



**NCTR**  
NATIONAL CENTER for  
TRANSIT RESEARCH

The Bus Operator Simulator Experience —Lessons Learned

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National Center for Transit Research | University of South Florida

## Background Information

- Managed by FDOT and NCTR
- Multi-Year Research Project
  - “A Qualitative Analysis of Bus Simulator Training on Transit Incidents – A Case Study in Florida”
- Case Study Sites: Three Florida Agencies, Four others outside of Florida

## The Study

- Collect Data From Agencies:
  - Incident Data (Type, Frequency, Date, Time, Location, etc.)
    - Preventable/Non-Preventable
  - Training Data
  - Employee Turnover
  - General/Other
- Review of National Transit Database (NTD) Data – S&S 40 form “Major Incidents”
- Best/Model Practices
- Lessons Learned



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## Simulated Environment

- Simulated 3D Virtual World (Geo-Specific Database Modeling)
- Facsimiles of Full Sized, Fixed Route/Paratransit Bus Cab Enclosures
- Comprised of Actual and/or Representative Parts and Components



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## Simulated Environment- Hardware

- Simulators:
  - Bus Operator Seat, Radio, Active Steering Wheel, Seat Belt, Foot Pedals, Vehicle Control Panels, Transmission Selector, and Other Operational Controls, Gauges, Indicators, and Switches



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## Simulated Environment- (Software)

- Sight Lines and Angles Required to Safely Operate a Bus are Accurately Preserved for Presentation to the Operators in the Simulated Environment



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## Simulated Environment- (Software)

- Microsoft Windows™
- Simulated Driving Surfaces: Various Roadway Materials and Conditions (Pavement, Grass, Gravel, and Dirt/Sand with Traction)
- Integrated Sound Variations on Each Surface to Replicate Both Dry and Wet Conditions



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## Simulated Environment- (Software)

- Weather Conditions
  - Customizable- Clear, Variable Fog Settings, Rain, and Snow/Ice
- Lighting Conditions
  - Adaptable Features to Represent Time-of-Day Sequences
    - Day, Night, or Dawn/Dusk and Sun Glare (Sunset and Sunrise)



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## Simulated Environment- (Software)

- Software Works in Tandem with the Vehicle's Cab by Providing Controlled, Immediate Performance-Based Feedback to the Operator
  - Vehicle Sounds, Ambient Noise (like weather), and Physical Seismic-like Vibrations, Pulsations and Sensations
  - Seismic-like Features Used to Replicate Physical Sensation
    - Vehicle Hits an Object (Cars, Roadway Rumble Strips, Signs, and/or other Vehicles)



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## Florida Case Studies

- Research Focused on
  - General Training Practices and Standards
  - Agency Specific Parameters for Defining Preventable and Non-Preventable Incidents
  - Employee Turnover and Retention Rates (when available)
  - Ridership Changes
  - Training Department Structures and Staffing



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## StarMetro

- Began Integrating into Training Program in December 2010
- Full Integration by May 2012
- 2010 -2012
  - 141 bus operators received simulator training



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## StarMetro Bus Operator Training (Annual Averages)

	Hours of Training				Total
	Classroom Training	Over the Road Training	Simulator Training (460Bus™)	Simulator Training (550Bus™)	
New Bus Operator Training	80	160	5	15	260
Post-Accident/Incident Bus Operator Training	24	0	10	10	44
Remedial/Refresher Training	0	16	10	10	36



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## StarMetro Total Accident/Incidents by Type

Accidents/Incidents				
	Contact with Another Vehicle	Fixed Object	Rear End Collisions	Total
2008	52	18	20	90
2009	56	9	17	82
2010	58	13	10	81
2011	68	17	17	102
2012	32	7	3	42



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## StarMetro Motorbus Collisions Reported as Major Incidents (NTD)

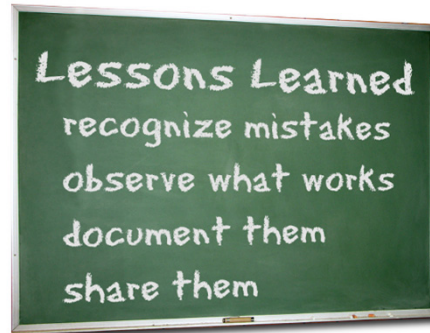
Year	Total	Total Preventable	Preventable Collisions		Revenue Miles Between	
			Injuries	Fatalities	Total Collisions	Preventable Collisions
2008	0	n/a	n/a	n/a	n/a	n/a
2009	3	1	1	0	655,589	1,966,766
2010	0	n/a	n/a	n/a	n/a	n/a
2011	3	2	2	1	706,757	1,060,135
2012	1	0	n/a	n/a	2,140,799	n/a



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## StarMetro “In Their Own Words”

- Challenges
  - Training Staff Changes
  - Operator Turnover
  - Decentralization
  - Ridership Increases
- Lessons Learned
  - Management Buy-In
  - Training Department
  - Spreading Manufacturing training out over time
  - Training Supervisors
- Benefits



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## VOTRAN

- Regional Training Center/Building (2007)
- Rolling, Multi-Year Integration of Simulator Training
  - 361 bus operators received training



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## VOTRAN Bus Operator Training (Annual Averages)

Hours of Training					
	Classroom Training	Over the Road Training	Simulator Training (460Bus™)	Simulator Training (550Bus™)	Total
New Bus Operator Training	80	200	4	4	288
Post-Accident/Incident Bus Operator Training	1	1	4	4	10
Remedial/Refresher Training	1	2	4	4	9



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## VOTRAN Total Accident/Incidents by Type

Accidents/Incidents				
	Contact with Another Vehicle	Fixed Object	Rear End Collisions	Totals
2008	34	21	13	68
2009	26	17	16	59
2010	37	16	16	69
2011	52	19	24	95
2012	37	18	19	74



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## VOTRAN Motorbus Collisions Reported as Major Incidents (NTD)

Year	Total	Total Preventable	Preventable Collisions		Revenue Miles Between	
			Injuries	Fatalities	Total Collisions	Preventable Collisions
2006	6	1	1	0	888,060	5,328,359
2007	6	0	n/a	n/a	884,478	n/a
2008	2	0	n/a	n/a	2,405,442	n/a
2009	6	0	n/a	n/a	757,581	n/a
2010	2	0	n/a	n/a	2,262,989	n/a
2011	4	0	n/a	n/a	1,115,376	n/a
2012	1	0	n/a	n/a	4,630,394	n/a



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## VOTRAN "In Their Own Words"

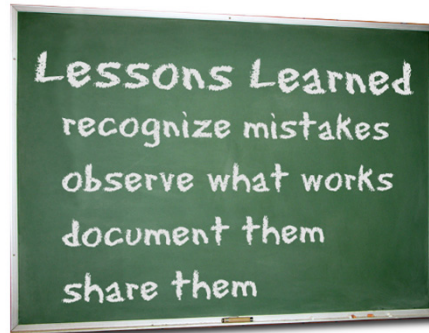
- Challenges
  - Training Staff
  - High Operator Turnover Rates
  - 13-16% Annual Ridership Increase
  - Motion Sickness
- Lessons Learned
  - Management Buy-In
  - Training Department
- Benefits



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## VOTRAN “In Their Own Words”

- Challenges
  - Significant Training Staff (Migration)
- Lessons Learned
  - Management Buy-In
  - Training Department
- Benefits
- Served as an intervention tool that helped with problem-based issues, and resolution.
- BCT’s training staff sees the simulators as providing ideal opportunities for operators to practice fundamental and complex driving skills.



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## Broward County Transit (BCT)

- Collection of Simulator Training Data(2011)
- Comprehensive Simulator Training Program



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## BCT Bus Operator Training (Annual Averages)

	Hours of Training				Total
	Classroom Training	Over the Road Training	Simulator Training (460Bus™)	Simulator Training (550Bus™)	
New Bus Operator Training	90	260	10	n/a	360
Post-Accident/Incident Bus Operator Training	1.5	2.0	.5	n/a	4
Remedial/Refresher Training	0	0	0	0	0



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## BCT Total Accident/Incidents by Type

Year	Preventable Accidents	Total Accidents	Ratio of Preventable to Total Accidents
2008	103	602	0.17
2009	99	564	0.18
2010	140	590	0.24
2011	147	621	0.24
2012	180	704	0.26



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## BCT Motorbus Collisions Reported as Major Incidents (NTD)

Year	Total	Total Preventable	Preventable Collisions		Revenue Miles Between	
			Injuries	Fatalities	Total Collisions	Preventable Collisions
2008	42	9	16	0	334,536	1,561,168
2009	46	7	15	0	326,495	2,145,541
2010	52	10	23	0	286,072	1,487,573
2011	67	8	12	0	207,499	1,737,807
2012	63	10	16	0	223,739	1,409,554



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## BCT Experience

- Significant staffing issues in their training department during the study period, with the majority of their training staff retiring. These trainers had been the driving force behind the simulator training program.
- While BCT hired new trainers, their focus was on traditional classroom and over-the-road training.



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## National/International Case Studies



- Houston Metro
- MBTA (Boston)
- Champaign Urbana Mass Transit District (CUMTD)
- York Regional Transit/Viva



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## Statement on NTD Limitations

- Researchers utilized NTD's Safety and Security 40 Form – Major Incidents
- Only captures incidents within the following thresholds:
  - Fatality (30 days or less from collision)
  - Injury requiring immediate medical assistance away from the scene
  - Property damage  $\geq$  \$25,000
  - Evacuation due to life safety reasons
- Data would not capture reductions in minor incidents not meeting the thresholds



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## Qualitative Benefits

Agencies are Steadfast in their Acceptance of Simulators as a Valuable, Supplemental Training Tool:

- Acquire, Practice and Develop Skills
- Rehearse Reactions to Situations
- Improve Decision Making Skills
- Review Learning Experiences with the Benefit of Replay
- Reflection



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## Considerations Based on Lessons Learned

- Practices to Improve Employee Retention Rates and Succession Plans for Trainers
- Identification of Model Bus Operator Simulator Integration Practices
- General Training Practices and Standards Recommendations
- Practices and Standards of the Collection of Performance Related Data
- Recommended Preventable and Non-Preventable Incidents Definitions, and
- Prevailing Training Department Structures and Staffing Model Practices and Continuity Planning.



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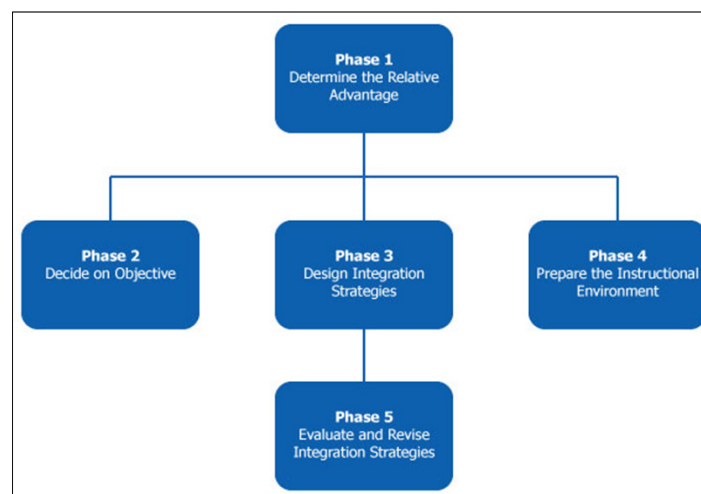
## Considerations Based on Lessons Learned

- Finally, it is evident that comprehensive procurement plans, a technology integration plan and a continuity plan are fundamental, critical components of a simulator training program and need to be incorporated as minimum elements by transit agencies when purchasing bus simulators.
  - help the agency plan, measure, improve, identify, enhance, and realize the benefits of transit operator training simulators.




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## Technology Integration Planning Model (TIP Model)



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