Volpe Center, U.S. Department of Transportation

GROUND

BY RICK DARBY

Technically sophisticated driver training simulators are upgrading

Imagine that you are a newly hired driver in an airport ground crew. You are operating a tow vehicle, busily engaged at rush hour in pushing back aircraft from the gate and towing others. As you shift from one job to another in response to radioed instructions, making a sharp turn, your windshield is suddenly filling up with a moving airplane, which will soon be occupying the same space that you are heading toward.

Fortunately, your inexperience will not put you, your vehicle or the airplane at risk, because the view through your windshield — although it is a close representation of the ramp area where you will be operating and the aircraft you will be sharing it with — is a simulation.

Simulators in which new hire ground vehicle drivers are trained, and experienced drivers receive recurrent training to keep their reflexes sharp, are one of the industry's answers to the problem of accidents involving ground vehicles.

Based on activity data developed by the International Air Transport Association, the Flight Safety Foundation Ground Accident Prevention program estimates that 27,000 ramp accidents and incidents — one per 1,000 departures — occur worldwide every year. "About 243,000 people are injured each year in these accidents and incidents; the injury rate is 9 per 1,000 departures," the Foundation says. Although not all of these accidents and injuries involve ground vehicles, many do.[1]

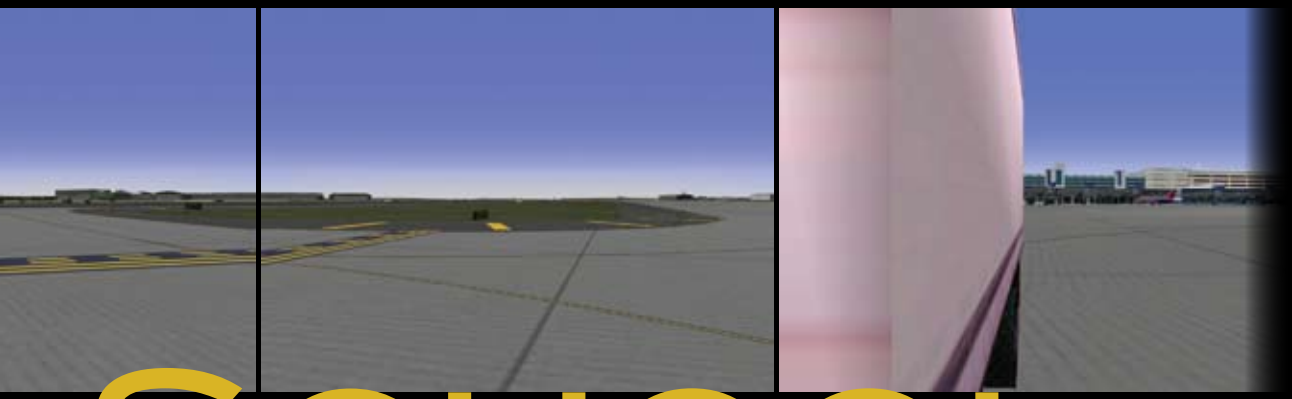
Norman Hogwood, co-director of Auckland, New Zealand–based Airside SimuDrive, the manufacturer of a simulator used by Air New Zealand, said, "Training for ground staff done the old fashioned way — that is, classroom, chalk-and-talk, and in the field with a buddy — means bad practices are copied, leading to staff injuries and aircraft damage."

David Bouwkamp, executive director business development for Arotech's FAAC Inc., which has been awarded a contract for a custom driver training simulator at Baltimore/Washington International Thurgood Marshall Airport (BWI), said that "ground time for training is vanishing, so simulation training is more important than ever before. With today's security concerns, the FAA [U.S. Federal Aviation Administration] has virtually eliminated this option for off-hours training; thus, simulation training has become critical."

The advantage of the driver training simulator is that it "provides a virtual environment where an individual can make mistakes without consequences," said Steve Heim, chief of the Department of Public Safety, Metropolitan Nashville (Tennessee, U.S.) Airport Authority (MNAA). "Mistakes made while driving on the actual airfield can have catastrophic results. The simulator also allows the drivers to become more confident and familiar with the airfield environment, and once a certain confidence level is reached, actual airfield driving begins."

"The simulator offers the 'teaching manager' complete versatility in deciding how he or she is going to conduct the training — by self-teaching sessions, or with instructor guidance supplemented by blackboard explanations, as a re-validation session, and so on," Hogwood said. "The immersive nature of the simulator ensures that students enjoy the experience and therefore more readily absorb the skills. And one of the main purposes of the simulator is to provide a more common standard of training for the myriad ramp driving tasks."

Adacel, based in Orlando, Florida, U.S., said that its Flightline Driving Simulator trains airport personnel to "operate in airport movement areas in changing environmental conditions; safely interact with moving and stationary aircraft; develop and maintain



Forward view (center) and rear views (left and right) in the cab of a driver training simulator.

SCHOOL

the skills of ground vehicle operators, with a payoff in safety.

situational awareness; understand and comply with airport signs and markings; learn airport-specific standard operating procedures; understand which movements and maneuvers require clearance, coordination and/or approval; coordinate with other ground vehicles and aircraft; [and] coordinate with [control tower] and ramp control personnel."

Pushback/tow vehicles are not the only devices for which initial and recurrent training can be conducted. Depending on the model and software ordered, one simulator might also serve as an avatar for baggage, aircraft rescue and fire fighting (ARFF), fueling, and catering vehicles. FAAC's multi-purpose simulator for BWI offers selectable functions, including towing, emergency response and even snow removal.

No overall figures are available on the numbers of driver training simulators in service, but their use appears to be growing. In 2007, Dallas/Fort Worth (Texas, U.S.) International Airport took delivery of eight new ground vehicle simulators.[2] gForce Technologies, which introduced deicing truck simulators in 2006, has added a pushback simulator that is in service with Northwest Airlines at Detroit Metropolitan Wayne County Airport.

"The more realistic the simulator, the better the suspension of disbelief," said Bouwkamp. "An accurate cab setting with physical controls, a realistic visual database including a visual replication of the airport, force-feedback steering and a 6-degree-of-freedom motion base are used in FAAC's airport driving simulator. The student feels the bumps and jars of pushing snow, running over an object, or leaving the runway and going onto unpaved terrain."

Even "desktop" simulators are sophisticated in their ability to replicate the real-world user experience through computer software. Some simulators use multiple screens to replicate forward and side vision and provide realistic sound effects, including mock radiotelephone communication. Raphael Juarez, of gForce Technologies, said, "The trainee interfaces with the 'pilot' during a 'pushback' by using a touch screen to walk through an appropriate script that each customer has requested. Although most of the verbiage is cross-company, some minor words and commands may be specific to each customer."

"The value of the simulator is in training or endorsing airside skills

rather than driver training for the vehicle," Hogwood said. "Nevertheless, a high degree of reality is achieved by the steering wheel being programmed through the use of an algorithm to calculate the necessary force feedback. The 3D [three-dimensional] sound logic parameters include distance factor, Doppler factor, rolloff factor, update frequency and a maximum of 32 channels. The sound channels are fully configurable in the lesson files, should variations be required."

Specifications for the Airside Driver Trainer, a new-product launch from Micro Nav of Bournemouth, England, are typical of driver training simulators. They include such features as "three-screen LCD [liquid crystal display] flat-panel display with high-quality images; picture-in-picture rear-view mirror; simulation of day, night, dusk, reduced visibility, adverse weather operations and emergencies; simulation of aircraft and other vehicles; [and] accurate 3D model and database of selected airports."

Simulators may or may not have a reproduction of the vehicle cab, but all have a steering wheel and brake and accelerator pedals. At the Nashville International Airport training facility, the simulator can be tweaked to change the time of day, level of sunlight, visibility distance, precipitation, surface conditions such as the degree of friction, and wind direction — the latter an important consideration for firefighters. It can also add foreign object debris.

The software can be customized to conform to the specific airport where the simulators are used, including the taxiway configuration and types of aircraft in operation there. "The simulation is virtually identical to the actual airport environment," said Heim.

Juarez emphasized that the gForce Technologies' driver training simulators are more than just fancy versions of computer games. "Computer gaming applications manufacturers typically employ one or two scientists, gaming 'content' managers and many artists," he said. "Their goal is to make applications that are fun and look good. Our work is focused on the physics behind the training applications in order to provide a truly realistic training environment and maximize what is called 'positive training transfer' and minimize 'negative training.' This can only be done by getting all the aspects of the simulated environment truly representative of the real world, such as how pushing back a narrowbody differs from pushing back a widebody. These are the math and physics that we work to get right."

The Nashville simulator, a model designated ADMS (Advanced Disaster Management Simulator)-DRIVE manufactured by Environmental Tectonics Corp. and housed in the cab of an ARFF vehicle, includes touch-screen panels that replicate vehicle-specific gauges and controls. The system is outfitted with a fully controllable high-reach extended turret and a forward-looking infrared camera, which work with the synthetic environment.[3]

At Nashville, new hires spend 16 to 24 hours in the simulator, becoming as familiar as possible with the airfield before actually operating a vehicle. Heim said, "Current Department of Public Safety officers are required to spend at least one hour per month in the simulator, for a minimum of 12 hours annually. The simulator is also used to train tenants, such as fixed-based operators and FAA staff, who operate vehicles on the ramp."

In a 2005 study, psychologists Daniel J. Hannon, Ph.D., and Stephanie G. Chase, Ph.D., of the Volpe National Transportation Systems Center of the U.S. Department of Transportation, assessed the potential for driving simulators in ground vehicle operator training.[4] They studied the use of an ADMS-DRIVE simulator in operation at the Minneapolis-St. Paul International Airport, focusing on validity — how closely the simulator resembles the real world; using simulation in training; and using simulation in recurrent training.

Their overall conclusions were that "driving simulators have potential benefits for ground vehicle operator training programs; simulators should be evaluated with respect to the training objectives; both new and experienced drivers can benefit from the use of a simulator; [and] simulators made from low-cost hardware may make them more accessible to airports around the country."

Steve Heim agrees. He said, "I cannot think of a safer and more productive way to train new people on airfield navigation and tower procedures than in the simulator. I also cannot think of a more efficient way to allow all current employees of MNAA that work in an airfield environment to maintain and sharpen their skills than in the simulator."

Notes

1. For example, see "Training Deficiency Leaves Catering Driver Unprepared to Resolve Disorientation," *Airport Operations* Volume 31 (March–April 2005), and "Tug Driver Fails to Yield Right of Way" on p. 59 of this issue of *AeroSafety World*.
2. "Runway Safety Call to Action in High Gear." *Air Safety Week*, Oct. 29, 2007.
3. For a YouTube video of an ARFF simulation using an ADMS, see <www.youtube.com/watch?v=hclY8DUuM4g>.
4. <www.faa.gov/airports_airtraffic/airports/regional_guidance/northwest_mountain/airports_news_events/annual_conference/2005/media/driving_simulator.ppt>.