

Realistic Air Traffic Control Communications: A Critical Component in Commercial Pilot Training

An ASTi Whitepaper



The greatest challenge facing the commercial aviation industry in the coming years is a significant shortfall in qualified pilots. Conventional methods of pilot training require many years of incremental advancement before a commercial pilot is considered qualified to occupy the First Officer's seat. With an estimated need for some 533,000 commercial pilots over the next 20 years¹, new training approaches and capabilities are required to meet demand.

The International Civil Aviation Organization (ICAO) develops international standards and recommended practices for its member states and global aviation organizations. For the past eight years, ICAO has addressed outdated commercial pilot training (CPL) training methods. The ICAO "Manual of Criteria for the Qualification of Flight Simulators, Doc 9625," articulates the importance of a more dynamic type of training known as Multi-crew Pilot License (MPL) training. MPL embraces the concept of competency-based training as opposed to hours-based training. The ICAO believes that the "training and licensing standards in use did not adequately account for the enormous advancements in technology and learning methodologies along with the increasing complexities of pilot work environments."

With the industry moving from the traditional hours-based method to MPL's outcome- or competency-based training approach, programs will begin to evaluate the pilot in a more in depth manner than the "standard" or "above standard" assessments prevalent today. Knowledge, skills and attitudes (KSA) are measured and the areas where the pilot needs reinforcement training identified. Students don't gain competency from hours; they get it from practicing in realistic situations where their skills are being measured, evaluated and improved in a commercial flight scenario. The benefits of an aptitude-testing program such as MPL include enhanced safety, lower overall training costs, and a higher training success rates.

The greater the degree in which training captures all of the realistic details of an actual commercial flight the better trained a pilot will be. Most Level D simulators are excellent when representing the physics of flight – for example, a jet's motion – and realistic-looking visuals (such as the sky and airport environment that the pilot sees outside the simulated windscreen). But pilots don't fly through empty skies, and aviation accidents don't usually happen without multiple outside factors playing a role. If the simulator doesn't put other planes on the runway, in the air, and/or in holding patterns waiting to land, then the trainee doesn't gain experience operating in the complex and dynamic real-life aviation ecosystem.

Many commercial flight simulators do not employ even limited ATC communications, leaving that function to the harried onboard instructor, who inevitably fails to reflect ATC reality in a timely manner. These simulation approaches often lack sufficient or detailed information about the world's numerous airports, airport frequencies and procedures, flight schedules, flight plans, and genuine weather conditions. Incorporating this real-world data into the simulator system involves a large amount of work for the flight simulator manufacturer or flight instructor who must populate the database, for example, one airport at a time.

¹ Boeing: "2014 Pilot & Technician Outlook"



A well-simulated commercial cockpit experience, according to ICAO, requires an ATC simulation that fully correlates to the visually simulated traffic. Simply put, this means that everything the pilot-in-training sees and hears must be realistic in relation to the simulated environment. ICAO also calls for flight phase-specific ATC frequency recognition, which means that all communications received by the pilot should be appropriate to the radio frequencies set in the cockpit.

The same ICAO specification calls for background chatter over the radio, thereby simulating the busy communications reality for which pilots must be prepared. The real world isn't an isolated, tranquil, silent vacuum, and so the training environment should not be empty of all of the potentially distracting, yet sometimes useful, airplane-to-ground and airplane-to-airplane communications from other participants in the aviation ecosystem.

At Advanced Simulation Technology inc. (ASTi), we agree with ICAO in the firm belief that realistic and dynamic simulated ATC communications are an integral part of this progressive MPL training which will lead to more effective and efficient commercial pilot training.

In tune with ICAO's forward-thinking and innovative views toward commercial pilot training, ASTi has developed SERA (Simulated Environment for Realistic ATC). SERA provides pilots with fully immersive flight training by incorporating all aspects of the external environment including ATC radio instruction, radio calls from other aircraft, and a corresponding visual representation of traffic in the simulation.

However, SERA is not limited to MPL standard training, it can also be employed to improve conventional CPL standard piloting skills through its ability to simulate any part of a commercial flight. With its automated ATC capabilities, SERA enhances the realism and efficacy of simulated commercial flight training while reducing the instructor's workload. Platform-agnostic, SERA supports commercial flight training anywhere from a simple desktop trainer all the way up to a full-flight Level D simulator.

SERA surrounds pilots-in-training both visually and aurally, synchronizing the two representations. Leveraging its artificial intelligence (AI), SERA directs representative air and ground traffic from every airport in the world automatically. As pilots-in-training fly, all of the ATC communication handoffs occur just like in real life, and all the traffic operates similar to a worldwide database. While piloting the immersive simulated aircraft, the pilot gets instructions, follows them, and then practices the appropriate verbal responses, requests, and reports. If the pilot makes a wrong move or replies with incorrect terminology or read-back, the advanced SERA AI prompts him or her toward the next appropriate piloting action.

ASTi developed SERA to meet the specifications in Section 9 of the upcoming ICAO 9625 v.4 standard governing ATC communications, but in many cases the pioneering, low-cost SERA environment exceeds the ICAO requirements.

One notable example is the ICAO requirement that the flight simulator simulate at least three commercial airports. SERA provides a real-world database of ATCs (including frequencies, functions and sectors), flights and all airports (including weather conditions and traffic), without the need for configuration. This information is already in the product. In the past, when entering a flight plan for simulated pilot training, the flight instructor would have to fill in manually all the controllers and facilities and all the navigational points and procedures (e.g., arrival, departures, and popular routes).



Thanks to SERA's database, the simulator manufacturer or training facility does not have to collect and incorporate this data into its simulator or training scenarios. SERA constructs and maintains a complete external environment along the simulated aircraft's route, automatically including all appropriate ATC functions such as Clearance Delivery, Ground, Local, Approach/Departure, and Center. With SERA, all of this airport information, including airport facility frequencies, airport procedures, traffic, gate, taxiway and runway locations and more, is available out of the box, relieving SERA customers of the slow and costly practice of having to build each airport into the system one at a time.

SERA serves as the network of ATCs along the flight path, providing appropriate procedures, altitudes and vectors for the trainee to fly and handing the trainee and/or multi-member flight crew successively off to each ATC facility along the route of flight, liberating the flight instructor from this all-encompassing role-playing responsibility. All of the facilities and boundaries are where they should be, providing instruction according to logistics, wind speed, and more. Along the way, authentic waypoints and navaids familiarize the trainee with the route or routes he or she might take during an actual flight. The SERA AI also issues ATC instructions to achieve the proper trajectory for climbs and descents among all the other interactions a professional pilot will encounter.

On the runway and in the air, SERA enables pilots-in-training to encounter the approximate scheduled volume of other aircraft along any route. With the trainee immersed in this realistic environment, SERA acts as a director of various elements and entities, making for the most realistic simulator experience on the market today. It synchronizes the ATC communications with representations of all aircraft traffic that a pilot would actually encounter on the ground and in the air, to prepare them for the real commercial flight experience. SERA also accurately and realistically simulates how all the different aircraft (small aircraft versus commercial jets) perform (how they ascend and how they approach, for example).

This realism also includes the chatter from other flight crews, which the trainee would overhear during an actual flight. They will listen in and gain valuable information such as the turbulence to expect and also gain practice in blocking certain chatter out. Because SERA sends its worldwide database information to the simulator's display system, even the position of the other airlines and gates at each airport are as they should be, orienting the pilot to what they will encounter and where.

Best-in-class speech-recognition technology from ASTi enables AI-driven ATCs to understand the trainee regardless of whether the trainee is using the precisely correct phraseology or not, and regardless of accent. This AI is incorporated not only in every ATC but also in every airplane that SERA directs in an environment, giving each of these entities realistic behavior. Vice versa, SERA employs best-in-class text-to-speech technology to respond intelligently to what the pilot is doing or not doing and offers corrective action based on any situation or conditions and is not a set response.

The ATC will speak in a manner that is consistent with that region (accent and phraseology) along the flight route. If the trainee's reply is not 100 percent precise for that region, the AI does not stop; it will make sense of the reply or prompt the trainee to reply correctly. SERA's ability to represent other pilots adds an additional dose of realism, something that flight instructors almost never find time to reproduce through role-playing. Again, this frees the flight instructor for one of the most important roles: that of evaluating the trainee in a realistic commercial flight scenario. An additional feature is that, at the end of any training exercise, an instructor can view the transcript from the training with SERA highlighting any areas where the trainee diverged from strict phraseology.



Thanks to the SERA database, flights plans from anywhere in the world can be simulated, enabling the student to practice coping with, for example, the differences between FAA and ICAO transition altitudes, procedure types (departures and arrivals), facility types (e.g., in Europe, radar and director), barometric pressure metrics (altimeter vs. QNH) and phraseology differences. SERA also allows the flight instructor to set ownship priority to eliminate blocking traffic and to maximize useful training time.

SERA is scalable to any training facility and can be integrated with any fixed-based training or full-motion flight simulator, including flat-screen desktop models and simulation cockpits that provide real knobs and buttons. Entirely manufacturer- and platform-agnostic, SERA can support any professional flight simulator. It is the ideal add-on training tool for any commercial flight simulator or commercial airline pilot training program. It supports all levels of ICAO-specified airplane flight simulation training devices (FSTDs) according to the MPL recommended standards, i.e., Level 1 through Level D.



Bibliography / References

“Manual of Criteria for the Qualification of Flight Simulators, Doc 9625,” International Civil Aviation Organization (ICAO)

“Guidance Material and Best Practices for MPL Implementation, 1st Edition,” International Air Transport Association, October 2011

Contact Us

For more information about ASTi ATC communication training solutions for commercial pilots, contact us at (703) 471-2104 or sera@asti-usa.com.

About SERA

SERA (Simulated Environment for Realistic ATC) is a pioneering, low-cost commercial pilot ATC communication training environment. The product provides pilots with fully immersive flight training by incorporating all aspects of the external environment including air traffic control (ATC) radio instruction, radio calls from other aircraft, and a corresponding visual representation of traffic in the simulation. SERA employs a real-world database of flights, airports and weather conditions, enabling pilots and copilots to learn valuable radio and operational skills in a lifelike environment. SERA constructs and maintains a complete external environment along the simulated aircraft's route, automatically including all appropriate ATC functions such as Clearance Delivery, Ground, Local, Approach/Departure, and Center. The solution also responds intelligently to what the trainee is or is not doing properly and communicates corrective action.

About ASTi

Since 1989, ASTi has been at the forefront of simulation innovation, delivering products that provide highly immersive synthetic sound effects, virtual radio communications, live radio-over-IP bridging, networked voice integration and interactive voice-enabled training solutions to enhance training and experimentation effectiveness across live, virtual, constructive and gaming domains.

