CASE STUDY

INTEGRATED SYSTEMS SIMULATION OF ELECTRIC BUSES

EKA MOBILITY IMPROVES THEIR GO-TO-MARKET WITH ALTAIR'S INTEGRATED SYSTEM-OF-SYSTEMS SIMULATIONS

Background Information

Delivering e-Mobility is a significant engineering and operational undertaking that also involves substantial investments. As OEMs begin to create electrified vehicles for their mainstream customers and address issues like range, drivetrain efficiency, and charging times, there's a need for closer multi-disciplinary engineering to avoid developmental silos. A system-of-systems approach therefore becomes vital throughout the product development process.

A single connected model comprising an electric motor, power electronics, vehicle dynamics, battery models, and more allows teams to simulate the performance of the entire product – thus providing better information on its behavior and the interactions between its components and subsystems. This leads to efficient, sustainable e-Mobility solutions for urban transportation.

About the Customer

Pinnacle Industries is a leading automotive seating, interiors, and specialty vehicles company. Together with the Dutch conglomerate VDL Group – one of the world's largest manufacturers of electric buses, trucks, and coaches – the firms have established EKA by Pinnacle Mobility Solutions. EKA is one of the 20 applicants approved under the Indian government's Production Linked Incentive (PLI) scheme to boost domestic manufacturing of advanced automotive technology products. Driven by a low-investment, high-profitability model, EKA introduces innovation and sustainability across every aspect of its business to create new mobility solutions that meet the market's rapidly evolving needs.

4 MONTHS ▼

TIME SAVED WITHIN THE PRODUCT DEVELOPMENT CYCLE

92-95% ▲

SYSTEM SIMULATION ACCURACY WITH ACTUAL DATA

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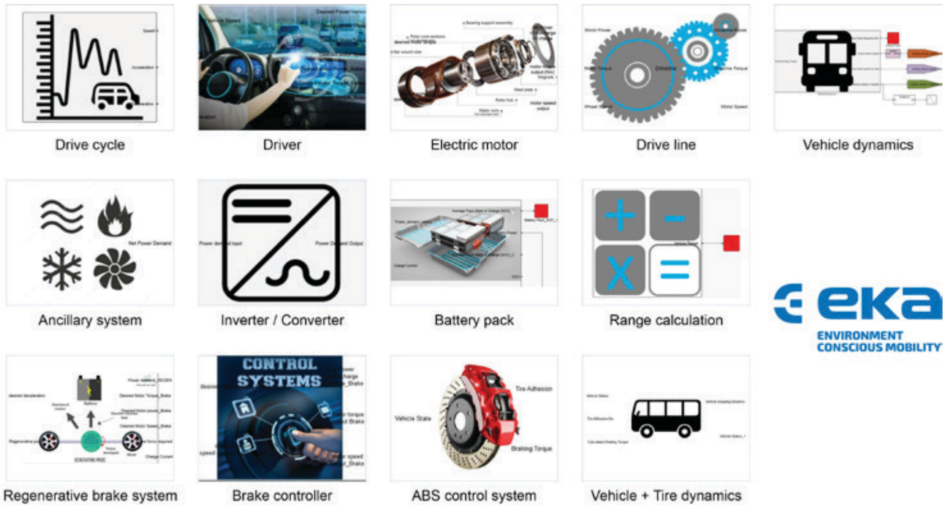

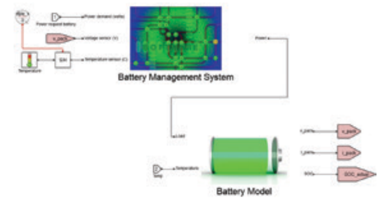

Their Challenge

Electrification drives the competitive mass e-Mobility market that expects innovative products with reduced release timelines. This means teams must understand and optimize systems and components early in the design lifecycle. Insight into system behavior and performance of all the physics-driven subsystems, along with the study of subsystem interactions, can help size key system components early. Further, it verifies if any system-level optimization can be done without compromising system performance targets. A system-level simulation would therefore provide vital inputs on key performance characteristics such as range, state of charge (SOC), motor torque/speed, power consumption, distance traveled, battery parameters, and more.

Our Solution

To gain an understanding of an electric bus's behavior, a full system model was developed encompassing various components such as the battery, motor, driveline, vehicle dynamics, antilock brake system (ABS), regenerative brake, range, and controls. This model was developed using state space dynamic representation of all the key subsystems, which allowed engineers to simulate and analyze the system's behavior for different input drive cycles. The team also used key inputs like rated parameters of the motor and battery, a motor efficiency map, vehicle specifications like weight, drivelines/wheel parameters, and more to represent the system model. The EKA team undertook a thorough validation with the physical test results obtained from standard drive cycles and the real-world random drive cycle data. This validation increased confidence in the simulation output.

Moreover, the team used other factors such as frontal area, rear axle ratio, gross vehicle weight (GVW), and drag coefficient to obtain an optimal combination that maximized the performance of key factors such as energy efficiency, range, and drivability.

Using Altair Activate®, an integrated system simulation technology, upfront insights were available on the key system behavior and battery performance for various drive cycles. This calibrated system model can be extended for the development of digital twins by connecting it to the physical assets running in the field.

Results

An efficient model-based development approach can shorten the go-to-market timeline by centralizing the product development process around a system model. This approach reduces development efforts, helps teams make informed design decisions, saves considerable product development time, and reduces costs.

The results are 92-95% accurate with actual test results. This minimized the need for extensive physical testing and iterative optimization runs, saving both the time and resources the team previously needed by four months.

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