Simulation Training Article Series

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TOP THREE WAYS TO GET THE MOST OUT OF A BUS SIMULATOR TRAINING PROGRAM

Using immersive simulators for Bus Operator training has some obvious benefits, they allow you to practice the mechanics of right and left-hand turns without risking safety or equipment, introduce foul-weather driving skills — even on sunny days, practice situational awareness without endangering the public, review disablement and emergency procedures, and much more. The sim can never 100% replace classroom and behind-the-wheel training, but it's a remarkable tool for quickly helping novice drivers learn basic operating skills and become road-safe, returning Operators recovering their skills, or experienced Operators correcting bad habits.

But not every agency is making the most of their bus simulator. The major mistake that Instructors often make with their sim training programs is focusing too much on the actual "driving." Because a traditional behind-the-wheel driving exercise typically takes about 20 minutes, they assume that the analogous simulation-based training exercise should also last 20 minutes. This is never the case.

There are also benefits to having a group of students involved in the training as opposed to one-on-one driving. A typical Student-to-Instructor ratio is 3:1. A group sim session could double or even triple that number. This is a cost-effective method that can be utilized on days that have manpower issues. Also, some students adapt to the simulator better than others. Having a group session with 6-9 students allows students who do not adapt well to still get the learning objectives by observing and then participating in the after-action review phase.

Simulation training is effective because of the three ways it doesn't have to be like real life:

1. the session doesn't have to take long
2. the trainee's bus doesn't have to be moving
3. the exercise doesn't have to be continuous

This doesn't just make for more efficient training. It also helps address concerns about the potential for motion discomfort (sometimes called "simulator sickness" or Simulator Adaptation Syndrome (SAS) that some trainees occasionally experience during simulator training scenarios. On the road, frequent stops and starts associated with driving in heavy traffic can make for a stuttering progress that can increase motion sickness. But in the sim, the opposite is true: frequent pausing can relieve or prevent any perceived discomfort.

Tip #1. Short Sessions

One of the huge advantages of using a simulator is that you don't have to waste time moving several tons of steel into position to complete a training exercise. The sim can drop the trainee directly into the exact moment and setting that they need to experience and practice. The learning objectives are covered immediately without a lot of additional driving around. Plus, the training experience is consistent and repeatable – no waiting for traffic or pedestrians to be in exactly the "right spot" to complete the required maneuver.

This allows for a sort of "round robin" with a group of trainees at the simulator. For example, while one is actually behind the wheel driving a right-hand clearance scenario, the others observe from the Instructor's view (which can also show different perspectives on the action, like an overhead view), giving them further insight into how that bus is negotiating the roadway. The driving portion of the exercise is often just 15 seconds or less. Then the trainee is out of the seat, rejoining the class at the Instructor's Station to review the exercise with the class. After review and corrective action, another trainee takes the wheel.

Tip #2. Static Scenarios

In many cases, hazard spotting and situational awareness scenarios require no actual simulated movement of the vehicle — and thus have an extremely low risk of generating potential discomfort. Such exercises can be either entirely static or involve the movement of the objects in the simulated

environment (cars and pedestrians navigating the roadway and sidewalks, for example) while the trainee's bus is stationary or running on "autopilot." This unique approach to training doesn't have a real

world equivalent, allowing trainees to hone critical observational and task management skills in a way that isn't repeatable or safe out on the roads.

Just seat the trainee in the simulator and prepare them for a hazard-spotting exercise. Describe their situation (e.g., pulling away from a transit stop) and ask them what they should be on the lookout for. Then, let the simulation roll, including something unexpected (e.g., a careless pedestrian darting out from between parked vehicles). Allow the trainee to be surprised by the situation. Then rewind the exercise and point out the warning signs (such as the pedestrian stepping off the curb and slipping between two vehicles). Other situations could be a passenger running for the bus, or the position of the bus when berthed at the curb. A bus that is angled inward from the front causes a dangerous situation on at least three levels (Passengers crossing in front, vehicles with an obstructed view passing on the left, and an increased blind spot in the rear when pulling out of the stop).

Tip #3. Non-Continuous Exercises

Many agencies use their simulators to model problem intersections or actual collisions in their training scenarios. This is a terrific use of a sim, with major safety benefits. But you can take it one step further by breaking the exercise into segments and then switching the trainee's perspective. For example, midway into that problem, when the trainee is making the same mistakes as the real-life Operator did, you can pause the exercise and switch to a bird's-eye view. Now the trainee can see what they and the real-life Operator potentially missed during the actual incident. How did the combination of speed, poor positioning, hazard awareness and/or sloppy scanning conspire to lay the groundwork for a collision? You can then continue the exercise or jump back in time and shift perspectives so that the trainee can learn from their initial mistakes. Allow the trainee to work through several different approaches and in the process develop a much more complete mental picture of how the bus moves through space and negotiates traffic. You could also create more training segments by creating versions of a problem intersection that can present different hazards at different times of the day. For instance, mid-day will have light vehicle and pedestrian traffic, while rush hour will have an increase of both, including bicycles and oversized vehicles. At night visibility is decreased. To train on the road in those situations you would have to visit the intersection at least three different times on multiple days. By creating three driving simulator scripts in which you add light traffic, then add trucks, bikes, pedestrians to create blind spots and hazards, and then reduce the environment to nighttime, you can quickly move through training exercises in less than an hour.

BUS DRIVING TRAINING: USING YOUR SIM TO RAPIDLY TEACH THE FUNDAMENTALS

The Massachusetts Bay Transportation Authority (MBTA) is the fifth-largest transit authority in the U.S. They've relied on simulation-based bus driving training since 2006. In recent years they've discovered that their sims are especially good for teaching driving fundamentals to new operators. According to expert instructor Derek Sullivan, "I find the most use [of the simulator] in teaching fundamentals to students."

MBTA's bus driving training program now begins with a compressed three-day basic "Vehicle Operations" unit. Using a combination of standard and custom simulation scenarios, they can teach generically good driving habits while preparing operators to navigate some challenges specific to MBTA routes and communities. By day three, operators who've never driven any sort of commercial vehicle are ready to safely operate a vehicle on Boston streets.

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The first day of MBTA's course is a standard classroom lecture with the entire group (usually around 30 students). Topics covered include policies, procedures, an introduction to the air brake system, blinker locations, an introduction to simulation training, and so on.

"Getting Them Comfortable in the Seat"

On the second day, MBTA breaks the 30 student class into two groups of 15. One group heads to the classroom, the other to the sims. (They'll later swap—small group sizes facilitate discussion and improve student engagement.)

The classroom group discusses turn techniques, setting the seat, setting mirrors, off-tracking, stopping distance, and explores the practical applications of the lecture material from day one.

The other group heads to the simulator. As Sullivan explains, "When you first get new students—especially [those who] don't have their Class-B licenses yet—they're very intimidated because they know they're gonna be driving a 43,000 pound, 40-foot vehicle, and they've never driven anything bigger than a moving truck." This would be a deal-breaker for many trainees if they had to go directly from sitting in class to sitting behind the wheel—even in the relative safety of a closed training course. "[Working in the sim] breaks the tension a little bit."

Sullivan begins with proper seat and mirror setup. He then starts his Blindspot Awareness Script. This is an immersive exercise in proper scanning and movement. "I made kind of a game," he explains, an approach that helps students "get comfortable in the seat."

"I put [random] objects in the blindspot around the bus, so when the operator finally gets their seat set and sets the mirrors, I ask the operator: Please identify all of the hazards. A lot of times new operators don't move around like they're supposed to. We teach them to 'rock & roll' in the seat. So I coach them, why don't you lean forward a little bit and tell me what you see? ... [T]o get them used to moving around in the seat to see around the blind spots of the bus."

Using Standard and Custom Simulation Scripts

From there, trainees begin working through a series of standard simulation scripts. These cover off-tracking, stopping distance, and similar route tasks. Each script was designed by FAAC (a leading provider of simulation solutions) and is based on feedback from countless transit agencies and trainers. These "road-tested" scripts have demonstrated their effectiveness at helping new operators integrate the rules and procedures covered in the lecture.

Following these basics, MBTA moves into a series of custom scripts. These were all created with FAAC's drag-n-drop scenario-authoring tool, **Scenario ToolBox** (STB). This tool makes it easy for MBTA trainers to quickly develop new immersive scripts based on actual local incidents—down to the weather, visibility, and traffic conditions at the time of the accident.

For example, one script Sullivan relies on is based on an intersection that has been the site of several pedestrian strikes. "Operators tend to sweep that turn," Sullivan says. A reenactment of one such incident is included in the lecture portion of the unit. "We try to just train them to make that nice square turn, so the blind spot moves." During the lecture portion, trainees see reenactments of the accident (including aerial views of the intersection and how a bus passes through it). Then, in simulation, they personally experience that same intersection from the operator's point of view. Using the simulation to tie together the intellectual understanding of how to handle such an intersection and the visceral experience of being in it has proven to be a remarkably efficient way to fully engage new operators. This reliably prepares them to move to on-the-streets behind-the-wheel training on the third day of their program.

BUS OPERATOR TRAINING FOR A DIVERSE ARRAY OF FLEET VEHICLES

As we've discussed in the past, one key to the effectiveness of public transport simulation training is "presence"—i.e., the trainee's convincing subjective experience of being in an actual vehicle. As Rob Raheb (an internationally published author and expert in simulation and driver training) has noted:

"The more realistic the simulation is, the more 'buy-in' from the student. "When a simulator's Operator's cab is designed using a vehicle's specification, rather than just incorporating a generic dash panel, it gives the trainee the opportunity to develop experience and muscle memory with the location and function of the actual operating controls. Because the components are in this consistent location newly hired operators can avoid confusion when transition to the real vehicle."

Every element of a FAAC simulator bends toward creating that immersive training experience. This ranges from how a vehicle feels as it traverses different terrain with our cab only integrated motion system, what the operator sees with our crisp 4k graphics and even how passengers behave with our new Transit Response passenger interaction simulator. All of this can be customized to a specific fleet of

vehicles—including dash layout, OEM gauges, and other authentic components integrated with the hardware so that their behavior matches the real-life experience.

But what if your transit agency uses several different types of vehicles? Are you stuck getting a generic panel that approximates the common features of all of them? Or filling a warehouse with different sims to match your different buses?

Not with FAAC. Drawing on our experience designing and fabricating flexible and modular training simulators for the military, we've brought swappable panels to public transport simulation training.

One Public Transport Simulation System, Many Vehicles

As fleets blend their OEMs, a single transit training sim can now be used introduce Operators to a variety of vehicle controls they might encounter on the job: New Flyers, Proterra, ENC, Gillig, 40-foot transit buses, articulated buses, and more. The simulator cab is constructed in a way that facilitates easy panel swaps through quick disconnects. The improves the trainers experience by simplifying the process to 2 connection points – total.

For example, FAAC fabricated a swappable simulator for NICE (Nassau Inter-County Express) Bus, headquartered in New York. This is a large transit agency, with 600 operators working on more than 300 pieces of equipment. That equipment ranges from articulated buses and 40-foot transit buses to a variety of cut-away paratransit vehicles.

"We have a constant training and renewal process," explains Todd Chever, Director of Safety and Training for NICE. "Getting Operators, for everybody, is a constant battle. So it's got a lot of benefits, having a single simulator that accurately represents [our entire fleet]. Ours is primarily used as a New Flyer Bus—one of the primary vehicles we have here. But it's fully adaptable to the variety of Orion, as well as our various cut-away vehicles. The mirrors are adaptable to anything you need."

More importantly, many transit agencies are discovering that investing in a sim with swappable panels means that their simulators can grow with their agency. As they add new vehicles to their fleet (such as EV buses), new panels can be added to their collection. Furthermore, FAAC is dedicated to developing components and software that allow for continued upgrades as new technology emerges so that your training programs are never out of date. No longer will a transit simulator be "frozen in time" upon delivery.

TRANSIT RESPONSE AND TRAINING FOR UNPREDICTABLE PASSENGER INTERACTIONS

Staff retention problems continue to grow for almost every transit agency in the United States and Canada. According to the latest report from the American Public Transportation Association, more than 90% of all agencies surveyed faced transit operator shortages. And 84% of those agencies reported that staffing shortages were preventing them from providing full service.

Driving a bus has always been a challenging job. That's only been made more so by worsening economic conditions, which have made it hard for public services to keep pace with inflation. But this report also found indications that those working within transit cite pay and scheduling as their biggest concerns. While some Transit Operators who leave the field may be doing so because they are struggling with increasingly unpredictable "passenger interaction" challenges.

The issue of passenger interactions and the risk they pose to Bus Operators is such a serious issue that it has been addressed in last year's Bi-partisan Infrastructure Law. The law requires Section 5307 recipients serving large urban areas to develop and add to the Agency Safety Plan (ASP) a risk reduction

program or transit operations to improve safety by reducing the number and rates of accidents, injuries, and assaults on transit workers, based on data submitted to the National Transit Database.

It further requires transit agencies to update their comprehensive safety training programs to include maintenance personnel and require de-escalation training for all covered employees, including operations, maintenance, and personnel directly responsible for safety.

In recent years, Metro Detroit's Suburban Mobility Authority for Regional Transportation (SMART) has focused more intensely on supporting Operators and preparing them for passenger interactions. SMART has correspondingly had less difficulty maintaining staffing levels when compared to other transit agencies in Southeast Michigan.

As SMART Training and Development Coordinator Lafeyette Kelly previously noted in the past, "The day-to-day problems of passengers' [interactions and] conflict resolution are the big ticket items for us. What gives [transit Operators] the most trouble, their most pressing concern, is if someone is upset … I'm on this bus by myself; what can I do?"

SMART worked with FAAC to create a simulation-based immersive interaction/communication tool for their training program. This tool allows drivers to "rehearse" a wide range of passenger interactions, from simple fare-related issues to de-escalating arguments, addressing medical emergencies, and more.

As Kelly explained, "We hope that, with the use of these different [branching simulation] scenarios, [that will] give [drivers] a . . . kind of tool belt they can use. 'Oh, I saw this before. When I see a person do this, I should say this.'"

Transit Response Trains Drivers to Cope with Challenging Passenger Interactions

FAAC has now released a version of that tool that any transit agency can use: **Transit Response**. This is the most advanced version of FAAC's scenario-based immersive passenger interaction training tool and the only solution of its kind on the market today.

Based on similar "stress inoculation" communication/situational awareness tools FAAC has built for first responders and the military, Transit Response is integrated directly into the transit driving simulator system. This gives veteran Operators and trainees alike an opportunity to develop a balanced approach, applying their communication and passenger interaction skills while operating a large transit vehicle, and following your agency's established policies and procedures.

Jason Francisco is FAAC's Transit Business Manager. He has worked closely with agencies deploying Transit Response as part of their programs.

"Having this passenger interaction training built right into the driving sim," he notes, "that's proven to be its most powerful feature. Because, whatever the situation, there's a natural human inclination to stand up and 'take charge.' But that's the one thing a transit Operator cannot do. In Transit Response you are

addressing whatever it is—a medical emergency, a fight, an agitated passenger, an accident—right from the Operator's seat: assessing the situation, getting information from passengers or over the radio, relaying information, giving instructions, safely controlling the vehicle. All from that seat, with your eyes on the road, keeping a clear mind and making sure you cover every important item—Did I radio in? Did I secure the bus? Did I apply the parking brake? —while in the fray."

Transit Response can be added to any FAAC Bus Simulator package. It comes standard with both a complete library of ready-to-run branching scenarios and the platform, tools, and support you need to make your own scenarios to match unique factors at play in your community. Contact FAAC's expert simulation training team whenever you're ready to learn more.

THREE TRAINING TIPS TO ENSURE BEB SUCCESS

Transit agencies are rightly concerned about deploying electric vehicles (EVs). According to Jason Francisco, Transportation Business Manager at FAAC Incorporated:

"Everyone knows that an EV bus has a lot more torque than a conventional diesel bus, on top of a very different feel to the braking and deceleration. They know that creating a smooth and comfortable ride for the passenger will need to be top of mind for bus drivers, even experienced ones. But no one knows what that's going to look like in actual practice, or how vehicle range is going to be affected by an individual's current skills and driving habits.

Your immersive transit simulator is a potent tool for ensuring the success of your agency's electric bus deployment. First and foremost, like any simulation-based training, it lets you safely train for all conditions at any time, and prepare for even the lowest-frequency, high-impact events. But more importantly in the case of electric bus driver training, your sim makes it easier to help new and veteran drivers build the EV-specific skills they need well in advance of vehicle deployment.

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Tip #1: Train Prior to EV Deployment

The earlier training begins, the better. As Jason explains, "You go a long way toward laying the groundwork for success if you can give your Operators the experience of driving a zero-emission bus prior to actual deployment"—or even before your EVs are delivered.

Agencies that already use FAAC simulation technology can begin virtual "behind-the-wheel" training now before they've even settled on a specific model of zero-emission bus. FAAC's standard transit simulator software package now includes vehicle dynamic models for both generic and manufacturer-specific EV buses (e.g., New Flyer, Proterra, etc.)

These models will enable a FAAC simulator to replicate the operating dynamics of an EV bus. More importantly, each vehicle dynamics model is customizable. You can modify any of them to precisely match the handling and responsiveness of the electric vehicles you'll be receiving for your fleet.

"Every manufacture is different," Jason notes. "And, on top of that, the regenerative braking system on most electric buses is a tunable item from the OEMs. When we visited Proterra, they took us out onto a closed course in an EV bus. When the driver took his foot off the accelerator pedal and the regen began applying, it felt like braking. I'm told that on that particular bus, an experienced bus Operator could practically drive the entire course without actually touching the brake pedal."

That said, every electric bus has a lot of low-end torque, compared to a diesel bus. "Smooth on and smooth off are key skills. This means applying the accelerator pedal smoothly to avoid a sudden jerk that rattles the passengers, as well as coming off the accelerator smoothly in a way that anticipates the topography of the roadway and leverages the regen-breaking effect. And you really aren't going to learn these skills until you have a chance to feel it for yourself and work on that muscle memory."

Tip #2: Leverage Your Transit Simulator as a Planning Tool

Your transit simulator likely includes tools that let you track bus driver performance during a simulated drive. At the very least, assessment tools allow the instructor to "score" a drive, track progress, and flag potential problem areas.

But automated assessment tools don't have to be just a scorecard. A more advanced tool, like FAAC's VITALS (the Virtual Instructor/Trainee Assessment and Learning System), can be used to develop custom training plans for each trainee.

VITALS is an interactive assessment tool that creates a complete record of the trainee's performance. It now includes a **Regen Dashboard** for electric buses. This is a unique training feature that graphs and maps how the trainee's driving behavior impacts EV bus performance and range on a scenario-by-scenario basis. For example, two bus drivers might struggle with EV bus range. A simple "scorecard"

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assessment system might give them both the same final score. But that won't help them identify the potentially small habits that are taking a big bite out of their battery regeneration levels that ultimately affect the vehicle's overall range.

Meanwhile, a tool like VITALS helps trainers identify and address the unique set of habits and behaviors that are keeping that Operator from hitting their battery regen goals.

"We recently attended a conference session in DC," Jason says, "and the speaker mentioned that, for many transit systems, their EV buses will need to be able to last three drivers on a single charge. That's a big ask. It takes a lot of driving skills to maintain the battery state of charge necessary to operate an EV all day. Prior to EV bus deployment, you can use a tool like VITALS to track each Operator's energy usage and battery regeneration during simulated drives. You get a head start on tracking down those habits and behaviors that were fine when driving a conventional bus, but don't translate very well to an EV bus."

Tip #3: Prepare for Emergency on an Electric Bus

With any new technology comes new risks—many of which are hard to anticipate. Electric buses are no exception.

"For example," Jason says, "take thermal events—a.k.a., fires. Current bus Operators are familiar with the existing early warnings for a bus fire, and what to do in that situation. These practices are going to change with the introduction of EV buses. Some of the warning indicators and alarms are different, in terms of their sights and sounds and the way the vehicle behaves. Preventative maintenance and pre-shift checklists that help to ensure safety will also need to change. As a result, Operator response, and those of community-based emergency personnel, will most certainly be different as well."

Of course, not every issue that arises is a five-alarm emergency. An EV bus may have issues with a pantograph sticking, low tire pressure, or unexpected changes in the battery's state of charge. FAAC transit simulators can emulate every kind of vehicle fault—from a flat tire to erroneous gauge readings—as well as maintenance issues, fires, collisions, inclement weather, situations involving emergency responders, and more. Specific scenarios and content can be built around such emergencies, or they can be added into other scenarios by the instructor on the fly, helping bus Operators "stay on their toes" and develop situational awareness and emergency response readiness.

ELECTRIC BUS SIMULATORS WITH INTEGRATED ASSESSMENT TOOLS IMPROVE TRANSIT WORKFORCE DEVELOPMENT

The federal government is going all-in on a battery-powered future for mass transit—but transit agencies themselves aren't so sure. Last year Vice President Harris announced a collection of new federal initiatives to cut carbon emissions from buses and trucks. These initiatives include "$1.1 billion in new funding to help cities and states purchase electric buses for their public transit systems, and $17 million for school districts to purchase electric school buses. ... Of the $108 billion in new funding for public transportation... electrification is a top priority."

But many agencies have found themselves on a bumpy road as they've transitioned to electric buses. Some operators immediately take to driving an ebus, appreciating the difference in torque, as well as the quieter and smoother ride. But many operators struggle to adjust to the handling (e.g., "it kind of feel[s] like the whole bus is waddling") and managing range/battery state-of-charge.

The transition to ebus means a fundamental shift in how we approach costs. With diesel buses, tuning and maintenance are the primary ways to control fuel costs. Ebus is different. Here, the driver is a much

bigger factor. A well-trained operator gets further on the same charge. That can translate to less charging during the day, shorter charging periods at night, and even a less extensive build-out of charging infrastructure.

That's why the 2021 Bipartisan Infrastructure Bill's $5 billion expansion of the Department of Transportation's Low- and No-Emission Transit Vehicle Program includes allowances for operator training and other workforce development.

Electric Bus Simulators and Workforce Development

Immersive simulation training is widely considered the best tool currently available for transit workforce development—especially as they transition to electric buses. Electric bus simulators don't just give operators a platform for becoming accustomed to the interaction of terrain, weather, outdoor temperature, and range/battery state of charge. Simulator training also has a proven track record for high trainee throughput and demonstrated efficacy in quickly and effectively introducing drivers with little previous experience to safely operating a large commercial motor vehicle (CMV).

A key element for ensuring that your immersive bus simulator will help transit operators adapt to electric buses is an integrated interactive assessment and learning tool. FAAC's immersive electric bus simulators include VITALS (the Virtual Instructor/Trainee Assessment & Learning System). The VITALS Dashboard is a graphical display with colored zones that can be seen in real-time from the Instructor Station during a live scenario or once a scenario is completed. More than simply a "score sheet," VITALS acts as an interactive playbook for the instructor. It helps them develop custom curricula for each trainee based on recognized best practices, agency policy, and that trainee's specific strengths and areas of improvement.

The VITAL Element in Electric Bus Operator Training

With FAAC simulation solutions every immersive transit training scenario has been "vitalized": the system automatically tracks key operator behaviors (i.e., acceleration, braking, approaches to intersections, curb kicks, traffic violations, etc.) without any extra effort from the trainer.

But both standard and custom scenarios can also be "fully vitalized" by the trainer. This means they can define zones along the scenario route where specific driver actions are expected. Fully vitalizing a

scenario gives trainers the ability to track trainee progress with unprecedented detail, zeroing in on problem areas while highlighting strengths.

For electric bus applications, VITALS includes the **VITALS Regen Dashboard** for electric buses. This unique training feature graphs and maps how the trainee's acceleration and braking behavior affect the electric bus's battery state of charge throughout the driving scenario. After every training drive, the operator has immediate visual feedback, helping them dial in new driving habits to make the most of electric bus range. No other training system on the market gives trainees, instructors, and agencies this level of insight into the interaction between operator behavior, driving conditions, route layout, and vehicle performance.

USING SIMULATION TRAINING TECHNOLOGY TO EMBRACE THE "SAFE SYSTEM APPROACH"

U.S. traffic fatalities have climbed throughout the pandemic, despite 30 years of steady declines. Early this year the National Highway Traffic Safety Administration (NHTSA) announced that in just the first nine months of 2021 traffic fatalities increased 12%. That's the largest such jump in fatalities since 1975. In total, 31,720 people died in traffic accidents between January and September 2021–the highest total since 2006.

This increase comes on top of the fact that, according to the World Health Organization, US roads were already 50% more deadly than those in similar nations.

Transportation Secretary Pete Buttigieg recently noted that these exceedingly high roadway fatality rates are treated "as normal, sort of the cost of doing business. Even through a pandemic that led to considerably less driving, we continue to see more danger on our roads. ... We cannot tolerate the continuing crisis of roadway deaths in America. These deaths are preventable."

A Holistic New Approach to Highway Safety

According to the Department of Transportation, "Safety is an ethical imperative of the designers and owners of the transportation system." With this in mind, they've formally shifted to a "Safe System Approach" to highway safety. This is a "holistic view of the road system that first anticipates human mistakes and secondly keeps impact energy on the human body at tolerable levels."

Secretary Buttigieg described this as "a bold, comprehensive plan" that brings together driver training, civil engineering, automotive engineering, and first responders. "We will work with every level of government and industry to deliver results because every driver, passenger, and pedestrian should be certain that they're going to arrive at their destination safely, every time."

The Safe System Approach has already proven beneficial elsewhere. Adopting a Safe System Approach in Sweden and the Netherlands corresponded to a 50% reduction in traffic fatalities over two decades.

Minimizing Deadliness Instead of Eliminating Accidents

A Safe System Approach assumes that there will be accidents, and simply aims to decrease the deadliness of those accidents. It does this by addressing five elements that contribute to making mistakes less deadly:

1. safer road users: Minimizing the risk to all road users: pedestrians, cyclists, drivers, mass transit riders, etc.
2. safer vehicles: Embracing designs and regulations that minimize collision severity.
3. safer speeds: Slower speeds reduce impact forces, improve visibility, and give drivers time to take evasive action.
4. safer roads: Incorporate passive systems that reduce speeds, reduce forces in the case of an impact, etc.
5. improved post-crash care: Get responders to the scene of accidents faster and ensure they can take decisive action when they arrive.

Communities and organizations are already embracing the Safe System Approach with simulation technology. Immersive simulators play a key role in research to improve roadway design and better understand road user behavior. Some communities are using funds from the American Rescue Plan, Bipartisan Infrastructure Investment, and Jobs Act to buy scenario-based simulation training technology that improves EMT driving and increases their readiness for emergency situations. And, of course, immersive simulation already plays a key role for automakers exploring human-machine interaction as they design the next generation of control systems and ADAS.

As Secretary Buttigieg noted, "People make mistakes. But human mistakes don't always have to be lethal. In a well-designed system, safety measures make sure that human fallibility does not lead to human fatalities.

USING SIMULATION TO PREPARE OPERATORS FOR PASSENGER INTERACTIONS AND DE-ESCALATIONS

Fights on the bus. Verbal harassment and assault. A bus window smashed with a hurled rock.

These aren't new problems, nor unique to Detroit and other major urban hubs. But the tight labor market and high-stress/high-stakes nature of operating public transit in a COVID context has helped the rest of the world sit up and take notice: transit operators have a lot to deal with.

Given the complexity of the job (even prior to the pandemic), truly qualified operators have long been in short supply. As Russell Nikiforuk, Manager for Operator and Technical Training at Coast Mountain Bus Company, explained in 2019:

"You have to manage not only the technical aspects and those skills of operating the vehicle itself, but it's also doing it while having to deal with members of the public, which can present their own

set of challenges. Someone may have really strong technical . . . [but] run into some challenges here and there in the sense of how they're handling themselves in relation to dealing with customers in different situations."

Metro Detroit's Suburban Mobility Authority for Regional Transportation (SMART) has committed themselves to making sure their operators have the tools they need to meet this challenge head on. They've teamed up with FAAC (an organization noted for advancements in simulation training technology for mass transit and public safety workers) to create the first fully-immersive situational awareness training system integrated with a public transport simulation system.

According to Beth Gibbons, Manager of Marketing Communications and Education at SMART, the goal is to "incorporate customer service into the driving experience."

Public Transport Simulation Training Technology to Improve Customer Service

As SMART Training and Development Coordinator Lafeyette Kelly explains, "the day to day problems of passengers, conflict resolution, [these] are the big ticket items for us. What gives [transit operators] the most trouble, their most concern, is if someone is upset … I'm on this bus by myself; what can I do? We hope that, with the use of these different [branching simulation] scenarios, [that will] give them a . . . kind of tool belt they can use. 'Oh, I saw this before. When I see a person do this, I should say this.'"

SMART's Beth Gibbons fully expects to see this kind of fully integrated public transport simulation training to become the norm in the near future. "In talking with other transit agencies," she notes, "it really is amazing how similar our training experiences are. My sense is that everyone is trying to change their focus. You can hire anybody to drive a bus. But the public part of it, quality service is more important now than before. If they have a pleasant experience when they board the bus and throughout their trip, all the other things that might delay a trip or create other issues, kind of minimize.

"BUYING THE BUS IS THE EASY PART" EV/ZEB BUS DRIVER TRAINING CHALLENGE

Given the realities of climate change and energy production, we are moving to a ZEB (zero-emissions bus) world sooner than later and not looking back. As more agencies explore what it will take to transition their fleet, they're beginning to appreciate that, as one European transit agency recently put it, "buying the [zero-emissions] bus is the easy part."

Among the most challenging parts? Developing appropriate bus driver training and retraining programs. As we recently explored, early adopters have quickly discovered how pernicious "range anxiety" can become in a transit agency that's shifted to ZEBs. Likewise, some operators will be put off by how "stiff" a ZEB can feel. The higher-torque electric motors often feel like they're "all-or-nothing," rather than smoothly accelerating (and coasting) like a conventional internal-combustion drive train. And EV regenerative braking systems can prove tricky: stiff at some speeds, loose at others. Many operators report feeling like they're perpetually on the verge of tossing passengers around like dice in a cup.

Most ZEB OEMs offer an initial day or two of behind-the-wheel training for your operators. Such trainings are a good start—especially when they include a train-the-trainer element. They will definitely help drivers work past their initial hesitation and acclimate to the EV torque and regenerative braking.

But a day of training behind the wheel is a start, not a training program.

Limitations of Single-Day EV/ZEB Bus Driver Training

Consider range optimization. Operator acceleration and braking behavior have a huge impact on battery state-of-charge. Estimates vary by vehicle and other factors, but most experts say that you can increase range by up to 25% simply by taking care to optimize acceleration and braking. Learning the fundamentals of managing acceleration and braking is well within the scope of a single-day OEM training.

But as operators settle into their new EV routine, they'll find that passenger loads, HVAC set-points, and road conditions can all have a surprising impact on vehicle range. Slippery road conditions, for example, can cause more than a 25% loss in energy recovered through regenerative braking unless drivers properly adjust their technique.

In freezing temperatures, operators may discover that the acceleration and braking strategies that assured them the range to cover their routes are no longer performing as expected. Sub-freezing temperatures prevent batteries from capturing and storing energy as efficiently during charging. And a ZEB doesn't benefit from the "waste heat" produced by an internal combustion engine. Running the heater off of the same battery pack that drives the bus can reduce range by 25% in winter conditions. In fact, in some situations, the draw for heating the bus and defrosting windows can be higher than that for running the driveline.

Using Sims for EV/ZEB Bus Driver Training

Over the last several years, FAAC has worked tirelessly to stay on the forefront of simulation-based EV/ZEB bus driver training. In 2018, FAAC furnished New Flyer with a fully immersive, full-cab EV bus driver training simulator for their world-class New Flyer Vehicle Innovation Center (VIC) in Alabama.

In the intervening years, FAAC has worked to build relationships with ZEB OEMs in order to offer a path for customers to incorporate their specific EV bus dynamics into FAAC's vehicle modeling software. These relationships with ZEB OEMs also mean that FAAC is capable of building new or possibly refurbishing sim cabs with genuine ZEB OEM controls and gauges—or creating swappable panels so that a single sim platform can match any of the buses in your fleet as you transition.

USING BUS SIMULATORS IN COLLISION MITIGATION: A THREE-STEP PROCESS

Your bus simulator is an ideal tool for addressing a bus-on-bus, fixed-object, or pedestrian-contact collision/near-miss. But some agencies find themselves having trouble "getting traction" with their corrective action. Often, this comes down to having an inefficient or inconsistent strategy for addressing the root causes of those collisions and near misses. By adopting a "List/Fix/Follow-Up" approach, you can be sure you're building your collision mitigation strategy on a solid foundation:

1. **LIST** possible factors contributing to the collision

2. **"FIX"** the problem, minimizing or eliminating those factors

3. **FOLLOW-UP** to be sure the fix worked

It's important to bear in mind that even if the post-collision verdict is a non-preventable contact, that doesn't mean there isn't an opportunity to improve forward planning and recognize the problem before it's a problem. You may even discover that the issue isn't in the operator at all. It's entirely possible that some element of your agency's standard operating procedure (SOP) fails to properly account for a road reality your operators face. Consistently using List/Fix/Follow-Up makes it much easier to pinpoint and address such shortfalls.

LIST THE FACTORS

Very few collisions arise from a single factor. Working from the written collision report, begin by listing primary and contributing factors that led to the incident. For example, if the collision report indicates that the point of contact between a private vehicle and the bus was on the bus's right side, it's safe to assume that failing to cover the right led to the collision. The bus operator inadvertently gave that driver the sense that they were "welcome" to move up alongside the bus and put themselves in harm's way.

But "failing to cover the right" can have many causes: was the operator distracted by a customer service issue? Was speed a contributing factor? Incorrect right-side mirror positioning or use? Incorrect seat setup?

Armed with your list, review the video from the bus camera system and interview the operator, to be sure you understand both what happened and what the operator perceived was going on (which are often very different). This step may add items to your list, or cross items off.

Finally, perform a simulator-based performance review. This is somewhat better than doing an on-board review, as the safety of the sim allows you to focus entirely on the operator, without worrying about public safety. We've found that being able to give the operator your undivided attention during this review is extremely valuable; you may note small lapses in SOP that are having an outsized impact on operator performance. You may also be able to rule out certain factors at this stage.

FIX THE PROBLEMS

Now that you understand the problem, corrective action is relatively straightforward. Your bus simulator likely came with a library of scenarios that can address any fundamental skills issue or lapse in SOP. Higher quality sims will also include a set of open software tools so you can craft your own simulation scenario, customized to the collision conditions from the specific incident and branching from there.

The initial bus simulation session may take a bit longer, as it often needs to include longer training and debriefing portions, so the trainer can "tune" the scenario to the collision factors that need attention. But this is a good investment of time: subsequent simulation training and retraining sessions can be very short, reviewing the critical skill, procedure, or policy multiple times in just a few minutes.

FOLLOW-UP

This is the step that most often falls by the wayside. Do several on-board performance reviews, as well as regular short follow-up drives or re-trainings in the simulator. Has the troublesome behavior crept back in? Have other problem factors cropped up? This is a job that tests the patience, endurance, and focus of even the best drivers. Everyone benefits from having the opportunity to step back and objectively see how they're doing.

GETTING RESULTS WITH PUBLIC TRANSPORT SIMULATION

Public transport simulation technology isn't a solution by itself—it's a tool for extending and supercharging your entire training program. But like any powerful, complex (and expensive!) tool, an organization cannot get the most out of it if no one takes "ownership" of that tool. Billy Cameron has spent his career in transit. Over the past 21 years with the Massachusetts Bay Transportation Authority (MBTA, the fifth-largest transit authority in the U.S.), he's worked as a vehicle operator and instructor and now serves as MBTA's Superintendent of Bus Training.

Cameron has used immersive full-cab simulators in his MBTA's training programs since 2006, training thousands of employees on their public transport simulation technology.

In light of all of his experience, Cameron firmly believes that the most important element of a public transport simulation training program isn't any specific technological component: It's your training team. Building a solid training team from the start is the key to getting results from your public transport simulation program.

Step 1. Gather Your Simulation Team

Find a group of people in your organization (regardless of their current role) who connect with the simulation technology on some level. Preferably, do this early in your purchase process, so their insights can inform your sim buying decisions.

"You have to identify which instructor or instructors are going to have the talent to maintain and develop the curriculum," Cameron notes. It's important to keep in mind that this is a matter of technical acumen and curiosity, not prior training, experience, or current job title. Cameron points out that when he first began using simulator technology, he had a high school diploma and no more advanced training, certification, or computer science/programming experience.

"You don't have to have a degree from Microsoft University to use this piece of equipment," he notes. You just need to be someone who "isn't intimidated by technology … [or] afraid to break it."

That said, age can be a factor. "I'll be honest," Cameron explains, "In my experience, [you often have] a digital divide: You have older instructors who don't have smartphones, don't use email, and the technology is a little intimidating to them. But [you] also have a younger generation … who grew up on technology…playing video games, having a [mobile] phone, working on computers, and things like that."

Step 2. Instructor Buy-In

First and foremost, no training initiative (simulation-based or otherwise) can succeed if the instructors don't believe in it. Sometimes, a lack of buy-in comes back to that digital divide, with some trainers being uncomfortable with the idea of new technology.

But also, even with a very technologically adept training staff, if they have the sense that something new is "being shoved down their throat," they will resist—even if it's a solution that they might otherwise embrace.

"You want to go in with a positive attitude," Cameron says, "and [a willingness] to introduce new ideas… and new ways to train our operators with the simulator."

This doesn't just work to ensure that your program—as planned—gains traction. It also greatly increases the likelihood that you'll get the most out of that sim because the instructors will be constantly looking at ways to push the program further.

Step 3. Develop a Succession Plan

Very few agencies set up a proper succession plan. They make one person "the expert," and then either fail to encourage (or actively discourage) that person from training up a support team.

"If I hit the lottery Megabucks and left the organization, they'd be stuck, or have to start all over with another instructor." While that lottery scenario is unlikely, losing your instructor is not, Cameron

says. "People do get promoted, people retire, people get sick, so you definitely want to have a team of instructors...who are able to keep the program running continuously."

Having a team of trainers with a clear "line of succession" ensures that a series of unfortunate events doesn't leave a perfectly good simulator gathering dust.

For more insights into how to get results with public transport simulation technology, check out FAAC's recent webinar and free downloadable ebook: "Engagement Training for Mass Transit.

USING SIMULATOR TRAINING TECHNOLOGY TO SAFELY DEVELOP MASTERY

Advances in simulator training technology have made it possible to overcome the roadblocks that regularly prevent adults from truly mastering new and complex skills.

In 1980 Stuart and Hubert Dreyfus—working at the University of California, Berkeley and supported by the U.S. Air Force—formulated the "Dreyfus Model" of Adult Skills Acquisition. They sought to analyze and systematize our understanding of how adults acquire new skills (in contrast to the chaotic and varied learning styles that come naturally to children). As Dreyfus & Dreyfus explained in their introduction:

"Anyone who wishes to acquire a new skill is immediately faced with two options. He can, like a baby, pick it up by imitation and floundering trial-and-error, or he can seek the aid of an instructor or instructional manual. The latter approach is far more efficient, and in the case of dangerous activities, such as aircraft piloting, essential."

While the "instructional" approach is clearly more efficient (and safer), can it lead to true mastery? An otherwise uneducated person learns their native language through the baby's strategy of "floundering trial-and-error"—and almost certainly ends up with a mastery of that language's nuances that even the most educated adult learner struggles to match.

Why Adults Struggle with Mastery

Initially, Dreyfus & Dreyfus identified five developmental stages for adult skills learning: **novice**, **competence**, **proficiency**, **expertise**, and **mastery**. But they included an important note:

"[A]ccording to our model, there is no higher level of mental capacity than **expertise**, [but] the expert is capable of experiencing moments of intense absorption in his work ["**mastery**"], during which his performance transcends even its usual high level. ... this masterful performance only takes place when the expert, who no longer needs principles, can cease to pay conscious attention to his performance and can let all the mental energy previously used in monitoring his performance go into producing almost instantaneously the appropriate perspective and its associated action."

From the Dreyfus perspective, "as the student becomes skilled, he depends less on abstract principles and more on concrete [real world] experience. ... [S]kill in its minimal form is produced by following abstract formal rules, but that only experiences with concrete cases can account for high levels of performance."

This highlights the advantage of the child's "floundering trial-and-error," which can't be reproduced in traditional instruction: repeated concrete real-world experiences.

Using Simulator Training Technology to Create Real-World Experience

Simulator training technology allows us to bridge the gap between traditional adult instruction and the naturalistic trial-and-error learning process. In the simulator, the trainee can repeatedly experience a safe virtual environment, one based on real-world conditions—even modeled after actual real-world incidents and accidents.

As Rob Raheb explained in a recent webinar, "With simulation, judgment can now be developed through experience, but under controlled situations. When unsafe behavior is met with consequences, the unsafe behavior is eradicated. The best part of simulation training is that unsafe behavior can be met with a consequence every time."

Raheb is an expert in simulation and driver training and has written and spoken extensively on driver training and the psychology of driving. He's quick to remind organizations, "It's not just about purchasing a simulator ... How do I use this tool effectively? That's what it really comes down to."

FAAC trainers regularly work with customers to ensure that the system is integrated into their program, meshing with their policies, procedures, and curriculum to create the best possible environment for a student to develop mastery.

STARTING OUT RIGHT WITH SIMULATION TRAINING TECHNOLOGY

No piece of simulation training technology can "fix" a broken training program—or replace one entirely. But the right sim can be a powerful tool for improving any training program. The key to a successful rollout is to start with a clear idea of what "success" looks like.

Establishing a Focused Goal for your Simulation Training Technology

The most successful simulation-enhanced training programs start with a single, discrete focus and goal:

*A specific **group** receives focused **training** to meet a well-defined **goal.***

Broadly speaking, there are four ways transit agencies use their simulation training technology:

Recertification — Cyclical refresher training for existing drivers and senior operators. This group of operators has a solid grasp of the fundamentals but could benefit from some practice, or need a safe environment in which to adjust to aging joints, slowing reaction times, and changes in vision.

Remedial — Corrective training following a collision. This group includes both good operators who seem to be struggling and "problem" operators (those with chronic small issues: clipping mirrors, hard braking, etc.)

Requalification — Requalifying experienced operators who are returning after a prolonged absence. This group includes both those with experience in mass transit, and commercial motor vehicle (CMV) operators making the shift to mass transit. They know large vehicle operations broadly but may be a little rusty or lack some of the situational awareness/customer service skills mass transit demands.

Basic Training — Teaching fundamentals. This group is always new hires. They have no prior experience with operating a mass transit or CMV.

Although a good sim can be used for all of these, it's important to introduce your simulator to your program by choosing just one. Identify the group you'll work with, and set a concrete, measurable goal with a timeline. For example, "Reduce mirror strikes by X percent over the next calendar year" or "Increase training throughput to Y operators per Z weeks before the end of 2023."

Selecting a Sim to Meet Initial and Long-Term Goals

While any quality simulator can improve a training program, your initial vision of "success" should inform your purchasing decision. For example, it is common for agencies who are looking to evolve their corrective action program to explore using simulation training technology. If this is your initial use, then you're going to want a bus simulator that makes it easy to program your own scripted training scenarios, since the best way to rehabilitate a struggling driver is to precisely model those factors, unique to your routes or community, which are troubling them.

Other agencies purchase their first sim primarily looking to increase throughput and reduce wash-out rates in new hire training. Training operators quicker is an excellent use of a simulator because it allows for both quick repeats of specific tasks and eliminates all risks to equipment and the public. This is especially good for working on some of the fundamentals that most often trip up and frustrate new operators: pivot point comprehension, backing, issues around the proper front/side clearances, lane placement, and 'covering' the right.

Programmable scripted scenarios are still important in this situation—but you don't want to program every basic skill. Look for a sim that comes with a full library of "essentials."

Ongoing Technical Support

No piece of simulator training technology can be a "universal bandage" for an underperforming training program. But a simulator can be a remarkably powerful tool for any training program— provided it's properly integrated into a program that also includes seat time in the actual vehicle. If you don't have the in-house expertise to build these types of training programs, then you should be

looking for a simulator vendor who does.

FAAC is notable for their long history of advancing simulation training technology systems and solutions for mass transit. More than twenty years ago FAAC developed the world's first immersive bus transit training simulator. In 2015 this simulator was named among the top 100 safety improvements of the last 150 years by the APTA. But even more important than that long history of building custom simulators is their long track record of working closely with every customer to integrate those sims into their existing training regimen.

SIMULATOR TRAINING TIP: USE SPATIALLY ACCURATE CABS TO ENSURE TRAINING TRANSFER

We already know that simulator training is <u>excellent for introducing novice operators to large commercial and transit vehicles.</u> But is every driving simulator equally suited to training basic skills?

In 2010 researchers took a detailed look at the training of 100 large vehicle operators. (This work was ultimately published in 2011 in the journal Accident Analysis & Prevention as "On the Training and Testing of Entry-level Commercial Motor Vehicle Drivers.") These authors noted that:

"[Commercial and large vehicle] simulators and scenarios that create a sense of presence and connection for the driver are likely to be more effective as compared to less immersive simulations and scenarios."

The authors defined "presence" as "a subjective sense of being in one environment while being physically located in another," noting that "presence is connected with greater levels of performance and enhanced learning in simulator-based training. Presence in simulations is dependent on the responsiveness and emotional connection of the user to the simulated task."

In the interest of maximizing this sense of "presence," the researchers used a FAAC TT-2000 full cab driving simulator. They opted for this full-cab simulator specifically because it could be configured to precisely match the exact vehicles that participants would be using for the road and range behind-the-wheel (BTW) testing portions of the study. They found that this "appears to have beneficial effects on drivers' abilities … [D]rivers trained with the majority of their driving occurring in [a full-cab] simulator possess skills equivalent to those trained in an actual vehicle."

Ensuring "Presence" in Simulator Training

Presence goes beyond simple "immersive" simulation. A commercial VR gaming headset, a smartphone mounted in a cardboard holder—even an old View-Master toy or 3D glasses—will give an "immersive" experience. But this rarely translates into durable skills. Lots of people enjoy the latest VR battlefield video games; playing them does not transform them into competent soldiers.

Many trainers who specialize in simulation training have found that the best way to assure consistent skills transfer from the driving sim to BTW is to select a simulator that closely resembles the look and feel of your fleet vehicles.

Rob Raheb is an expert in simulation and driver training, as well as an internationally published author and speaker on driver training and the psychology of driving. In his experience, "the more realistic the simulation is the more 'buy in' from the student. When a simulator is built more to a vehicle specification rather than a generic dash panel it gives the student additional time with muscle memory development."

This is why FAAC specializes in custom simulators that precisely match specific vehicles—including dash layout, OEM gauges, and other authentic components. Because many fleets are diverse, FAAC goes one step further: Drawing on their experience building military driving simulation platforms, they offer simulators with swappable panels. A single sim can be used to train operators on every vehicle type they might encounter on the job: New Flyers, Orions, 40-foot transit buses, articulated buses, smaller cut-away vehicles, and more.

SIMULATION TRAINING TECHNOLOGY: THREE QUESTIONS TO ASK BEFORE BUYING A BUS SIM

Investing in simulation training technology is serious business. For many agencies, this is a "once-in-a-lifetime" purchase—especially if stakeholders cannot easily see a clear return on the investment. A poor start can leave a training program floundering for years.

Asking these three questions before you begin weighing your options is an important step in building a solid foundation for the future growth of your existing training program:

What's the Purpose?—What's the primary purpose for buying the simulator now?

What Are Our Goal(s)?—What are your immediate and long-term goals?

Who is the Simulation Team?—Who inside your organization is going to "own" this simulation training technology solution?

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Starting your search with these questions puts you significantly ahead of the game. You won't just choose the right simulation training technology at the outset—you'll have a solid foundation for integrating the training technology into your program from day one and evolving that program to meet the unforeseeable demands of the future.

Determine the Purpose

What's our primary immediate purpose for buying simulation training technology? Who are we training and **what** are we teaching them?

As we've discussed in the past in "Starting Out Right with Simulation Training Technology", there are four primary uses of simulation training:

- **Recertification** – Periodic refresher training for existing drivers and senior operators
- **Remedial** – Corrective training after a collision and for operators with chronic issues (e.g., clipping mirrors, hard braking, etc.)
- **Requalification** – Requalifying experienced transit and CMV operators coming to mass transit operation after a prolonged absence
- **New Hire Training** — Introducing the fundamentals to those totally new to operating mass transit vehicles

Any high-quality sim can be used for all of these. But different features are more important in different situations. For example, we know that in order to ensure skills transfer for new hires ("Simulator Training Tip: Use Accurate Non-virtual Custom Cabs to Ensure Training Transfer"), it may be important to opt for an accurate non-virtual vehicle cab. (Research on skills transfer to date has largely been done on such full-cab sims, not VR headsets or desktop programs.)

Define the Goals

What's our immediate goal for simulator training? What are our "stretch goals" once we get that first program rolling?

A good goal can be tracked unambiguously over a given period. Examples:

- Reducing the total number of claims
- Reducing the total dollar amount in claims
- Reducing the total number of collisions
- Reducing the severity of collisions
- Eliminating a specific collision type
- Increasing training throughput
- Reducing trainee wash-out

What's important is to set a concrete goal with a clear timeline. Build specific "check-in" points to see if you're on track. For example, if the initial goal is "Reduce mirror strikes by X percent over the next calendar year," you'll want to check on your progress at least quarterly. Be willing to tweak the training program or investigate further if you don't see the numbers you expect.

Create the Simulation Training Team

Who among us "owns" this solution?

As we discussed in a previous blog post ("Getting Results with Public Transport Simulation"), your simulation team is the most important aspect of your program. Whenever possible, having that team's input as you begin comparing simulation training technology platforms will help ensure a smooth roll-out and an early return on investment. FAAC has programs in place to support your team in integrating your new and existing programs with simulation technology solutions.

A good simulation team has multiple members (don't put this all on one set of shoulders!) who are gathered from throughout your organization (if necessary) and are curious and enthusiastic about exploring how simulation can serve your agency.

FAAC has helped countless training teams bridge the gap between their existing training program and one enhanced by simulation training. Contact us now for links to free resources or to discuss how to help your program grow to meet a hard-to-predict future.

USING PUBLIC TRANSPORT SIMULATION TRAINING TO ADDRESS POST-COVID TRANSIT OPERATOR SHORTAGE
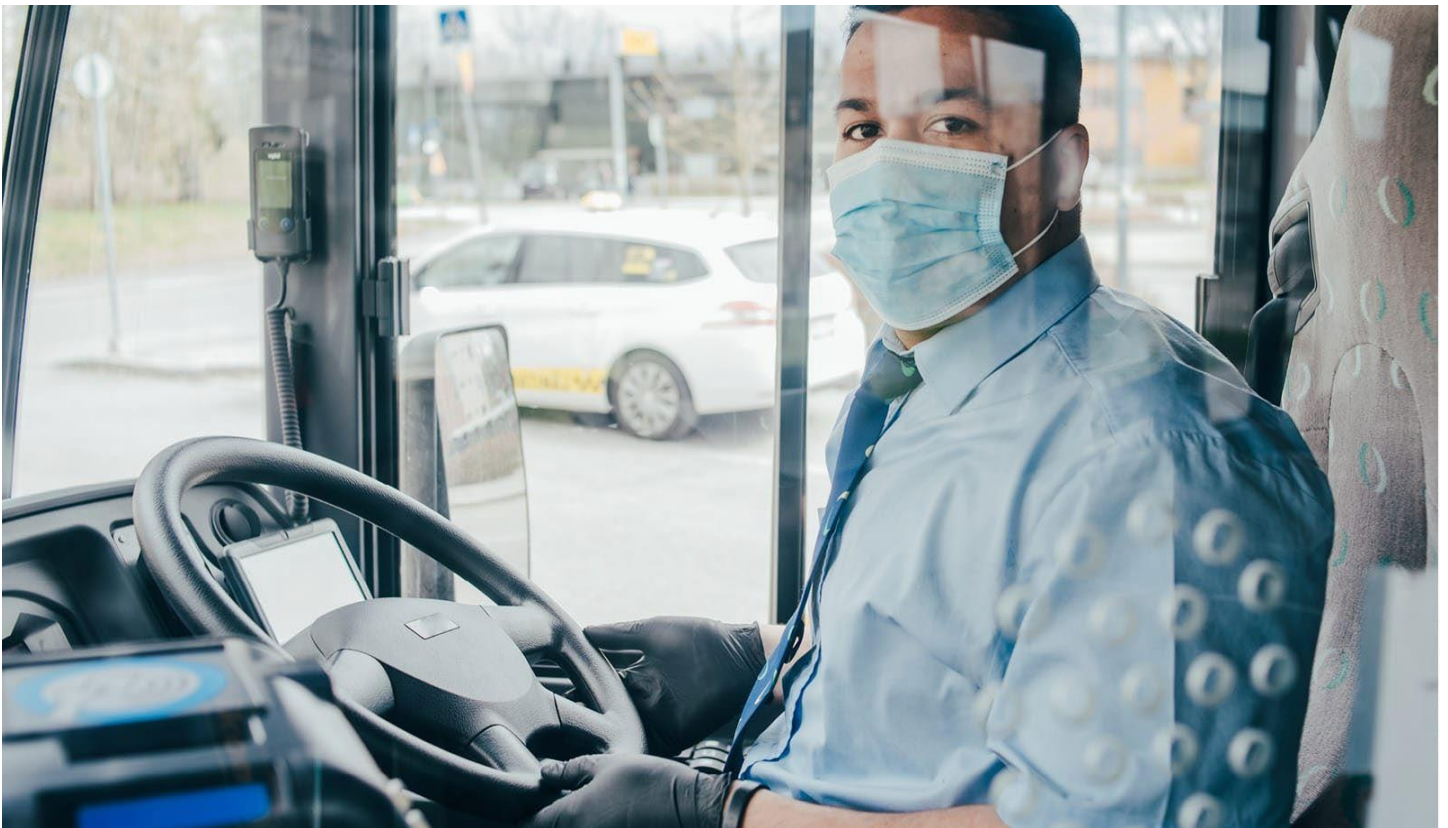
Even before COVID, there was a nationwide shortage of mass transit operators. More than a year of disruption has only made it worse.

While we're hopefully rounding the bend on COVID, experts now largely agree that herd immunity is not in the immediate future. This is our moment to re-assess how we get things done and make those processes more robust. Public transport simulation training offers an opportunity to fill empty seats behind the wheel today and build a better system for maintaining a robust pipeline of operators in the future.

COVID Made Our Nationwide Shortages of Mass Transit Operators Worse

Several Maine districts have had to cancel school because they don't have enough drivers to get students to reopened classrooms. According to Maine Department of Education spokesperson Kelli Deveaux, "School districts across Maine have been using bonuses, offered paid training programs, and even worked with other employment and training organizations to try and entice people to join our bus driver workforce."

Nonetheless, their staffing issues persist—and Maine is far from alone. Communities in Massachusetts, Pennsylvania, and Wisconsin are having similar issues. In Ohio, some areas are only able to muster around two-thirds of the drivers they need. In a recent nationwide survey, 78% of respondents reported a bus driver shortage in their area. Around 81% believed it had gotten worse under COVID.

In mass transit, the story has been the same: Paul Davis is the general manager and chief executive officer of West Virginia's Tri-State Transit Authority. They have openings for transit operators that are getting no applicants at all.

"We have tried everything we can think of to get people to apply but have had little success. Bus drivers here basically make around $25 an hour, and we still can't get qualified people to apply"— despite the fact that this starting wage is 50% to 70% above that of a school bus driver.

COVID and Mass Transit

Part of the issue is that mass transit has attracted an older workforce, especially in recent years. These workers are more susceptible to COVID and more likely to be hospitalized with it.

Nationwide, the average transit operator is 52 years old. It isn't uncommon for up to half of the bus drivers to be 60+ or otherwise immune-compromised in many areas. As a result, many took early retirement rather than risk their health.

And for those with large vehicle experience, COVID drove demand for their skills in less-risky sectors with less arduous training as Sandy Lake (director of the Georgia Center of Innovation for Logistics) told the Atlanta Journal-Constitution in April, "Anybody who can deliver a package is in demand. ... Driver pay is going up."

Addressing Shortfalls through Public Transport Simulation Training

Public transport simulation training systems can make transit training more engaging and less arduous and increase training throughout without exposing class participants to the risk of COVID and other infectious diseases.

The Massachusetts Bay Transportation Authority (MBTA) is the fifth-largest transit authority in the U.S. They've relied on public transport simulation training since 2006. It's proven especially useful in quickly onboarding trainees. MBTA's bus driving training program now begins with a compressed three-day basic "Vehicle Operations" unit that uses a combination of standard and custom simulation scenarios to teach generically good driving habits while preparing operators to navigate some MBTA-specific challenges. By day three, operators who've never driven any commercial vehicle are ready to operate a vehicle on Boston streets safely.

They've also found success using their simulator's built-in "Instructor Viewer Mode" to increase COVID-safety without compromising training quality. With these technologies and tools—included as standard with their sim—they can run smaller group sessions. These aren't only safer in terms of exposure to COVID or other infectious diseases; they also allow everyone to be more fully engaged in the training.

EV BUS DRIVER TRAINING TO COMBAT "RANGE ANXIETY"

It's no wonder that coach companies and transit agencies are investing millions in new electric buses. In many regions, shifting to EV mass transit will be a game changer. And mass transit, with its emphasis on low-speed stop-and-go driving, is perfect for EV buses relying on regenerative braking and turning that traditional fuel-waster into a valuable source of energy. But are you investing enough in bus driver training alongside your investments in your fleet? This isn't just about helping drivers more quickly get a feel for EV handling and the responsiveness of regenerative braking systems. It's also about addressing unforeseen new stresses that come with new vehicle types. As is the case with private EVs, mass transit agencies and coachlines are increasingly seeing drivers beset by "range anxiety."

What is EV Bus "Range Anxiety"

In 2019 Route One defined "range anxiety" as "a new and very real phenomenon where drivers start to worry that the bus might run out of charge while they are on the route. They may radio the office in a panic, worrying about what to do, and this in turn can be transmitted to passengers who will start to feel anxious too."

According to Tony Oldham, Operations Director for CT4N, "Our drivers had an initial induction course on how to drive the buses, but it wasn't until they were a few weeks into the job that we started seeing the issues with range anxiety." As the operators settle into driving EV buses and the initial excitement mellows, they discover how varied the range can be, and it dawns on them that "You can't just run out with a can of diesel to rescue them."

Simulation-based EV Bus Driver Training

Ironically, when piloting an EV, properly trained mass transit operators actually have more control over their "fuel" consumption than in a diesel vehicle. Operators can boost range up to 20% by driving style alone. Variations in weather and terrain—-and knowing how to adapt to them—can also play a major role.

In 2018 FAAC was selected to furnish the New Flyer Vehicle Innovation Center with the world's first immersive bus driver training simulator modeling the New Flyers Xcelsior® CHARGE electric bus. According to New Flyer:

"The simulator's main objective is to support driver training specific to regenerative braking, an energy-saving technique drivers can employ in conserving battery-electric energy. Operating techniques and skills gained from the simulator will improve bus operation, including extended range, reduced energy consumption, and less brake system maintenance."

According to Wayne Joseph (President of New Flyer of America), "A skilled driver of an electric bus can have as much as a 15% impact on the energy use, so critical skills training of this type can dramatically reduce Transit Authorities operating costs."

Whenever possible, FAAC sims incorporate full-scale original equipment manufacturer (OEM) components. This offers two key advantages. First and foremost, it helps ensure that skills transfer is as seamless as possible. But almost more importantly, by creating an operator environment as similar as possible to reality, operators are able to "rehearse" the experience of operating an EV bus in advance, acclimate to what is new in a safe environment, and work through their anxieties.

BUS DRIVER TRAINING THAT INCREASES AWARENESS, DECREASES ACCIDENTS
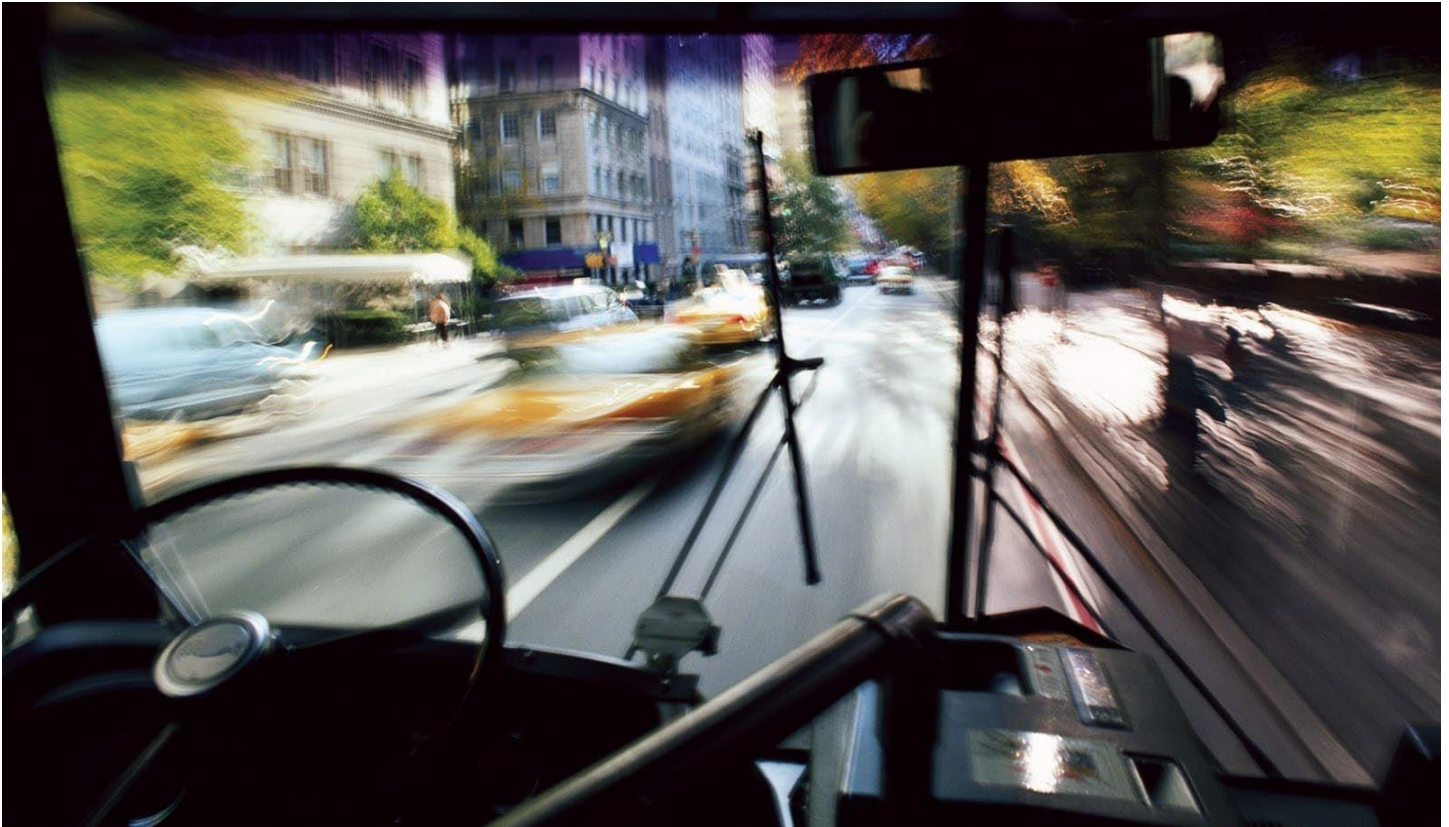
Bus training programs that rely on traditional closed-course driving can struggle to truly test operators' situational and hazard awareness. Fortunately, these are areas where "permission to fail" simulation training is known to shine.

Simulation Supported Bus Driver Training in Champaign-Urbana

Champaign-Urbana Mass Transit District (MTD) in Illinois has been using FAAC bus driver training simulators for roughly a decade. They integrated the simulator into their training program over a two-year period, starting in 2010. Jim Dhom (MTD's safety and training director) told Passenger Transport in 2013, "When I started in this position in 2004, people in their first year of employment accounted for 35 percent of our total accidents. In 2012, that number went down to 10 percent." Total accidents likewise declined 26 percent for that year. Dhom attributed these reductions to their shift to simulation-supported bus driver training.

"When they make a mistake, we can play it back for them," he notes, pinpointing the roots of that mistake, and highlighting better strategies. "You can't do that in a bus."

Simulation-based Bus Driver Training: A Two-Part Solution

FAAC worked with MTD to replicate geographic and traffic features unique to the local service area. These included narrow campus streets, a tangle of downtown one-way roads, and flocks of pedestrians and bicyclists. But the sim isn't a magic pill. It's one half of an equation that is equal parts technology and human:

"You need staff that are comfortable with technology and have some computer expertise. Dedicated staff people are needed to fully utilize the technology." Technologically adept trainers, Dhom points out, can create their own scripted exercises ("scenarios") to supplement the large library of exercises provided by FAAC.

For example, MTD procedure requires that trainees work through six bus preparation exercises before getting behind the wheel of an actual vehicle. Their trainees now use the sim to learn and practice pre-trip inspections and mirror setup, familiarize themselves with the bus controls, and drill on pivot points and turn radiuses. Later in the program, advanced simulation scenarios demand trainees to respond to mechanical problems, adjust to extreme weather, and even handle customer service issues.

Enhancing Hazard Awareness

Waco Transit (in Texas) has had a similar experience with their FAAC sim, which they've been using since late 2017. As Waco Transit general manager Allen Hunter assured the Waco Herald-Tribune in 2018:

"Everyone we hire is a well-equipped driver. This simulator does not teach you how to drive, but it teaches you to be more aware by raising your hazard awareness. With this tool, we can change weather conditions, daylight, the transaction of the vehicle, take away the breaks, or simulate a tire blowout. ... it can test all your senses ... in a controlled environment."

Waco Transit driver JT Colter agrees. "It is not 100 percent what you are doing out on the road," he explained, "but it is definitely as real as you are going to get. It is a good educational tool because it makes you a lot more aware of what's going on."

EXAMINING BUS SIMULATOR RETURN-ON-INVESTMENT: A TOOL, NOT A TOY

When communities consider investing in bus simulator training, they want to be sure they'll see a return on the investment (ROI). Rob Raheb is a simulation training expert who's worked closely with transit agencies for nearly a decade. According to Raheb, it's natural for any organization to say, "We just spent three-quarters of a million dollars—we want to know, 'What's the ROI on this? Do we just have a toy, or do we have a tool?'"

Independent studies have repeatedly found that driving and bus simulation training can be a tremendously powerful tool with a startlingly high ROI. Last year the National Association of Insurance Commissioners released a report (The Impact of Motor Vehicle Simulator Training on Law Enforcement Officer Driving Behavior: Empirical Evidence from Accident Frequency and Severity) that included a brief analysis of the effectiveness and ROI of simulation-based training programs. In one case, they found that law enforcement agencies in Georgia saw a 12 to 1 return on their simulation training investment over 15 years. In other words, for each dollar spent on simulation training, they saved $12.

What's more, that ROI was calculated based solely on savings in expenses associated with automobile liability and property damage losses. As they noted in the report, "motor vehicle accidents involving LEOs [law enforcement officers] also result in substantial workers' compensation-related costs to counties and municipalities, and these are not captured in our analysis."

Given that the simulation training program in question costs roughly $400,000 per year, this ROI translates to an annual savings of more than $4 million.

Bus Simulator ROI

While such an enormous ROI seems unbelievable, Rob Raheb isn't surprised. During his time with NYC EMS, Raheb instituted a simulation training program to address intersection "t-bone" collisions: "An intersection collision, at minimum, costs a million dollars—the damage, the injuries, the fatalities."

Raheb's training program reduced such collisions by 50%—at an estimated savings of over $200 million annually in a single year.

"Even if you only ever prevented one of these accidents in all the years you used your sim; you'd still be saving money—not to mention saving lives."

And such results aren't limited to public safety. Using a FAAC bus simulator, the Champaign-Urbana Mass Transit District recorded a 70% decrease in new-hire accidents in their first year of simulation-based training. Similarly, the Central Florida Regional Transportation Authority ("LYNX") happily found a 68% overall reduction in accidents after adopting a simulation-based training program.

ROI isn't limited to savings from accidents averted. When Miami-Dade County (Florida) adopted a simulation-based public safety training program, they saw a dramatic drop in litigation. As a result, bonding agencies chose to raise the region's bond rating, making it easier to borrow money for municipal projects and expand the regional economy.

BUS SIMULATOR VS. "BENDING METAL BEHIND THE WHEEL": HELPING OPERATORS ACCLIMATE TO VEHICLE DYNAMICS
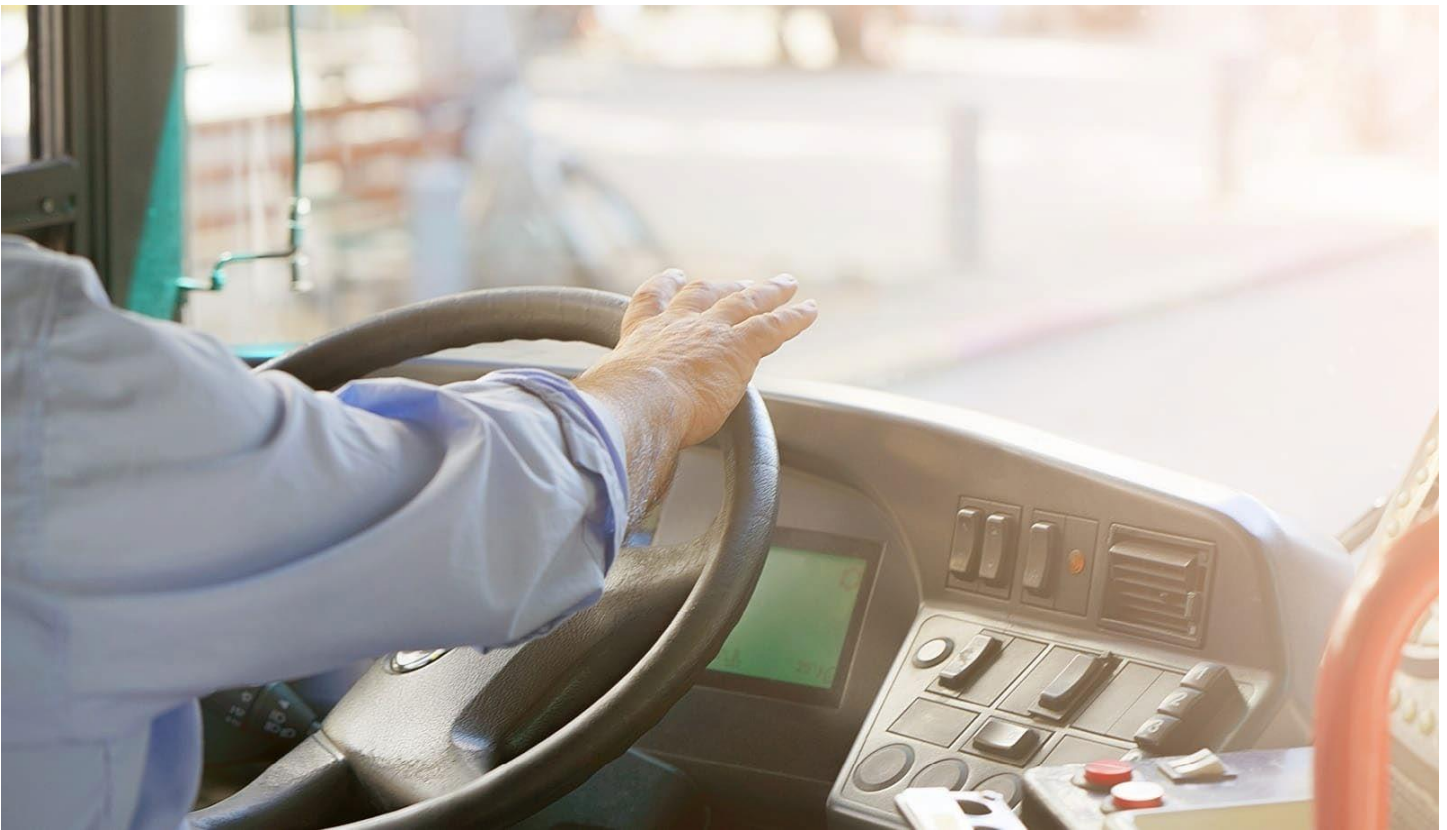
Even when transit agencies go out of their way to seek out applicants with prior large/commercial motor vehicle (CMV) experience, they find that those trainees can struggle to learn how to maintain proper right rear clearance, "walk" the bus around the corner, and continue to properly scan the area and mirrors. Increasingly, they are finding bus simulators are the superior tool for helping those new operators make the transition from other CMVs to large transit vehicles.

As Leeya Sutter, Human Resources Director for Southeast Michigan's Suburban Mobility Authority for Regional Transportation (SMART) said, "We get operators who are doing this as a second career. Even though they have large vehicle experience, they face challenges. We get truck drivers or school bus drivers accustomed to the semi-truck or school bus, where the wheels are still in front of you, like a traditional car. With our buses, the front wheels are in the back of [the operator].

So, it's hard for them to get acclimated because even though it is still a big commercial vehicle, you have to turn differently."

Russell Nikiforuk, Manager for Operator and Technical Training at Coast Mountain Bus Company sees this as well: "We have the same kind of issues in the sense that with our equipment the front wheels are typically behind the operator. So, there can be times when we look to use the simulator. Say, for example, if an individual is having trouble making turns or adjusting to those certain things. We can get them into the simulator and say, 'Before we go out on the road, let's try this and test it out.'"

Benefits Beyond Initial Acclimation and Training

The Coast Mountain Bus Company is far from alone in addressing transit vehicle acclimation problems using their bus simulator. For years, METRO magazine (a leading trade publication for bus, rail, and motorcoach operators) has advocated bus simulators as especially useful in acclimating drivers to the challenges of planning and executing right turns: "This is a great exercise to bring into a supplemental training tool, such as a bus simulator. This will remove the threat of physical harm and allow for greater repetition to promote proficiency."

Steve Berry, General Manager for Public Safety for St. Louis Metro, tends to agree.

"Bus characteristics are a big deal," Berry explains. "New CDL holders just aren't used to the size, weight, and dimensions. And once they get used to that, they aren't used to the variance in the weather. Snow is a major factor [in St. Louis], but so is rain, wind speed, and high gust areas—all of those play a very important role. You have a million-dollar piece of equipment with many occupants inside. There's a lot on the line, and the operator needs to be ready to make a call about when it's safe to operate. They are the first and most important safety component in our system."

USING YOUR BUS SIMULATOR TO HIRE FOR ATTITUDE, NOT JUST EXPERIENCE

Every transit agency struggles with churn and a shortage of good applicants. Take St. Louis Metro Transit as an example. That agency needs to hire and train at least 100 to 120 operators per year, just to stay ahead of churn.

Traditionally, transit agencies have dealt with this by seeking to hire individuals who already have large apparatus or commercial motor vehicle (CMV) experience (e.g. former military, retired firefighters and police officers, or over-the-road truckers looking for a job with less travel). The rationale is pretty straightforward: If someone already has a CDL or experience with large vehicles, we'll spend less time training or retraining them to safely operate a bus.

But what if we've been "over-indexing" these skills? Yes, safely piloting a CMV is challenging—but is it the biggest challenge transit operators face?

"Look at it this way," explains Steve Berry, General Manager for Public Safety at St. Louis Metro Transit, "Most people don't get fired because they don't have the skills to do the job. Most people get fired over poor behavior."

Instead of looking for individuals with a CDL or CMV experience (which often also means hiring older workers with little customer relations experience), many agencies are instead seeking out younger hires who have great people skills—and have maybe never considered getting behind the wheel at all. For this group especially—inexperienced drivers new to large vehicles—bus simulators often prove to be a superior training platform.

Bus Simulator Training for Younger, Customer-Focused Operators

Research has shown that bus simulators can be as good as, if not better than traditional behind-the-wheel closed course training—especially for new drivers. In a 2011 article published in the journal Accident Analysis & Prevention, researchers J.F. Morgan, Scott Tidwell, Alejandra Medina, and Myra Blanco wrote:

"Training in a CMV driving simulator can result in drivers having skills equivalent to drivers trained in a conventional BTW [behind-the-wheel] manner and the simulator group drivers had higher levels of performance on some tests as compared to CDL-focused trained drivers. ... Based on the findings of this study, increasing the amount of time an entry-level CMV driver trains offers advantages in terms of skill demonstration ... The results of the present study indicate that drivers trained with the majority of their driving occurring in a simulator possess skills equivalent to those trained in an actual vehicle."

Steve Berry of St. Louis Metro points out "Before, you'd only hire a bus driver because they may have previously had a CDL. But mass transit isn't just about getting our clients from here to there safely and on time. It's about getting our clients from here to there safely, on time, with a good experience. And the younger folks tend to meet that criterion more often. But they lack the driving side of it." That was a significant hurdle before having a simulator to support their training program.

"Whereas before, our average age to hire was mid-40s to early 50s; now they're starting to get younger. ... They're typically more used to the technology environment than what we were seeing about 10 years ago. They're more accepting to train with the bus simulator."

BUS TRAINING SIMULATORS PREVENT JOB STRAIN, IMPROVE RETENTION

As Jared Stancil, a VP at Nashville-based Anchor Tours, told a reporter back in 2013, "We have already invested a lot of time and energy in the drivers we have hired, and it is becoming increasingly harder to replace them. This is a very tough market for us to find quality drivers."

Conditions haven't changed.

If anything, the challenge of finding and retaining good drivers has *increased*. This isn't just a matter of a tight job market making it hard to fill open positions especially when it comes to operating large vehicles.

Driving a bus poses its unique physical challenges. According to *CityLab*, "chronic muscle and skeletal strains are common among drivers, another factor explaining high rates of absenteeism and turnover."

In part, this is the nature of the job: Most drivers are sitting for 8 to 12 hours with few breaks. That, by itself, is tremendously stressful on the body. This is compounded by a few bad habits that easily creep into an operator's daily routine but prove devilishly hard to address in conventional bus driver training situations.

Bus Driver Training to Prevent Repetitive Strain Injury

Zerry Hogan is a U.S. Department of Transportation Transit Safety Institute-certified instructor and recognized expert in transit and transportation training. He's found that something as simple as setting up your seat properly can have a whole host of benefits:

- **Avoid unnecessary strain on the knee and leg** by forcing the driver to engage the entire leg, not just the calf and ankle
- **Engage the arm and shoulder** through proper steering wheel technique (drivers chronically overstrain their wrists and elbows)
- **Sit properly** to avoid back, shoulder, and neck strain

But it's extremely hard to actively observe these aspects of how a trainee is operating the vehicle in traffic.

"You have a novice student at the wheel of a bus in traffic," Hogan explains, "he or she can easily get into an accident if you don't watch that student very carefully, giving them instruction."

For safety, your eyes are on the road—not on the student's hands, feet, shoulders and lower back.

"Working in the simulator allows you to fully observe the operator's habits—without also having to divide your attention, to be sure they're safe on the road. So you can pause the simulation at any time, show them what they're doing, and ask 'Why are you doing it that way?' Then you aren't just showing them the right way but giving them the *Why*—why you need to take a moment to adjust that seat correctly, why you need to hold your hands correctly."

Being able to grab those "teachable moments" immediately, make the student aware of the habit, and correct it, has proven nearly twice as effective when compared with conventional lecture-lot-road training.

Repetitive strains and chronic injuries that leave bus operators to leave the profession, "These are issues we can correct so much more effectively during simulation training."

BUS TRAINING SIMULATORS INCREASE SAFETY THROUGH REDUCED HUMAN ERROR

According to a report from the U.S. Department of Transportation (DoT), almost all bus crashes can be attributed to one of four types of bad habits:

- Inattention
- Distraction
- Haste
- Misjudgments

The DoT's Federal Motor Carrier Safety Administration (FMCSA) and the National Highway Traffic Safety Administration (NHTSA) "concluded that human errors by bus drivers, other vehicle drivers, and pedestrians or bicyclists were the critical reasons for bus crashes in 90 percent of the cases examined. The majority of those causal and contributing factors examined were related to driver error, fatigue, or other human factors."

Bus Training Simulators Focus on Human Error

The DoT further found that "In the 19 crashes where the bus was assigned the critical reason for the crash, the specific reason was driver error in 15 cases. ... The two cases where the buses caught fire, the one case where bus brakes failed, and the one case of ice on the roadway resulting in a crash were the only cases where critical reasons were not assigned to drivers."

Even more notable, although driver errors occasionally violated the law (such as illegal turns or following too closely), "many of the bus driver human errors, including inattention, distraction, haste, and misjudgments, are not violations of laws or regulations. ... While better enforcement [and equipment maintenance] can improve the safety climate, producing safer drivers cannot be ensured solely by police enforcement actions."

Zerry Hogan is an expert in transit and transportation training and simulation. He previously served as the training project manager for the LYNX Central Florida Regional Transportation Authority. In his experience, bus training simulators are especially well-suited to address the sorts of poor habits that can lead to fatal accidents.

"These are issues we can correct during simulation," Hogan explains. "Because remember, the simulation is to allow you to fully observe their habits—without also having to divide your attention, to be sure they're safe on the road. Hogan has previously noted that LYNX saw "a decrease of 69.23% in accidents for those operators trained on the simulator.

Bus Training Simulators Prepare Operators for the Unexpected

Let's add some context: the DoT's bus-crash study looked at a total of 39 crashes. The driver was only at fault in 15 of these. In the others, the bus operator and his or her passengers were largely the victims of circumstance. But you *can* prepare drivers to make the best out of a bad situation.

Nigel Lindsey-King is the former Superintendent of Surface Transportation Training and Curriculum Development Specialist for the Toronto Transit Commission. He has decades of experience, from operating a streetcar to designing and administering entire training programs. "With the inclusion of the bus training simulator, it means we can allow them [operators] to get into situations that we could never let them do out on the street. As an instructor, there's no way I could let you get into a dangerous situation. Whereas, on a simulator, I could let you do that, see the consequences of your actions, then play it back and let you see what you could do differently. That, in my mind, has made a tremendous impact" on bus safety.

ELECTRIC-BUS SIMULATOR FOR NEW FLYER'S VEHICLE INNOVATION CENTER

FAAC Delivers Worlds Most Advanced Electric-Bus Simulator for New Flyer's Vehicle Innovation Center

Ann Arbor, Michigan, USA — February 26, 2018 FAAC Incorporated was selected by New Flyer to deliver the world's first – bus simulator modeling New Flyers sophisticated Xcelsior® CHARGE battery-electric bus for its Vehicle Innovation Center. New Flyer, the largest transit bus manufacturer in North America, opened its impressive interactive VIC, Vehicle Innovation Center located next to the company's Anniston manufacturing plant. The VIC, a gallery-like experience, is North America's first innovation lab dedicated to the advancement of bus and coach technology that connects people to places with a focus on the environment.

FAAC, known for its transit simulation training tools, blends the engineering know-how with the needs of driver training programs that use simulators to educate a variety of audiences on differing objectives. For New Flyer, FAAC delivered a simulator that modeled its Xcelsior® CHARGE™ bus.

While the simulator is a training tool, it also offers drivers the ability to test drive the innovation New Flyer is bringing to the market. With a variety of audiences ranging from engineers, maintenance crews, and training operators, each is able to learn different objectives on one training tool. When working with all-electric, one primary training objective sought was the incorporation of regenerative braking, this feature along with other training attributes of an all-electric powered bus is important for training operators to fully comprehend.

Derek Fulk, Senior Project Manager for the simulator talked about the engineering on both sides of the project, "New Flyer has the most advanced bus technology hands-down and for them to look to FAAC for a simulator that showcases their innovation is a tremendous compliment."

David Bouwkamp, FAAC's Executive Director who was on-hand for the VIC ceremony stated, "The simulator is a high-fidelity, fully representative replica of the Xcelsior® CHARGE bus [we] integrated with all of the OEM components found on the real bus. When an operator sits in the seat of this simulator they are immediately immersed in all the functions, features and attributes of the real bus. They are driving the real bus at that moment."