Article and Infographic

# Title: Techniques in Progress to Resolve EV Obstacles in Lightweighting and Battery Performance

Electrification is driving disruptive changes for automakers. It requires new charging infrastructures, battery supply chains, and changes in design-to-cost strategies to name a few. Safety, efficiency, cost, and sustainability are key considerations.

Along with these changes come obstacles slowing their adoption as seen in this infographic.[1] Automotive companies can take these obstacles and turn them into opportunities where they can drive future growth.

In this article, we'll focus on the obstacles in lightweighting and battery performance in EVs. You'll discover some of the solutions being used to try to resolve these complex challenges.

## Obstacle: Lightweighting EVs

Lightweighting is basic physics. The lighter a vehicle is, the less power it takes to move faster. It has become a top priority for automakers to not just achieve better handling, but to also boost fuel efficiency, safety, and sustainability.

A report[2] by the U.S. Department of Energy found that a 10% reduction in weight leads to a 6-8% increase in fuel economy.

Lightweighting is especially important in electric vehicles. In addition to efficient fuel economy, lightweight materials in EVs can:

- Offset the weight of batteries and electric motors improving their driving range
- Enable smaller and lower-cost battery options
- Increase the ability for lighter weight materials (scraps coming out of manufacturing) to be recycled

Software plays a big role in lightweighting. The right software allows engineers to *reliably and predictably* change shape and composition. It begins with early stage product conception and design and continues through studying the effects of the manufacturing processes.

Using integrated digital design, simulation, and manufacturing solutions, such as Dassault's 3DEXPERIENCE Platform and SIMULIA tools[3], designers and engineers can define their design challenges right from the start. They can input parameters such as body mass, stiffness, NHV, and impact/crash across a range of environments to select the right structural material for the right application.

Then the software can automatically create dozens to thousands of design options that best solve complex challenges with EVs. Engineers throughout the process can consistently and efficiently track workflows and changes with less error. Virtual digital simulations can take the place of time-consuming and extremely costly physical prototypes. The result is better reliability and predictability.

Finally these prototypes can be used in additive manufacturing. SIMULIA tools are used to study the effects of manufacturing process parameters such as deposition path, build orientation, and heat intensity and then optimize results. 3D printers can create any shape, so it leaves the engineers with more innovative options for lightweighting of the final design.

An integrated process like the 3DEXPERIENCE PLM platform and SIMULA tools can save weeks of time in the design and manufacturing process while producing a lighter weight product with better performance, accuracy, predictability, and increased safety. It can also reduce manufacturing costs while increasing speed to market.

## Obstacle: Battery Performance

Battery technology has been slow to advance due to problems with materials, storage capacity, thermal properties, safety, environmental concerns, cost, and producing batteries at scale.

Romeo Power Technology[4], a California-based company, is on a mission to end global energy poverty by 2023 and this also means solving the EV battery challenges. They're using SIMULIA and Abaqus[5] software suite, by Dassault Systèmes, to consolidate their tools and their processes while more efficiently resolving battery issues.

EV batteries are based on lithium-ion technology, which happens to be Romeo Power's strength. They are focusing on reducing the battery weight, lowering the cost, and eliminating safety issues as batteries may short out from severe vibration, shock, or other abuses leading to catastrophic failure.

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*"SIMULIA and especially Abaqus are helping us to model these and other failure modes, predicting what will happen if there's penetration during a crash or the effect that vibration can have on cell positions within the pack. It's a very important part of our work." —Saeid Emami, technical specialist, Romeo Power*

Batteries are far more intricate than they appear. Emami describes a lithium-ion battery pack as hundreds of thousands of cells. Voltage levels vary from cell to cell and can cause performance issues. Temperature and humidity are other factors to simulate, and the bigger the pack the bigger the stress from loading. This can lead to short circuits, fire, or mechanical failure.

Each of these conditions are modeled and analyzed, and the individual cell and pack designs are modified. Romeo Power is working closely with support engineers at Dassault to develop a co-simulation model combining various events and behaviors of different electrical and mechanical components. They will test the vast array of potential problems with battery modules and structures. These tests and simulations are vital to meet their design goals of lighter, safer, and less expensive batteries for EVs.

**Summary**

Electrification is driving disruptive changes for automakers. It requires new charging infrastructures, battery supply chains, and changes in design-to-cost strategies, to name a few.

Lightweighting and battery performance are two top challenges in producing efficient, safe, sustainable, and cost effective EVs. With the help of integrated digital design and simulation software, such as Dassault's 3DEXPERIENCE PLM platform, and the SIMULIA software suite for manufacturing issues, these two challenges are on their way to being resolved.

Working with strategic business partners is crucial in identifying gaps and speeding up time to market. If you have questions about your digital design simulation and manufacturing process contact *Adaptive Corporation* and get your questions answered.

**References:** [Note: These are a temporary format requested by the client]

[1] Link to the EV Obstacles infographic | [See the PDF below]

[2] U.S. Department of Energy Report; http://lift.technology/the-road-to-lightweighting-the-tech-materials-leading-the-way/

[3] Dassault's 3DEXPERIENCE Platform and SIMULIA tools; https://www.3ds.com/products-services/simulia/resources/how-simulation-can-help-advance-additive-manufacturing-technology/

[4] Romeo Power Technology: https://www.3ds.com/fileadmin/PRODUCTS/SIMULIA/Initiatives/ev/scn-oct-2018-Romeo-Power-si-ev.pdf

[5] Dassault's Systèmes SIMULIA and Abaqus; https://www.3ds.com/products-services/simulia/products/abaqus/

The Infographic on the next page was a strategy I developed and created to add visual interest to the topic on EVs. Then I was able to repurpose the information and build out other topics specific to the company's expertise, like the article above.

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# 8 Electric Vehicle (EV) Obstacles

These obstacles could slow the adoption and rise of EVs. Advancements are in progress in several areas to open up new possibilities.

## 01 Unacceptable driving ranges

Most driving ranges fall short of consumer's expectations of 245-300 miles, or even on shorter trips using electronics, before battery needs charging.

## 02 Lightweighting EVs

Design-to-cost strategies need to be implemented by increasing design efficiency and reducing manufacturing costs.

## 03 Recharging times

Could take 30 minutes to 12 hours at a charging station. Charging times depend on battery pack sizes, vehicle acceptance rate, and charging stations max output rate.

## 04 Powertrain optimization

Motor efficiency, power supply, energy consumption, and power electronics all affect performance, efficiency, and cost of EVs.

## 05 Battery performance

Technology is slow to advance due to problems with materials, storage capacity, thermal properties, safety, environmental concerns, and producing batteries at scale.

## 06 Consumer appeal has dropped

Higher EV pricing, low gas prices, loss of consumer interest in fuel efficiency, and end of tax credits has limited the appeal to switching to EVs.

## 07 Vehicle connectivity

Challenges exist in accountability for generating energy and tracking production and usage.

## 08 Need more education on EVs

Many consumers don't understand the difference between an EV and a hybrid, the advantages of EVs, and what car manufacturers really offer.

SOURCES

Summary of Gartner Report: What a CIO Needs to Know About the Rise of Electric Vehicles
https://www.gartner.com/doc/3895006/cio-needs-know-rise-electric
EIA Energy Conference
https://www.eia.gov/conference/2018/pdf/presentations/alexander_edwards.pdf
https://www.eia.gov/conference/2017/pdf/presentations/rebecca_lindland.pdf
TeslaRati
https://www.teslarati.com/tesla-ev-industry-shift-production-strategy/
ClipperCreek
https://www.clippercreek.com/charging-times-chart/

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