

**“Bus of the Future”  
Redesign of Transit Bus Operator  
Compartment to Improve Safety, Operational  
Efficiency, and Passenger Accessibility  
Program**

**Jack Clark, Executive Director  
International Transportation Learning Center (ITLC)**

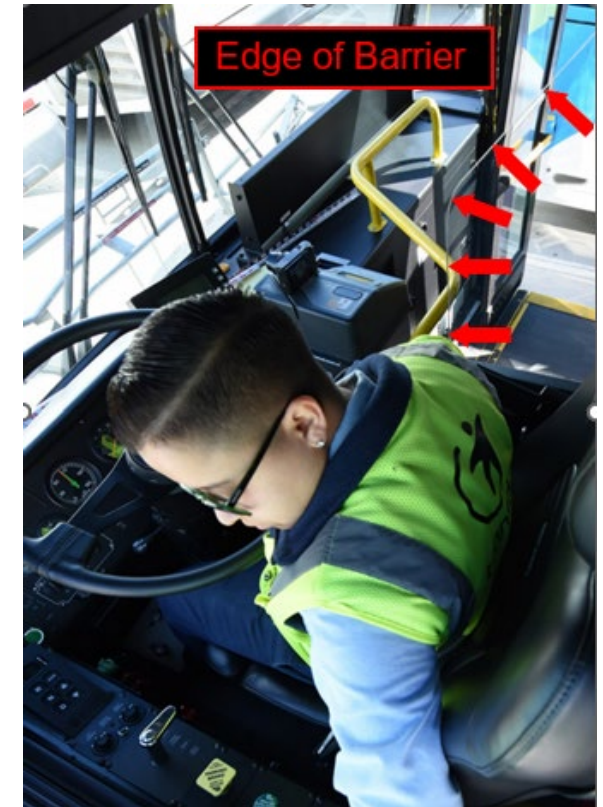
**June 22, 2023**

# Bus of the Future Project

- Bus Operator Compartment Program Provided Funding in 2020 for Research Projects that Protect Operators from Assault and Improve their View of the Road through Innovative Designs
- ITLC Led a Team of Experts that Produced a Bus Design Concept with a Fully Secure Operator Compartment
  - ATU
  - STYL&TECH
  - AC Transit
  - RLS & Associates
  - Vision Systems

# Bus Redesign Objectives

- Ineffective Operator Barriers



# Bus Redesign Objectives

- Poor Operator Visibility



Driver's Arm

19 Pedestrians Hidden by the Pillar and Mirror





# Operator Workstation Solution



- **Maximum flexibility and security**
- **Positive pressure protection**
- **Stowable, pneumatic-powered barrier door glazing**
- **Options for eliminating barrier reflections**

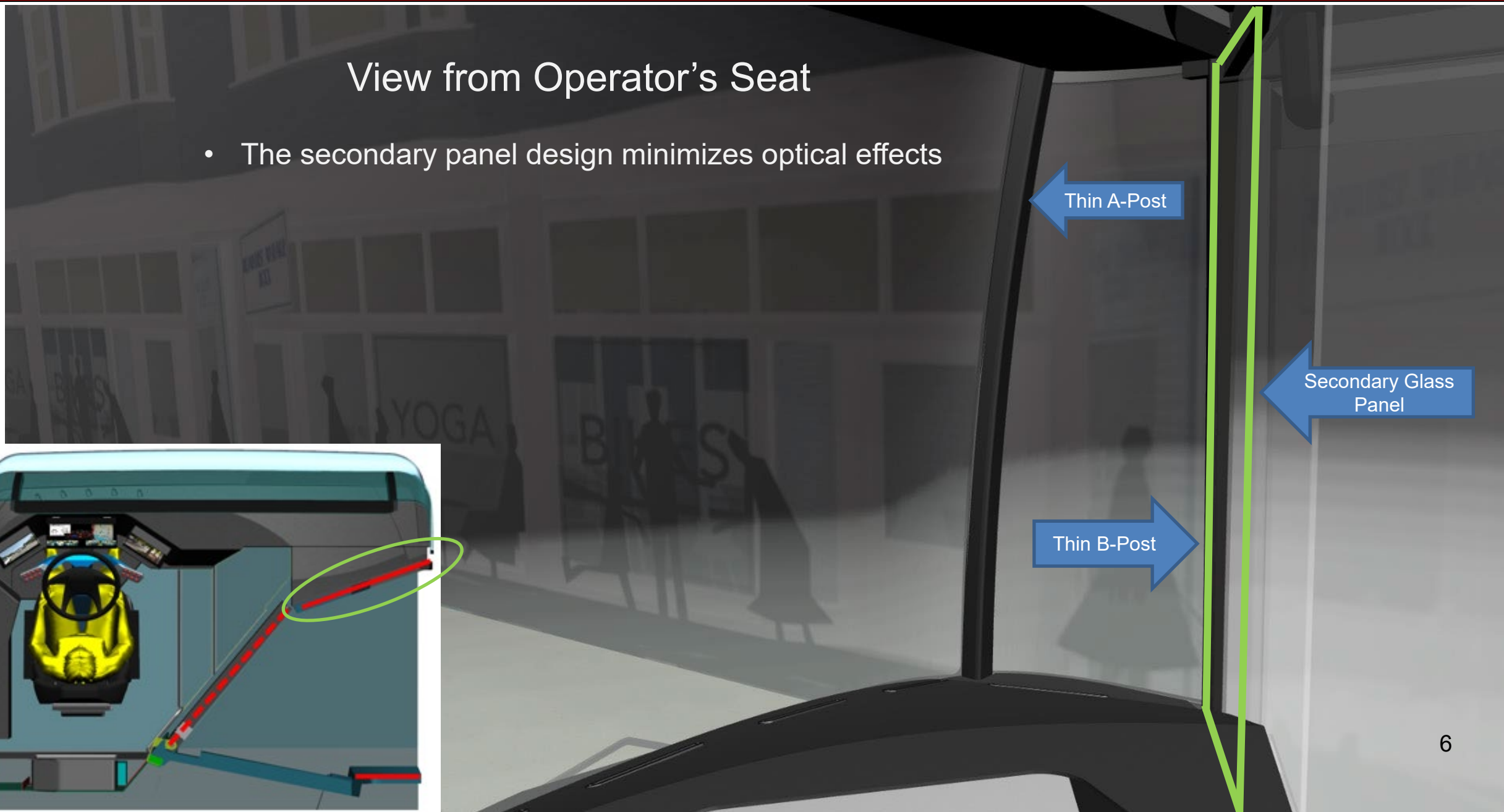
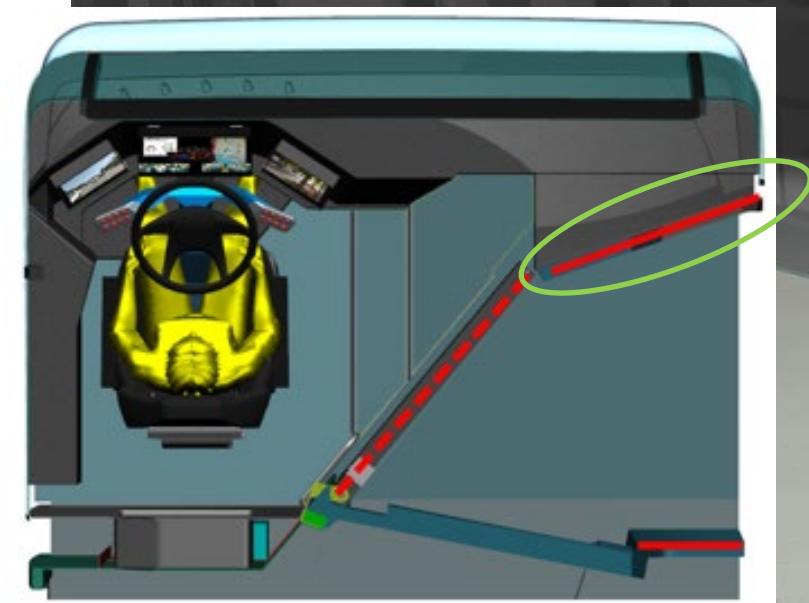
## View from Operator's Seat

- The secondary panel design minimizes optical effects

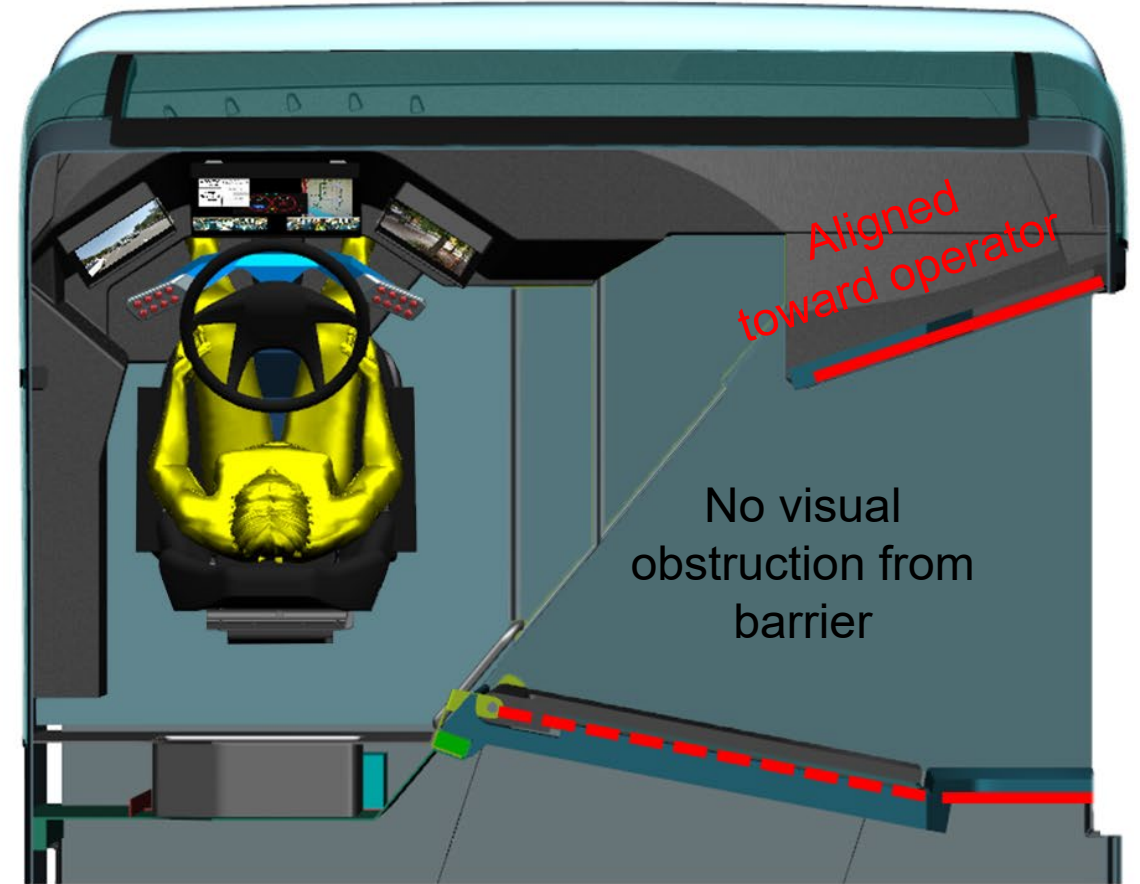
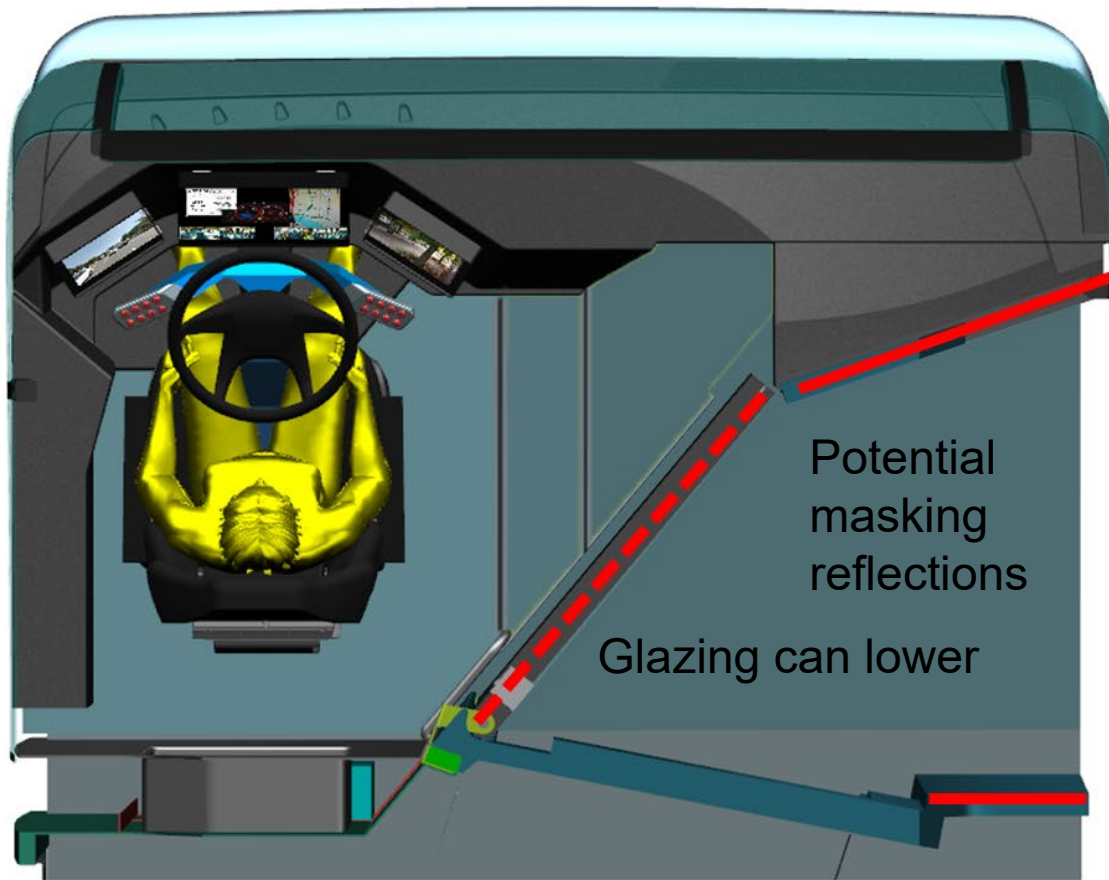
Thin A-Post

Secondary Glass Panel

Thin B-Post



# Operator Workstation Solution



# Operator Workstation Solution





# Optimized Direct and Indirect Vision



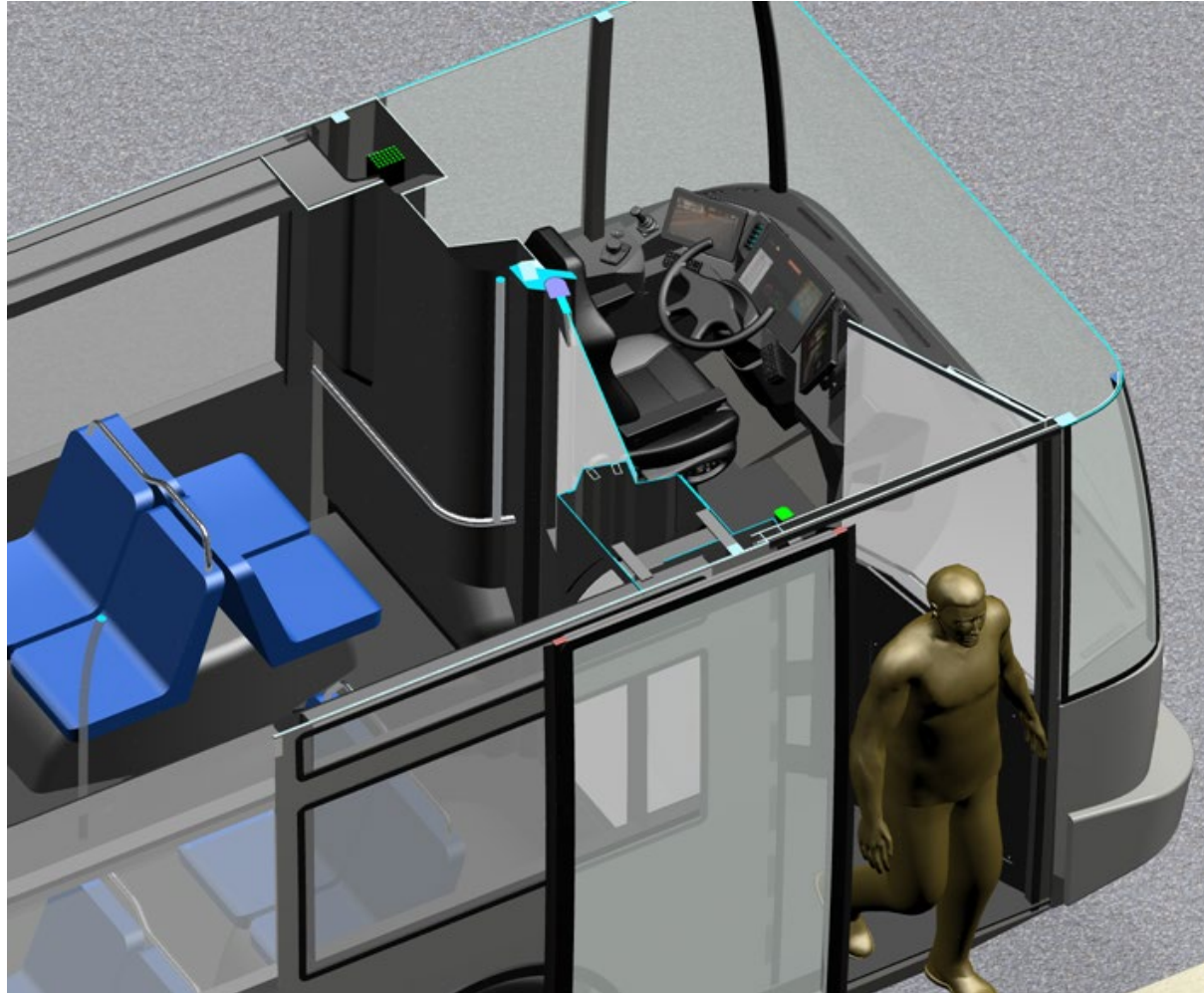
- Two screens replace four mirrors
- Near 360-degree view with lowered distortion
- Configurable center display for necessary information
- Lower operator cognitive load = less distractions

# Improved Ergonomics



- **Suspended pedals to prevent lower quadrant injuries**
- **Electric over hydraulic steering – less upper quadrant injuries**
- **Active seat – 50% less whole-body vibration**

# Operator Workstation Solution





# Future Work

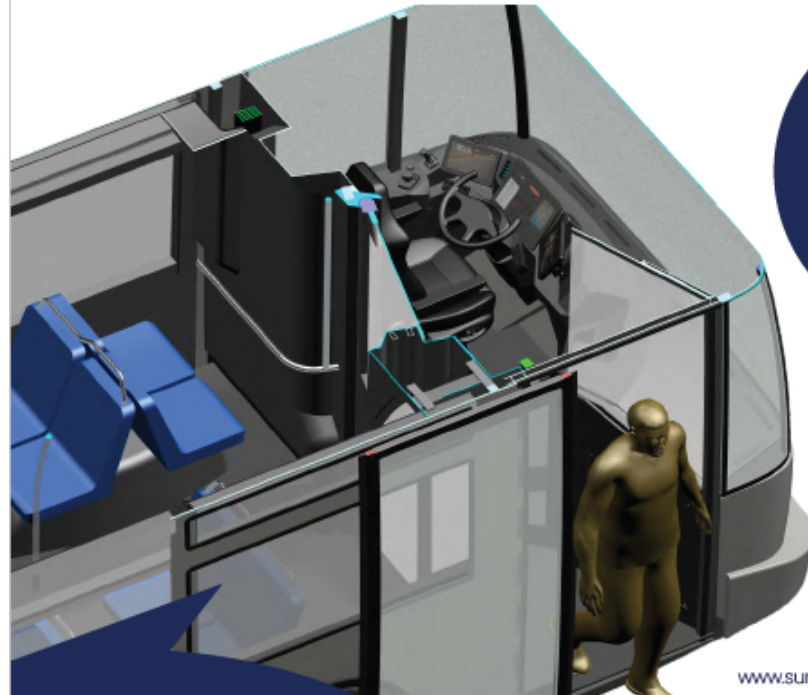
- Optimize Areas Outside the Workstation
- Provide Full Accessibility
- Improve the Passenger Compartment
- Apply the Operator Compartment Design Concepts to a Prototype Chassis





# Thank You!

>>> **BUS OF THE  
FUTURE**



Take  
our short  
survey  
online!



[www.surveymonkey.com/r/Busofthefuture](http://www.surveymonkey.com/r/Busofthefuture)

# Redesign of RTA's Transit Bus Operator Compartment to Improve Operator and Passenger Safety



Presented by

**Mike Smith**

Chief Safety, Security, and Emergency Management Officer  
New Orleans Regional Transit Authority



# Agenda

- Project Overview
- Process
  - Design
  - Installation
  - Operator Feedback
- Challenges
- Discussion
  - Other Preventive Measures
  - Recommendations



# Project Overview

- In partnership with New Flyer, their subsidiary NFI Parts, and the Amalgamated Transit Union (ATU) Local 1560 (representing RTA's operators), RTA initiated a two-year research and demonstration project to study protective, operator barriers on its entire fixed-route bus fleet.
- The project was supported by grant funds (80% share) through FTA's Bus Operator Compartment Program, which was established in October 2020 and is managed by FTA's Office of Research, Demonstration and Innovation.
- Operator feedback was solicited and taken into consideration during every phase of the project, from design to revenue service. The strong partnership between Operations, Maintenance, Safety, and ATU Local 1560 directly contributed to the project's success.
- 113 buses in RTA's existing fleet (Orion and New Flyer) were retrofitted in collaboration with New Flyer and NFI Parts and closely examined through this project.
- In addition, the design process influenced the configuration of 41 factory-installed barriers on new 35' and 40' New Flyer "Xcelsior" buses, purchased with Federal grant funding in 2021-2022. In total, 154 RTA buses are equipped with the NFI Parts/Arow Global barrier (as of May 2023).

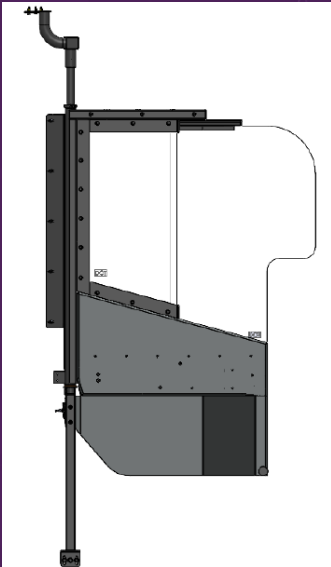
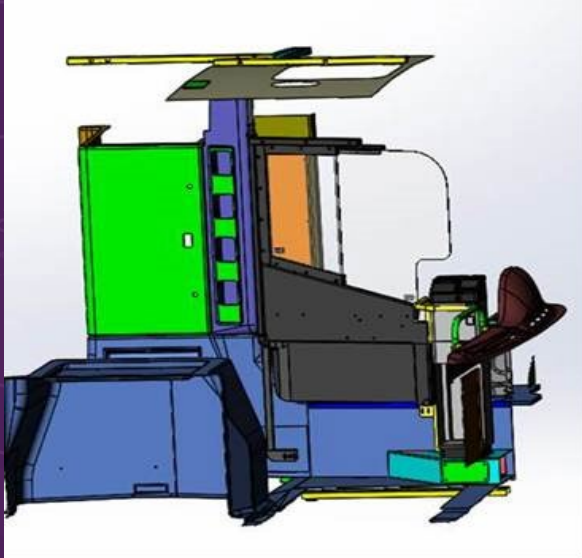




# Crime Data Analysis

- During the pre-installation phase, RTA analyzed crime and (non-criminal) security incident data from CY 2020 to establish a baseline.
- A baseline data analysis was important to:
  - Better inform the project team about the compartment design requirements,
  - Understand the overall risk of an operator being assaulted on a fixed-route bus, and
  - Identify other factors to consider when addressing the global security/crime problem.
- The specific incident types examined were:
  - Threats, assaults, lewd conduct, disturbances, battery, fare disputes, criminal damage (if inside the vehicle), and robberies.
- The specific criteria for the dataset were:
  - 1) occurred on a revenue service vehicle, 2) led to a police summons or citation for a Part 1 or Part 2 crime, and 3) either involved or was a direct threat to the safety of the RTA operator.
- The analysis concluded that the incident rate (based on 2020 data) was approximately 0.35 incidents/100,000 customer boardings.
- If an incident occurs, the likelihood that it directly threatens the operator's safety is approx. 1 in 4.
- Additional (post-installation) analysis is ongoing and managed through RTA's Safety Assurance process under the Safety Management System (SMS) framework.

# Design




- Bus Maintenance sent detailed specifications based on each fleet's configuration. This included details on the placement of RTA-owned equipment such as GFI fareboxes and Clever Device modules.
- Detailed, fleet-specific installation guides were produced by NFI Parts/Arow Global and vetted by Bus Maintenance management.
- The vendor team incorporated ADA requirements into their design, ensuring full compliance. (Arow Global cited "box test" in which a 30 in. x 30 in. x 48 in. box passes through the door and into the aisle way.)
- When finalized, the guides formed the basis of several on-site, train-the-trainer sessions with RTA Maintenance staff. (RTA tasked a mix of Bus and Streetcar Maintenance staff with installation, to optimize delivery of the redesigned compartment and to minimize any adverse effect on daily operations.)
- The sliding window "slide stow" allows operators to select a glass position that suits their preferences and line-of-sight needs.
- The latch is a heavy-duty/automotive grade rotary slam latch with easily serviceable components.
- The glass is tempered, laminated, and has anti-glare and anti-spall properties.
- The swinging movement of the door, construction of the door, and latching mechanism were largely based on existing designs. RTA and the vendor team had to make relatively minor adjustments.

Source: ArowGlobal



# Operator Feedback/Questionnaires

Date: \_\_\_\_\_ Bus: \_\_\_\_\_



**Bus Operator Compartment Questionnaire**

Please circle yes or no for the following questions.

1. Is the new compartment **comfortable** while in the operator's seat?  
**Yes or No** If no please explain:
2. Are you able to **comfortably** enter and exit the compartment with the new door?  
**Yes or No** If no please explain:
3. Is the compartment door **easy** to operate by opening and closing it?  
**Yes or No** If no please explain:
4. While in the operator's seat, is it **clear** to get the big picture while operating?  
**Yes or No** If no please explain:
5. While in the operator's seat, are you able to **access** all controls/buttons in a safe manner? **Yes or No** If no please explain:
6. Do you feel **safe** with the compartment closed while operating in the seat?  
**Yes or No** If no please explain:
7. Do you view the new protective barrier as an important contribution to Bus Operator **safety**? **Yes or No** If no please explain:
8. Do you believe that you can continue to provide excellent **customer service** with the new protective barrier? **Yes or No** If no please explain:


Additional Comments:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Date: \_\_\_\_\_ Bus: \_\_\_\_\_



**Bus Operator Barrier Shield Questionnaire – Non-Operator End Users**

Please check yes or no for the following questions.

	Yes	No
Will the barrier shield affect any of your tasks?	<input type="checkbox"/>	<input type="checkbox"/>
If yes, please explain:		
Will the barrier shield affect customer service?	<input type="checkbox"/>	<input type="checkbox"/>
If yes, please explain:		
Do you think the barrier shield is a good idea?	<input type="checkbox"/>	<input type="checkbox"/>
If no, please explain:		

Please provide additional comments and thoughts:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

In summer 2021, RTA implemented the operator and non-operator feedback portion of the project. Procedure:

- Operations clerks were provided a daily list of vehicles with the compartment installed
- Upon operators checking in for assigned runs with compartment buses, they were given a questionnaire
- Operators turned in their questionnaire to clerks at the end of their shift
- Safety staff picked up questionnaires daily and compiled data for further analysis.

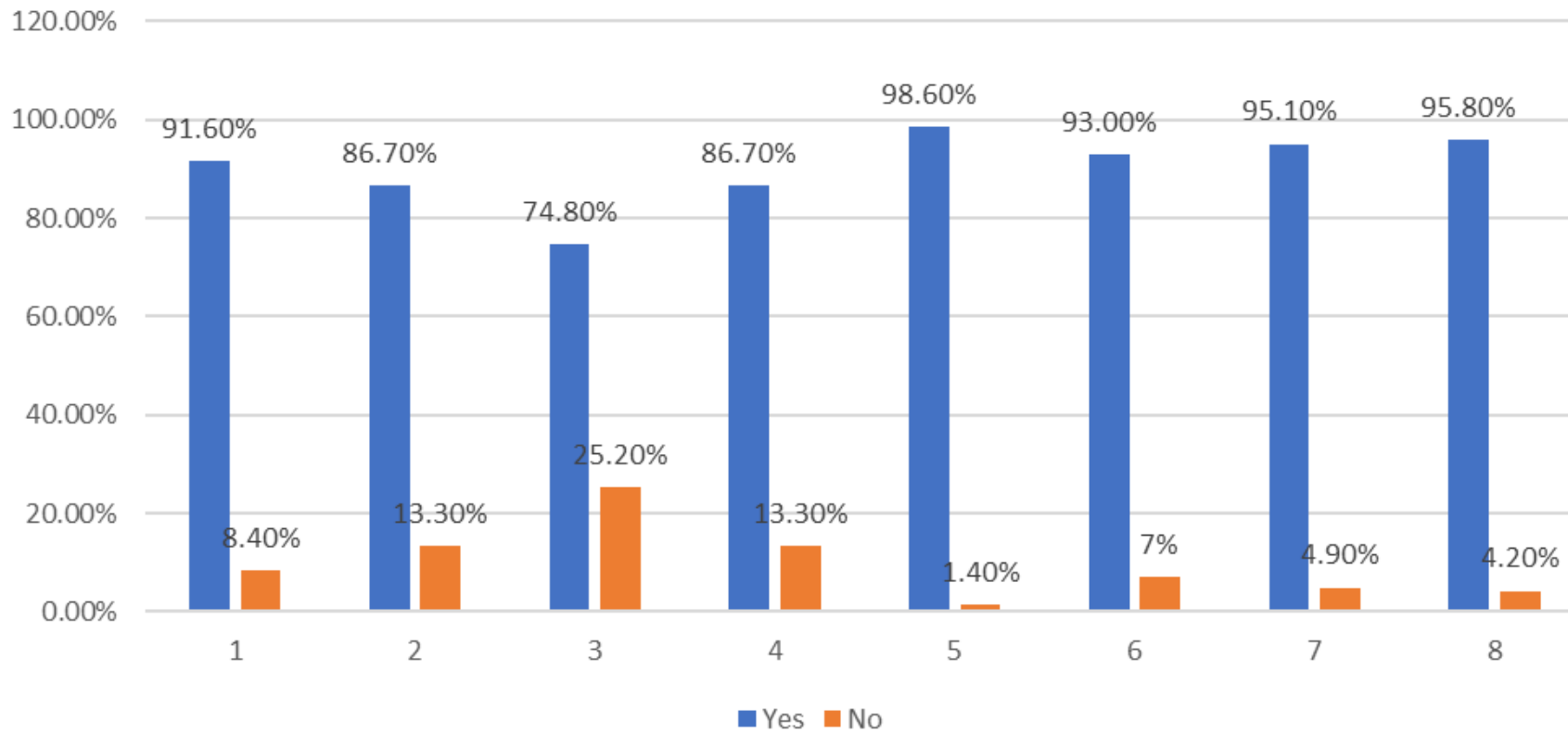




# Questionnaires - Findings

“...very comfortable ride...”  
“... safe and operational...”

### Bus Operators Responses



- 93% of operators who completed the questionnaire said that they felt safe while operating in the compartment.
- 91.6% of operators reported that the new compartment was comfortable.







Photos from 2021 and 2022 New Flyer application  
(factory-installed and now RTA's standard spec)



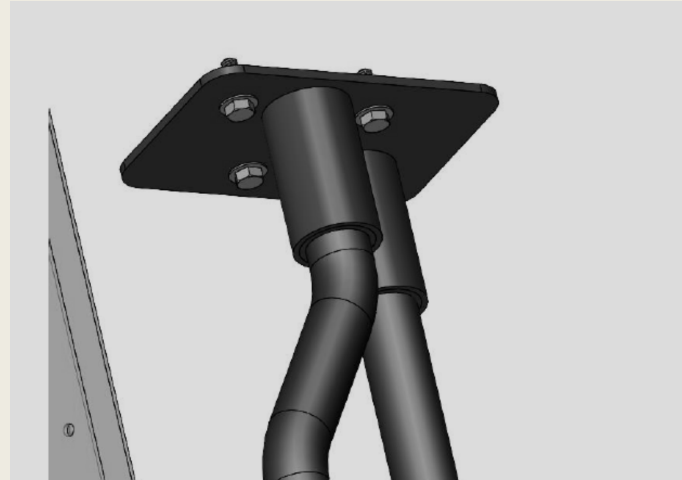
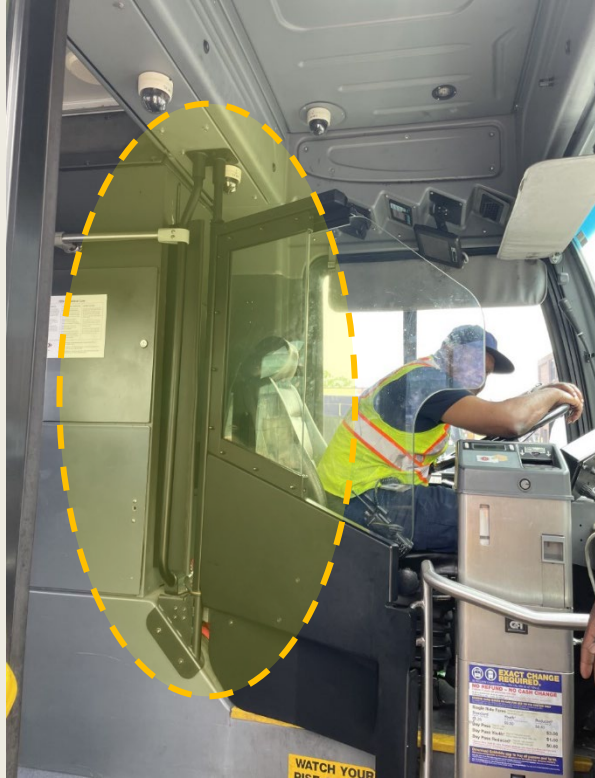


# Final Application

Model	Number	Notes
2019-2020 40' New Flyer Xcelsior	23	
2008 35' Orion VII	7	Existing fleet retrofitted with
2010-2012 40' Orion VII	67	NFI/Arowguard barrier (Total: 113)
2010-2012 60' New Flyer LFR	16	
2021 35' New Flyer XD35	21	New buses purchased and delivered 2021-
2022 40' New Flyer XD40	20	2022 (Total: 41)
<b>TOTAL</b>	<b>154</b>	



# Creative Solutions to Issues Encountered



Hinge post in original design conflicted with existing stanchion

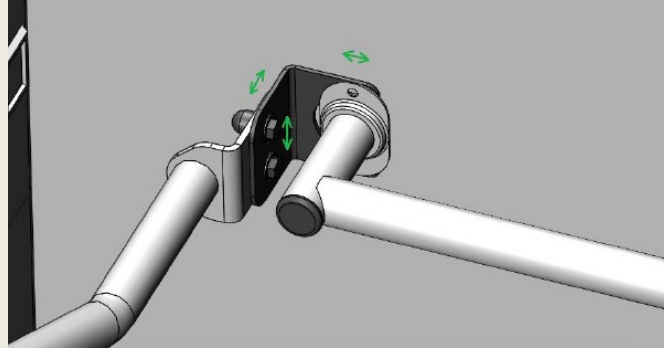
Team designed new upper mount and replacement stanchion



# Creative Solutions to Issues Encountered



GFI farebox probe blocked by bar



Technicians used bar adjustment bolts



Bar adjusted up to allow clearance



# Other Considerations – Multipronged Approach to Addressing Safety and Security Concerns

- Monthly Labor-Management Meetings and Labor-Management Safety Committee Meetings
- Developed all-new De-escalation and Crisis Awareness Training for operators in partnership with Transit Police Unit (New Orleans Police Department)
- Revised fare policy to clarify that operator safety is top priority
- Established Safety Management System (SMS) “101” training for all new-hires including all operators, to instill the importance of reporting safety and security concerns immediately and to demonstrate management’s commitment to safety



# Recommendations for Continuous Improvement

- Continue to solicit operator and mechanic feedback on perceived safety and comfort level
- Coordinate with Police Department and City officials to address code of conduct violations
- Continue to expand deployment of detailed, off-duty police officers and other resource types
- Research and conduct pilot studies of new, innovative security technologies
- Improve internal and external coordination on route changes or large service updates to minimize confusion and spread of misinformation which, in turn, leads to disputes and assaults
- Continue to explore newer fare media and technologies to reduce stress and confusion at farebox, and to minimize operator-customer conflicts







# Bus Transit Innovation Project

## Introduction

Bem Case

Executive Director of Innovation and Sustainability

Toronto Transit Commission





# Bus Transit Innovation Project

## Purpose

The Bus Transit Innovation Project (BTI) will explore and propose **innovative design solutions** that deliver both incremental and transformative changes to transit buses with **the ultimate goal of creating a safer, more modern, and inviting experience for operators, passengers, the public, and the global environment.**







# Bus Transit Innovation Project

## Objectives

Innovations will be considered that:

- **Prevent assaults** on operators in the driver's workstation through enhanced physical barriers.
- **Minimize blind spots**
- **Eliminate barriers** to passenger accessibility and improve support.





# Bus Transit Innovation Project

## Objectives

Innovations will be considered that:

- **Optimize ergonomics** of the driver's workstation to eliminate industrial injuries.
- **Minimize operator distractions** by reducing cognitive load.
- **Eliminate vehicle emissions** of pollutants harmful to people and the global environment.





# Bus Transit Innovation Project

## Objectives

Innovations will be considered that:

- **Prevent illness** by optimizing internal air circulation, sterilization, and/or filtration.
- **Minimize collision** probability and impact.
- **Minimize risk of fire**, arc flash, smoke, and toxicity.
- **Enhance the customer experience** through improved ride quality and new technology.







# Bus Transit Innovation Project

## Success through Collaboration

The BTI project will be delivered in partnership with ATU International as a demonstration of effective management-labour collaboration.

The project will leverage its long-standing relationship with Centennial College and other committed to the common objectives outlined.







# **Bus Maintenance & Shops**

## **Bus Barrier Assault/Biohazard**

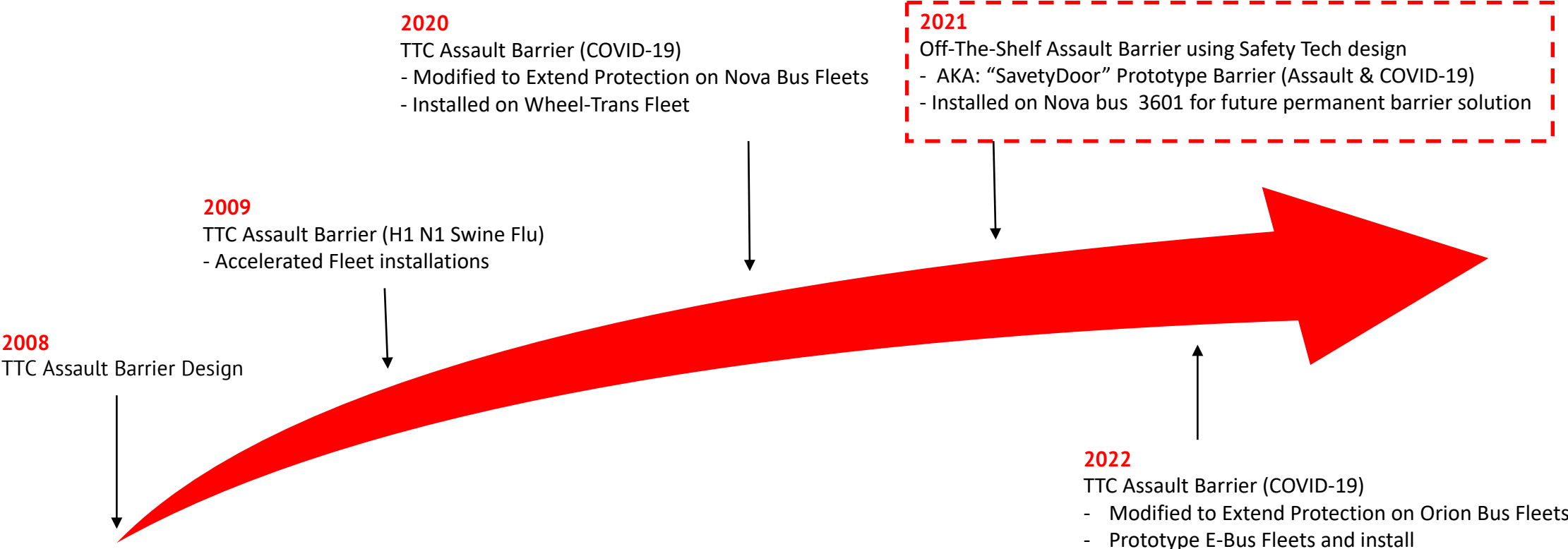
**Mike Farhoud – Manager Street Car Maintenance**

**SAVETYDOOR**

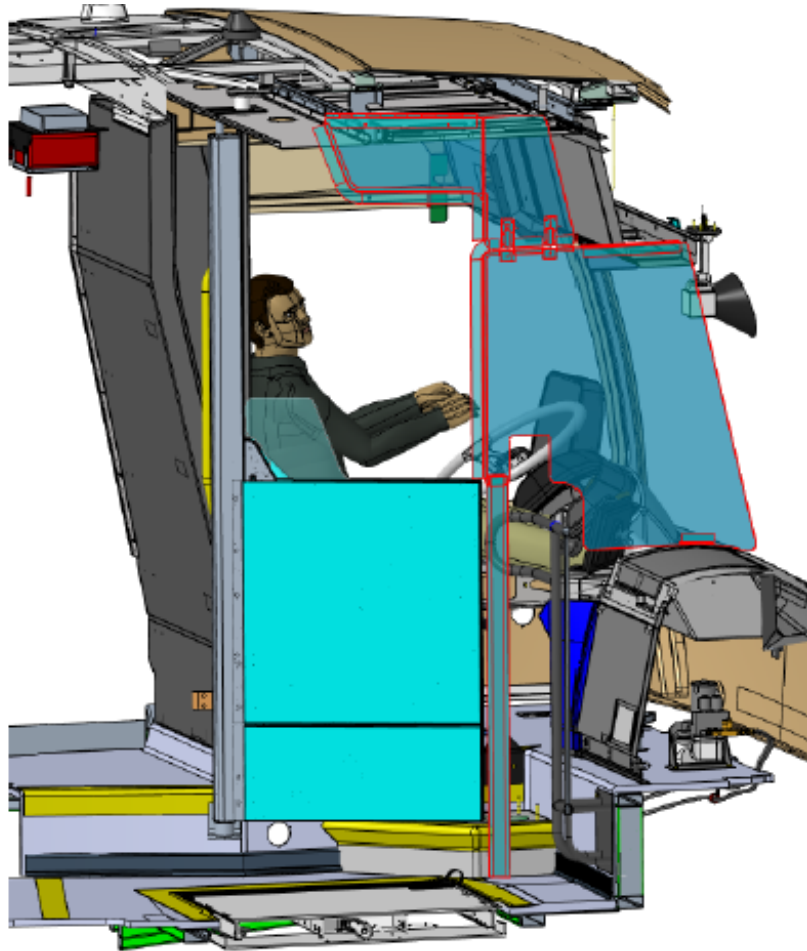
**TTC TORONTO**

SAVETYDOOR FINAL DESIGN

# Evolution of TTC Operator Barriers



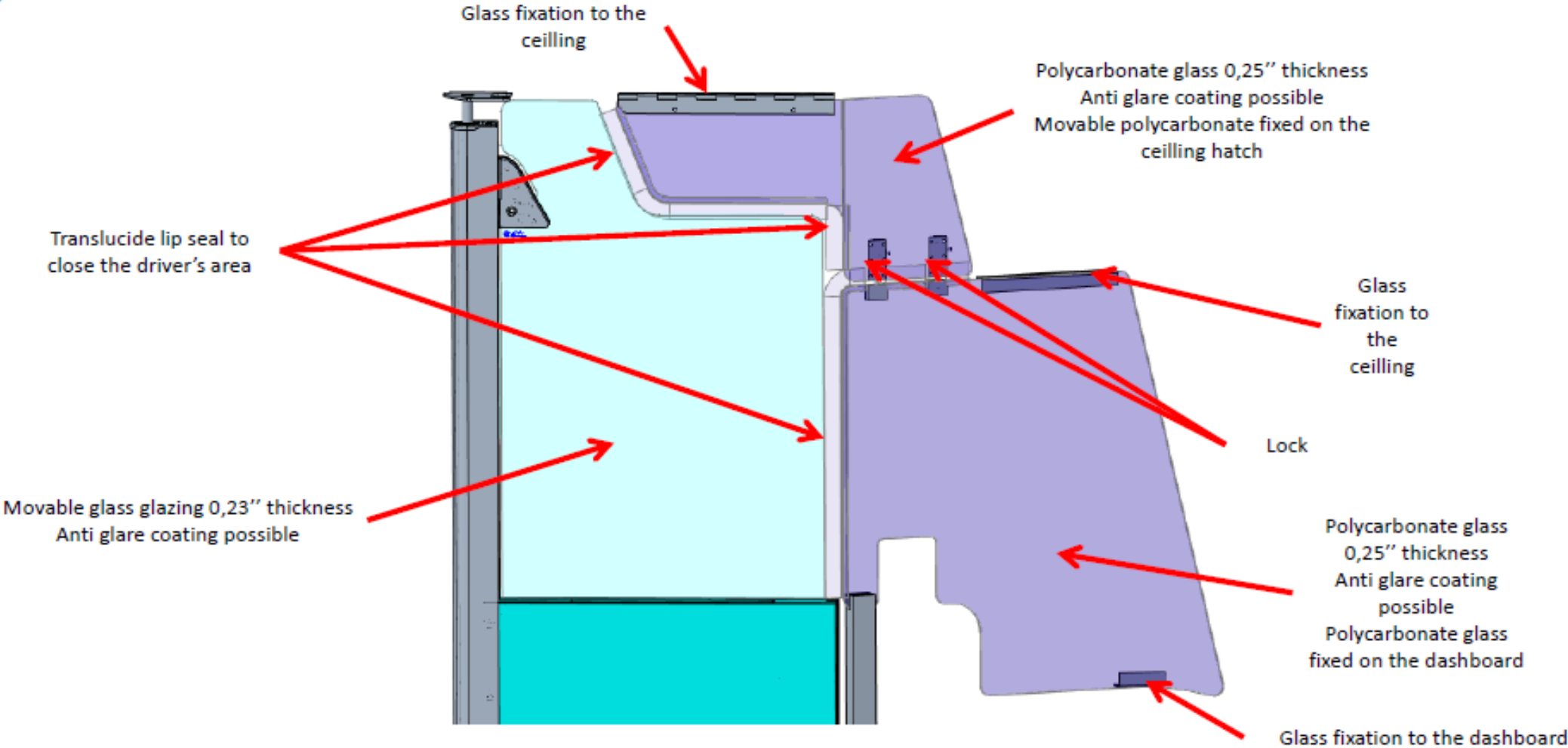
# SafetyDoor Prototype Operator Barrier



- Lexan to meet AS2 requirements
- Magnetic securement latch to lower vibrations & maintenance
- Anti-glare film to reduce reflection
- Eliminated speaker holes
- Acts as both assault and bio barrier
- Panic button retracts up and/or down
- Nova prototype bus underway at Harvey Shops
- Permanent solution



# SafetyDoor Prototype Operator Barrier



# SafetyDoor Prototype Operator Barrier

**This security door features a window which opens and closes pneumatically.**

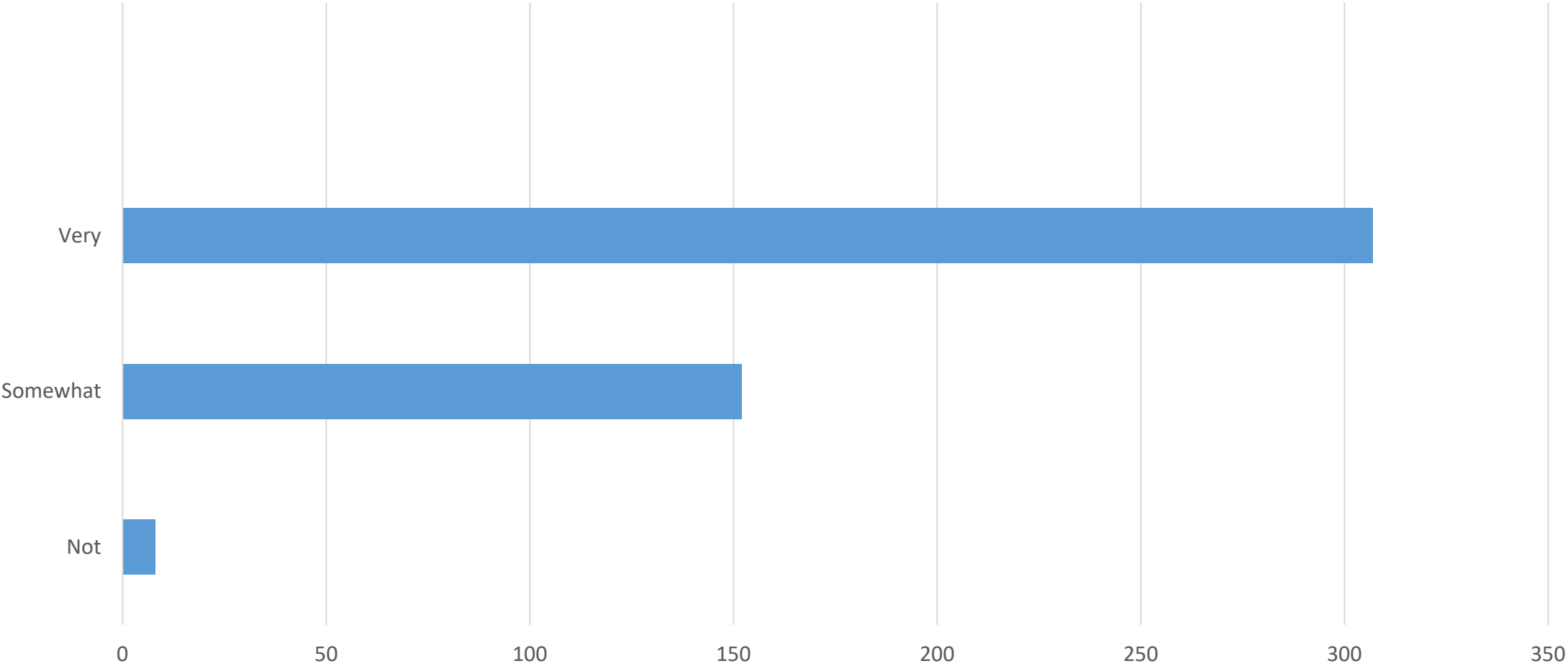
**80kg 187 lbs. in less that 5 seconds**

- **Highly durable: 200,000 cycles = 54 openings per day over 10-year period .**
- **Vibration resistant**

**Control  
Buttons**

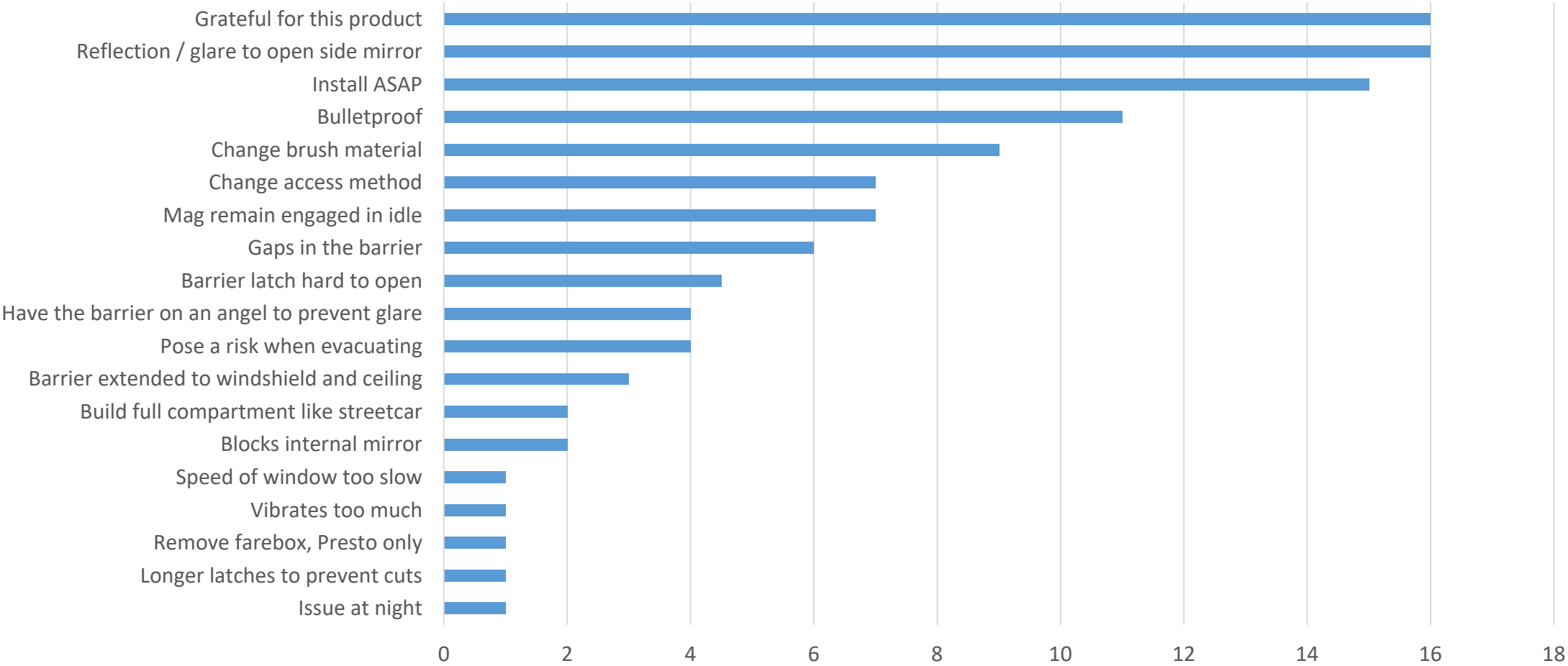


# Roadshow Overall Satisfactory Results





# Roadshow Overall Satisfactory Results



# Demonstration



