training. As in real flight training, a briefing, a demonstration and a practice phase and subsequent debriefings prepare candidates for their check phases. The aim is to evaluate aptitudes and to propose specific cockpit assignments (e.g. jet pilot, transport pilot, weapon system officer/ navigator) and to minimize attrition rate during basic flight training. GAF's aircrew selection is primarily conducted before applicants decide to join German Armed Forces. The aircrew selection process works quite well, as long term evaluation shows: Attrition rates during flight training are very low (e.g. in ENJJPT: 2007 to 2012: less than 10% total and less than 5% due to flying deficiencies). Approximately 200 applicants are tested at Phase III fixed wing per year.
This paper will describe the flight simulator as well as the scenario including players involved in the screening process and missions in use.

Flight Simulator used in Phase III fixed-wing: A test device

The FPS/F (Aviation Psychological Pilot Selection System/ Fixed Wing) is a flight simulator consisting of 4 cockpits with canopies, a spherical projection dome with 200° horizontal and 45° vertical field of view, a 5-channel high resolution projection system, a multi-functional display with all basic flight instruments plus a master caution panel for malfunctions and a radio panel (Figure 1). The instructor's consoles enable monitoring the applicant's activities and performance. Digital video protocols as well as mission logs are used for debriefing purposes. Data can be analyzed at an evaluation station.

The flight simulator is no training device, but a test device. A generic single seated single engine prop aircraft retractable landing gear is simulated. An automatic trim feature is implemented to ease aircraft control: If a certain flight attitude is set and no flight control inputs are made, the aircraft tries to maintain this attitude. Thereby, complexity is reduced (no trim is

necessary). Furthermore, there is no torque-effect, and the weather is always fine. The aim is to keep the simulation simple enough for the candidates: “Pedestrians” should be able to fly complex missions during one week. This is for sure a time frame too short to learn how to fly an aircraft – or would one assume that a “pedestrian” will get his/her driver’s licence that fast? In addition, missions in Phase III are designed to test how applicants deal with high workload and maneuvers above basic flying capabilities. Therefore, complexity has to be reduced, to avoid floor effects. For screening purposes, standardized missions are used. Mission flow and standardized test conditions are ensured by LUA. With the script language LUA new tasks, missions and evaluation matrixes can be designed.

Figure 1. The flight simulator used in Phase III/ fixed wing (FPS/F) consists of cockpits with a high quality screen comprising the field of view (200° horizontal, 45° vertical) (left), and the multifunctional display showing expanded instrumentation as well as touchscreen and radio (right).

Description of scenarios and players

Scenario: Structure and mission contents

The simulator-based screening takes one week. Six applicants are tested per week. Applicants are pre-selected “pedestrians”, mainly just about to graduate from college with an average age at about 19 to 20 years with no flight experience. Few applicants are active duty soldiers or civilians holding a licence. In Phase III applicants go through four simulator flight missions and two academic sessions. In both fields pace of progress has to be high and written tests are conducted. The combination of studying and learning to fly both at a time is a challenge regarding time management and again reflects demands in real military flight training.

As to the academic part, aerodynamics and navigation are main topics. Proper preparation is required (using a handout that is available at least 2 weeks before applicants arrive in Phase III). Further, the ability to understand and apply brand-new and more complex topics in limited time is tested.

Mission structure is as follows: Mission 1 allows for familiarization with the simulator. Mission 2 consists of traffic pattern procedures from taxiing to full stop landing testing rather procedural skills. Missions 3 and 4 are tactical missions requiring proper information management, fast decision making and task management. Maneuvering, including recoveries from unusual attitudes and trail formation, are elements in Mission 3. Mission 4 is also dynamic, but nevertheless different from Mission 3: A low level navigation route with additional tactical tasks that occur unpredictable for the candidate during the mission task saturates the applicants. Each of the above mentioned missions consists of specific requirements on the one hand and common parts that remain the same from Mission 1 to Mission 4 (e.g., take-off) on the other

hand. The last mentioned allows evaluation of training progress and automation. During each mission, radio transmissions and standard checks are required.

The schedule duplicates real flight training demands in German Armed Forces' flight training, as well as its structure. For example, learning and applying procedures are essential. Contents and demands of each mission are explained in a briefing (conducted by experienced former military Jet Instructor Pilots or Navigators) prior to flying. Afterwards, there is some time left for preparation. Further, each missions consists of three parts: At first, a demonstration phase shows what is going to happen – no action is required. Second, the applicant tries to fly the mission and is being supported by an Instructor Pilot, who is giving helpful advice during the mission and in a short debriefing. Third, the applicants conduct a solo flight – a test flight without help. Each test mission is followed by a debriefing using flight data (including visual system, instruments, maps, audio and video files) to show improvement opportunities.

The aim is to simulate real flight training, and to test the applicants' trainability.

Players in Phase III

Phase III is conducted using an interdisciplinary approach. Each test mission is graded by an Aviation Psychologist and an experienced military Jet Instructor Pilot or Navigator. Two observers grade independently from one another, as means of standardization: Inter-rater-reliability is high in Phase III. A Military Training Staff Officer teaches academics, observes and grades behavior in academic lessons (e.g. team-work, cooperation, participation), and evaluates tests.

At the end of Phase III, there are 3 equal votes (1 Instructor Pilot, 1 Aviation Psychologist, 1 Military Training Staff Officer) to decide if the applicant passes or fails the selection process.

The following section will describe ratings and conditions for passing or failing the selection process in Phase III.

Ratings in Phase III

Expert ratings and the decision process

Experts grade each maneuver, each pattern, as well as each Mission on scales from 1, "excellent", to 7, "unsatisfactory". Behaviorally based rating scales (Standard Operating Procedures) define standards for each and every maneuver and are used to ensure reliable expert ratings. Further, as already mentioned, 2 experts observe each test mission (1 Aviation Psychologist, 1 Instructor Pilot). The simulator also delivers objective criteria (e.g. procedure-evaluation, monitoring of minimum criteria, etc.).

Aptitudes assessed in Phase III are distribution of attention, situational awareness, multi-tasking, aggressiveness, task saturation, concentration, speed of automation, stress resistance, coordination, tolerance towards failure, mission preparation, radio transmissions, training progress and will to perform. Aptitudes are graded for each mission and average values are computed (based on 4 missions). Again, these aptitudes reflect aptitudes assessed during real flight training, easing comparison of results in Phase III with results in real flight training.

According to aptitude profiles, best suitable future flying assignments are determined (that is jet pilot, transport pilot or navigator). The pass/fail decision as well as grading (7-scaled, 1 = excellent and 7 = unsatisfactory) and proposals on cockpit assignments are based on aptitudes, performance and progress during the week and performance in academics. To pass

through Phase III, the average grade (based on performance in 4 missions) must be better than 6 or 7 (on scales from 1, “excellent”, to 7, “unsatisfactory”). Furthermore, no aptitude should be below “5”.

The quality management system is a crucial part of GAF’s aircrew selection system: Each (future) pilot or navigator is graded during the course of his/her flight training several times. Results are reported to Phase III to compare Phase III’s proposals and predictions with training outcomes. Feedback from training squadrons is also used to compute empirically based aptitude profiles, which help to determine assignments for future candidates: Aptitude profiles are computed for each flying assignment. Profiles are based on performance of those pilots or navigators who completed their flight training successfully at an at least average level. Nevertheless, decisions in Phase III do not fully depend on the above mentioned empirical data: Experts also consider training progress, peculiarities of missions, individual weaknesses and strengths in terms of trainability, potential compensation and maturation, to name only a few. Nevertheless, feedback from training squadrons is used to adjust the decision processes in Phase III to changing requirements in military flight training.

Among the applicants who successfully completed Phase III only the best should be selected by the Human Resource Department to join a specific flight training track according to hiring needs. However, the population of successful applicants decreases, e.g. due to demographic changes.

Results

Phase III/ fixed wing replaced flying screening in 1998. The simulator system described here has been established 2008. The main idea is to reduce attrition rates in flight training and training costs. The aircrew selection process works quite well, as long term evaluation shows: Attrition rates during flight training are very low, that is below 10 % due to flying deficiencies. In ENJJPT 2007 to 2012: Less than 10% total and less than 5% due to flying deficiencies. Besides, qualitative analyses show: Predictions in Phase III fit very well with feedback from training squadrons.

Conclusion and Discussion

Although Phase III is working well, there is an ongoing effort to use feedback from training squadrons – have there been changes in flight training; are there possibilities to improve predictions? Besides, there are attempts to establish methodological improvements, for example implementation of further objective criteria, especially for aptitude gradings, and development of new procedure-evaluators.