DESIGNING FOR DRIVERS THROUGH ERGONOMICS

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INTRODUCTION

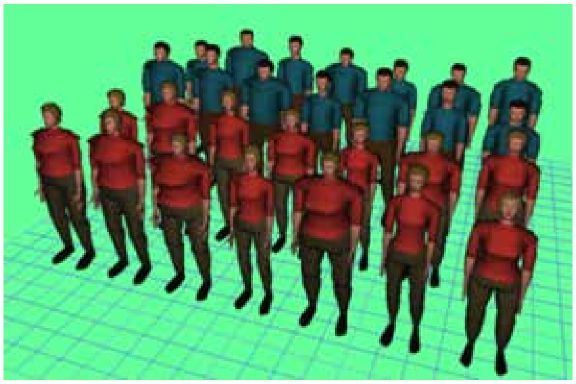
When designing our buses our goal was to create a vehicle that appeals to drivers. As such, our team focused heavily on how drivers use their buses day-to-day and then worked to create bus designs that support their activities and tasks. During the design process we modified our bus designs repeatedly to ensure the end product would be ergonomically friendly to its drivers.

But what makes an ergonomically friendly bus? Is it a more comfortable seat? Is it a cockpit layout that's easy to operate? At IC Bus, we view ergonomics as a systematic and deliberate approach to designing a vehicle that fits the needs of its drivers. This lets them concentrate less on the bus, and enables them to better perform their duties in a safe and effective manner. Following this approach, the design team focused on three core areas to deliver a bus that is designed for drivers: the drivers themselves, the tasks drivers perform, and the vehicle.

UNDERSTANDING THE DRIVER

First, we looked at the drivers themselves, or more specifically, at their sizes and shapes. We took 36 different body measurements of nearly 1,500 actual school bus drivers from six locations across the country. By understanding key physical characteristics such as height, weight, and arm and leg length, we could begin to understand how to lay out the bus cockpit to fit a wide range of drivers.

We then went one step farther by using this information to create 28 virtual bus drivers, or manikins, who represent the range of driver shapes and sizes. These manikins then became our driver "test pool." We used them in digital analyses to evaluate various bus designs for fit.



IC Bus Driver Test Pool: The 28 virtual bus drivers, or manikins, who represent the range of driver shapes and sizes.

Therefore, by forming this accurate picture of drivers' sizes and shapes the design team was able to match the final product with drivers' capabilities and limitations. And using real drivers to create these manikins for our test pool formed an essential part of our design process, thereby increasing the accuracy of our results.

UNDERSTANDING THE TASKS PERFORMED

Understanding the tasks drivers perform during their daily routes was the next step in the process. Our team videotaped drivers at work to learn how they do their jobs. From this video the designers observed drivers performing different types of tasks such as stopping at intersections, loading or unloading passengers, encountering pedestrians, merging onto a roadway, managing passengers and communicating by radio with dispatchers.

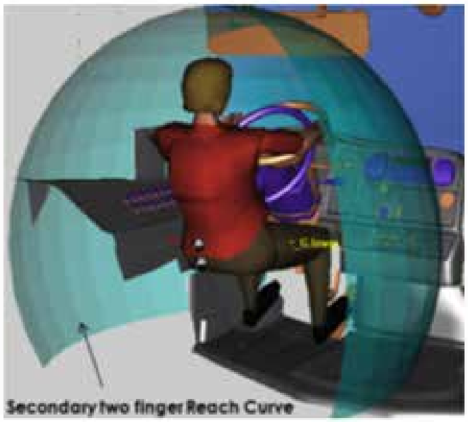
From the videotapes we extracted important information such as the order in which tasks are performed, which controls or switches are used for a task and in what order, the number of times each control and switch is used, and how long it takes to complete a given task. From these data, we were able to see that the traditional process for loading and unloading children involved up to 17 different steps. By revising the control layout in the bus to better match the logical flow of tasks, we were able to reduce that number to 12. With fewer steps for drivers to think about and perform each time they load or unload passengers, they are free to focus more on monitoring students inside and outside the bus.

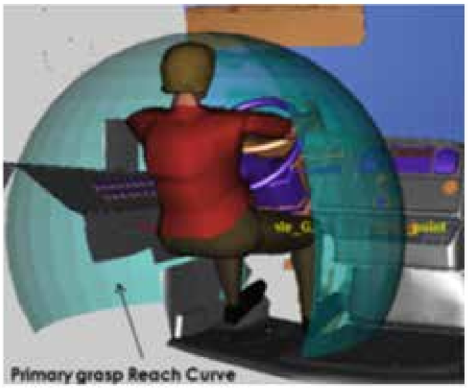
It's quite simple. This systematic approach to understanding how drivers interact with a vehicle allowed our team to build a bus that makes it easier for bus drivers to do their jobs.

UNDERSTANDING THE VEHICLE

Once we had an understanding of the driver and the tasks they're performing, we created digital models of IC Buses and those of our competitors and conducted digital ergonomic analyses. This allowed our designers to evaluate different bus designs in the digital world before creating physical bus models. This provided us with an efficient and effective process to iterate the bus design – trying different concepts and evaluating them – to zero in on the optimized vehicle layout. One practical example is our use of what we call a control reach curve – the reach area within which most drivers work. Building bus models that include all controls inside that area ensures we're designing a bus that goes beyond meeting drivers' needs to designing a bus that truly makes their jobs easier. Additionally, we looked at the optimal range of the driver seat positions as it relates to the steering wheel and pedals and ensured the seat can be adjusted to meet the needs of the largest number of drivers.

In addition to positioning controls within easy reach, we also focused on ensuring drivers can see the world outside the bus. While we design and position our mirrors to meet all applicable federal regulations and state requirements, we also used our digital bus drivers to help us position the mirrors. Utilizing two digital bus drivers, a large male and small female, to illustrate views of the mirrors from the driver's seat, engineers then positioned the mirrors accordingly. This ensures that mirrors aren't hidden from view by the sides of the bus and that drivers of different heights can easily see them.





Visual examples of the control reach curve – the reach area within which most drivers work.

RESULTS

Due diligence in the ergonomic design of our buses is an important differentiator that sets IC Bus apart. The results include the purposeful placement of the driver seat and the steering wheel, improving driver comfort (for school bus drivers of all sizes) and giving them the perception of a roomier workspace. Easy to read gauges and easy to reach controls, with controls like door open/close integrated on the steering wheel itself allow drivers to focus less on the bus and more on the most important part of their job: protecting the passengers.