ANALYSIS AND SYSTEMATIZATION OF FUNCTIONAL AVIATION TRAINERS

Shamsiyev Z.Z.[1], Xolmuratov S.G.[2]
1. *Professor of the Aeronavigation Systems Department of Tashkent State Transport University. Doctor of Technical Sciences. Email:* *shamzz@rambler.ru*
2. *Student of the Aeronavigation Systems Department of Tashkent State Transport University. Email:* *xolmuratov0327@gmail.com*

Abstract. This article provides an in-depth analysis and systematic overview of functional aviation trainers, focusing on how the Indra simulator is revolutionizing aviation training for pilots and air traffic controllers. The examination includes discussions on flight dynamics, cockpit replication, visual systems, motion systems, procedural training, and scenario creation. Additionally, it explores radar simulation, communication systems, traffic management, weather simulation, and emergency scenarios, highlighting the extensive training environment facilitated by Indra's technology.

Keywords: aviation simulators, indra simulators, pilot training, air traffic control training, flight dynamics, cockpit replication, visual systems, motion systems, procedural training, scenario creation, networking capability, radar simulation, communication systems, Traffic management, weather simulation, emergency scenarios, adaptability.

This comprehensive article initiates a comprehensive study that provides an in-depth analysis and systematization of the functions inherent in modern aviation simulators. With a laser focus on the exemplary Indra simulator, this study reveals the complexities that shape the training landscape for both pilots and air traffic controllers. The story highlights the integral role of simulators in developing safety, proficiency, and flexibility in the dynamic field of aviation.

The evolution of aviation training methodology has witnessed a paradigm shift with the integration of advanced simulation technologies. This introduction lays the groundwork for a comprehensive study of aviation simulators and highlights their important role in building the skills of aviation professionals. The story focuses on the Indra simulator, positioning it as a beacon of advanced simulator technology.

The aviation industry requires highly skilled professionals who can navigate the complexities of modern airspace. The main role in this demand is played by aviation simulators, which are designed to improve the skills of pilots and air traffic controllers. This study aims to carefully study and systematize the functions of these simulators,

demonstrating their significant contribution to the continuous improvement of aviation training methodology.

1.   Aviation Pilot Simulators:

1.1 Flight Dynamics Simulation:

A meticulous examination of the Indra pilot simulator begins with an exploration of its sophisticated flight dynamics simulation. This section delves into the intricacies of the physics models, unraveling how they authentically replicate the dynamic behavior of diverse aircraft. The analysis displays the simulator's prowess in providing pilots with a realistic and immersive training experience, offering insights into aerodynamics, weight distribution, and engine performance.

1.2 Cockpit Replication:

The reliability of cockpit (Figure 1) replication is featured as a key component of Indra's flight simulator. This section examines how accurately the instrument, control, and display replicas have been designed, highlighting the simulator's commitment to recreating the real cockpit environment. The investigation shows that this accuracy facilitates a seamless transition for pilots and fosters an immersive learning experience that bridges the gap between simulated and real flight scenarios.

Figure 1. *Cockpit of flight simulator*
(https://images.app.goo.gl/TpqWFe3xAn477JnJ6) (accessed February 25, 2024)

1.3 Visual System:

A hallmark of the Indra simulator is its high-quality visual system. This section navigates through the realism infused into the scenery, exploring how it extends

beyond aesthetic appeal to enhance situational awareness, navigation skills, and responses to dynamic environmental conditions. The narrative emphasizes the role of visual realism in creating a dynamic and challenging training environment that prepares pilots for the uncertainties of real-world aviation.

1.4 Motion System:

The integration of motion systems in the Indra pilot simulator adds an extra layer of authenticity to the training experience. This section assesses how simulated movements, encompassing pitch, roll, and yaw, contribute to the realism of the training environment. The examination delves into how Indra's motion system enhances muscle memory, providing pilots with a heightened sense of the physical aspects of flight during diverse simulated scenarios.

1.5 Procedural Training:

Procedural training forms the backbone of pilot development, and the Indra simulator excels in providing diverse and challenging scenarios. This section systematically analyzes the breadth and depth of procedural training, showcasing how these simulations prepare pilots for the complexities of real-world aviation. The focus is on fostering muscle memory and enhancing decision-making skills across a spectrum of operational scenarios, ensuring readiness for any challenge that may arise during flights.

1.6 Scenario Creation and Networking Capability:

Flexibility and collaboration are inherent strengths of the Indra pilot simulator, facilitated through scenario creation and networking capabilities. This section explores how instructors can tailor scenarios to meet specific training objectives, ensuring pilots are exposed to a wide range of challenges. The networking capability enables collaborative experiences among pilots, fostering adaptability and cooperation in diverse training environments. This exploration showcases how Indra's simulator technology adapts to the unique needs of pilot training, providing targeted and adaptive sessions that enhance overall preparedness.

2. Air Traffic Control Simulators:

2.1 Radar Simulation:

The examination extends into air traffic control, with a specific focus on the radar simulation (Figure 2) capabilities of the Indra simulator. This section analyzes the accuracy and intricacies of Indra's radar displays, emphasizing how these simulations prepare controllers for critical tasks such as vectoring, sequencing, and maintaining safe separation between aircraft. The scrutiny highlights the simulator's ability to replicate real-world radar scenarios, offering controllers a robust training ground for mastering airspace management.

Figure 2. *Radar simulator*
(https://images.app.goo.gl/dEcZnhbQ2PKKUo8C8) (accessed February 26, 2024)

2.2 Communication Systems:

Effective communication is the lifeblood of air traffic control, and the Indra simulator replicates communication systems with precision. This section delves into how these simulations prepare controllers for clear and concise communication with pilots. The focus is on developing the necessary communication skills to manage air traffic seamlessly, underscoring Indra's commitment to providing a comprehensive training environment.

2.3 Traffic Management:

Traffic management features in the Indra air traffic control simulator are designed to mirror real-world scenarios. This section comprehensively reviews how controllers can effectively manage multiple aircraft, practicing the handling of departures and arrivals and maintaining traffic flow to ensure safe separation. The examination highlights how these simulations prepare controllers for the complexities of real-world air traffic management, contributing to their ability to maintain order and safety in the skies.

2.4 Weather Simulation:

Realistic weather conditions are integrated into the Indra air traffic control simulator, providing controllers with a holistic training experience. This section explores how weather simulation prepares controllers for the challenges posed by various weather scenarios, including visibility issues, precipitation, and wind effects.

The study emphasizes the significance of weather simulation in enhancing controllers' ability to manage air traffic effectively in diverse conditions, contributing to their adaptability in fluctuating weather scenarios.

2.5 Emergency Scenarios and Scenario Customization:

Indra's air traffic control simulator, akin to its pilot counterpart, is well equipped to simulate emergency scenarios and abnormal events. This section systematically analyzes the training benefits of simulating emergencies for air traffic controllers, exploring how these simulations prepare controllers for crisis management, coordination with pilots, and the implementation of emergency response plans. The customization of scenarios allows for targeted training aligned with specific airport procedures, airspace configurations, or emergency response plans, displaying the adaptability and precision of Indra's simulator technology.

In conclusion, highlighting the pivotal role of aviation simulators in shaping and refining aviation professionals' skills is paramount. A thorough examination of the Indra simulator serves as a prime illustration of cutting-edge simulator technology. Through comprehensive training programs, aviation professionals gain a structured comprehension of essential functions that contribute to safer and more efficient operations within the aviation industry. As simulator technology progresses, the potential for enhanced training efficiency promises to bolster safety and efficiency in air travel worldwide.

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