



# THE TRIBUS E-BUS GOES TO TOWN

## ALTAIR SIMSOLID POWERS LIGHTER AND MORE ENERGY EFFICIENT ELECTRIC BUS

### About the Customer

The Tribus Group in Utrecht, Netherlands with operations in 19 countries, specializes in creating innovative mobility solutions. Its mission since its founding in 1998 is to make mobility possible for everyone. As a market leader in small-scale passenger transportation, Tribus Group develops products for wheelchair-accessible passenger transportation ranging from foldable, ergonomic seats and easy-to-install wheelchair lifts to electric minibuses and low-floor buses.

A recent innovation is its awarded Movitas electric city bus – an energy efficient, modular, and 100% electric city bus for public transportation and parcel deliveries. Designed and built entirely in-house, the bus features zero emission technology while offering the highest passenger comfort. Driven by its high-quality standards and its wish for continuous improvement, the Tribus team has been employing 3D design software and recently started using Altair simulation solutions.

### Their Challenge

The first Movitas design was based on a traditional chassis and wheel suspension with hydraulic springs, which greatly influenced the overall weight. The Tribus engineers were asked to optimize the entire bus within the existing design and dimensions to minimize energy consumption and extend the driving range. As range and comfort are important differentiating factors, the challenge was to reduce the weight of the vehicle by 1,500 kilograms while improving the ride comfort. Tribus, who previously used a 3D design software to develop and design its products, needed a solution that could perform finite element method (FEM) analysis and concept studies to predict the structural behavior of the new Movitas.

**1.9t** ▼  
WEIGHT REDUCTION

**100%**  
ELECTRIC TECHNOLOGY

**50%** ▼  
REDUCED DEVELOPMENT TIME

Looking for a dedicated software for rapid design iterations that supported FEM analyses, the team discovered Altair SimSolid™ and soon realized that it would enable them to quickly evaluate new design ideas while simultaneously leveraging unused optimization potential. Tribus was impressed by SimSolid's structural analysis capabilities, especially its speed and accuracy.

While the 3D design software used to develop the first Movitas prototype also included analysis and simulation capabilities, Tribus decided to add SimSolid into the workflow as it runs considerably faster and is easier to use for concept studies.

### Our Solution

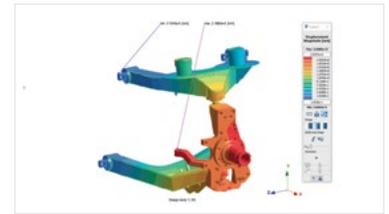
First, Tribus identified several areas with potential for significant improvement because the first prototype was designed based on existing bus knowledge and technology. As there is a direct correlation between weight and energy consumption, the Tribus engineering team carried out several FEM analyses to study the impact of each area on the potential weight reduction. The engineers redesigned the suspension as well as the associated steering and spring/damper subsystems from scratch. As a result, the second prototype now has air springs and improved power steering on the front axle. These two modifications alone reduced the weight of the second prototype by roughly 400 kilograms, while also improving comfort.

Additionally, the team was also able to optimize the chassis by using an improved battery pack on the floor of the vehicle which improved the roof structure to better absorb the occurring internal forces. Both improvements resulted in a weight reduction of around 1,900 kilograms. Even though a replacement of the steel rims and wheel hubs with aluminum could have saved additional weight, Tribus decided to stick with steel as the material is more cost effective and less prone to damage.

### Results

The optimization of the Movitas bus resulted in a total weight reduction of 1,900 kilograms, which far exceeded the set targets, making it both more energy-efficient and comfortable while also enhancing the overall competitiveness of the electric bus. For Tribus, working with SimSolid also accelerated its development process.

"A major advantage of SimSolid is the fact that you no longer need to simplify and 'mesh' a 3D CAD-model beforehand," said Bert van Oosten, M.Eng., Tribus. "The software also performs an analysis of large assemblies at an unparalleled speed. We have carried out static linear and static nonlinear analysis with different connection types on a 1.5 GB model. The FEM-modules provided with 3D design software require many additional hours of meshing and simplifying of such a model. In contrast, SimSolid's tremendous analysis speed is reducing our redesign phase and therefore the time-to-market for the Tribus Movitas."



**TOP:** Altair SimSolid enables the simulation of the rear suspension displacement at a vertical impact of 3G.

**BOTTOM:** The Movitas city bus is an energy efficient, modular, and 100% electric city bus for public transportation and parcel deliveries.