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Current state and prospects for the development of training in aviation universities

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Abstract: The article is devoted to the role of simulator training in the training system of cadets of aviation universities Republic of Uzbekistan. The relevance and economic feasibility of its application are considered. The concept of further development of simulator training for aviation specialists is presented.

Keywords: Aviation simulator, simulator training, cadet, aviation university, military pilot.

Introduction: In the current conditions of the development of the Air Force of the Republic of Uzbekistan, shaped by socio-political realities, there is an increasing complexity and growing tension in the professional activities of military pilots.

The level of scientific achievements used in aviation significantly exceeds the knowledge acquired by future pilots during their training at military institutes. Analyzing flight incidents shows that a pilot's error during the operation of a modern aviation complex is highly likely to lead to malfunctions in onboard equipment and systems of the aircraft, which, in turn, can be a precursor to aviation accidents.

The safe outcome of a flight in the event of special situations largely depends on the thorough preparation of the flight crew for each flight. Inadequate crew preparation for actions in exceptional circumstances may result in delayed or, worse, incorrect responses to a failure. This can lead to improper actions and confusion in an emergency. This is why such high demands, related to the increasingly complex design of aircraft and their equipment, and are placed on the professionalism and competence of the flight crew.

The limited capabilities of real flights do not allow for the formation of most complex special skills and abilities required when flight conditions become more complicated. In such a situation, ground training, and specifically simulator training, which is available in aviation units today, plays a significant role in training flight personnel (not only cadets).

Simulator training for future pilots has a number of advantages over training on real aircraft, especially in light of recent events where we increasingly hear about aviation incidents, many of which are due to human error. One of the main advantages of simulator training is its complete safety for the life and health of trainees. The effectiveness of such training is also high, thanks to the ability to perform actions without restrictions that are dangerous in real flight, or actions that cannot even be practiced in the air for safety reasons. Additionally, when flying on a simulator, the negative consequences of mistakes made by trainees during training are minimized.

Therefore, the simulator is an essential tool for improving not only the professional but also the psychological training of pilots. Simulator training serves as the link between theoretical and flight training in the process of cadet education at an aviation institute. Training on simulators is carried out to familiarize cadets with piloting techniques, radio communication procedures, aircraft and helicopter handling techniques, crew member operations, and their interaction while fulfilling their functional duties during flight preparation and execution.

Upon completing the simulator training program, the cadet must know the technology of crew member operations, the sequence of actions and attention distribution at all stages of flight, as well as the rules for operating the systems and powerplant of the aircraft both on the ground and in flight. They must be able to correctly operate the aircraft at all stages of the flight and act appropriately in emergency situations on the

ground and in the air.

Modern flight simulators can be divided into several categories:

1. Functional simulators – These are cockpit mock-ups with instruments and control devices designed for the crew to practice procedures for handling controls and equipment.

2. Specialized aviation simulators – These are designed for training individual crew members and instilling specific skills.

3. Complex aviation simulators – These are intended for formulating and practicing flight missions.

Aviation simulators have evolved significantly, from simple devices to complex systems with digital computing systems, moving platforms, virtual reality systems, and other flight-related factors.

In the early stages, the production of simulators was not on a large scale, and the priority of their manufacture was government orders. The first aviation simulators were produced in the mid-1960s. The scale of simulator construction and the use of simulators for pilot training has continuously expanded, especially as advanced technologies have made it possible to create realistic environments.

Based on their complexity and the scope of functions implemented, there are four levels of complex simulators: A, B, C, and D.

• **Level A** simulators are equipped with a basic mobility system or may have none at all.

• **Level B** machines are placed on a dynamic platform with three degrees of freedom, while **Level C** and **Level D** machines are mounted on platforms with six degrees of freedom, allowing trainees to experience overloads and angular accelerations along all three axes.

Key advantages of flight simulators for training include:

• The use of simulators reduces the time and cost of training flight crews without lowering combat readiness.

• Flight training on simulators significantly reduces the wear and tear on aviation equipment, fuel, lubricants, and ammunition.

• Simulator training enhances flight safety by producing crews better prepared for both normal operations and emergency situations.

• Training with simulators allows for comprehensive monitoring of the training process, offering a wide range of conditions and scenarios for training exercises.

Based on experience with flight simulators in training, other positive aspects can be noted:

• The ability to account for the individual pace of each trainee, allowing them to manage their learning process.

• Reduced time to acquire necessary skills.

• Increased number of training tasks.

• Easy differentiation of trainees based on the success of their program mastery.

• Enhanced motivation for learning, development of correct behavior in critical situations, and the ability to review one's flight, identify typical mistakes, and take corrective measures.

However, despite all the advantages, simulator training has some limitations compared to real flights. These include:

• The inability to simulate the psychological barrier (a person does not perceive the flight on a simulator as a real flight, which means that the instinct of self-preservation is effectively disengaged, and cognitive processes are less active).

• The inability to fully simulate weather conditions (the trainee does not experience blinding sunlight, heat, or cold).

• The mathematical algorithm for the aircraft's behavior in the simulator does not always correspond to the physical model of a real aircraft’s behavior under specific weather conditions.

The main drawback of flight simulators is the inability to model the spatial disorientation illusions that inevitably occur during flight training, particularly when flying under a canopy. These illusions arise due to the pilot's misperception of the aircraft's actual position, the lack of visual reference points (such as the ground or the sun), distrust in instrument readings, and erroneous perception of angular movements by the vestibular system. Combined with psychological stress during the flight, this results in the sensation of disorientation. When training on a simulator, the trainee is aware that they are on the ground, does not experience psychological stress, trusts the instruments, and does not rely on their own sense of spatial orientation.

Considering the prospects of manufacturing and implementing flight simulators, active development and production of flight simulation systems built with advanced technologies are currently underway. The simulator, as a final product, will aim to approximate real life as much as possible, with its virtual world becoming as realistic as possible. This involves ensuring that both the hardware and software components of the simulator closely resemble those of real aircraft.

Therefore, the current efforts of engineers and

scientists in improving aviation simulators are focused on the following tasks:

• Improving the quality of the visualization system, increasing image resolution, achieving photorealism, and incorporating virtual reality goggles;

• Complicating simulation models of various instruments, systems, and armament;

• Introducing operational-tactical servers into the simulator with models of adversaries or teammates, using neural network algorithms—artificial intelligence, and training models for tactical situations;

• Enabling unlimited group training in real-time.

CONCLUSION

In conclusion, the training process should be effective, safe, and economical. Certainly, significant expenditures are justified to enhance safety, but cost-efficiency must always be monitored. The costs and production expenses of simulator-based training are the key indicators for the economic assessment of their feasibility and further operation.

In modern conditions, developers of simulator systems continue to refine immersion technologies and improve the realism of training equipment, striving to minimize the shortcomings of training due to the imprecision between real-life conditions and their simulation. It is essential to continue improving simulator training systems and, ultimately, create the necessary regulatory framework. By developing and implementing quality standards for simulator systems and training methods, it is possible to ensure the required level of flight crew training in contemporary conditions.

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