

Detroit Engineered Products (DEP) is an engineering services, product development, software development, consulting, & talent acquisition company. Since its inception in 1998 in Troy, USA, DEP is now a global company with footprints in Europe, China, Korea, Japan, & India. DEP uses an accelerated and transformed product development process, accomplished by utilizing our proprietary platform, DEP MeshWorks, which rapidly reduces the development time of products for all segments. DEP, as an engineering & re-engineering service provider, is committed to developing world-class products for our customers that involve rigorous research, design studies, detailed engineering, & testing.

From concept to completion, DEP's product development suite encompasses a whole gamut of engineering services for a diverse product range, making it superior to other competitors in terms of cost, features, & performance. As an extended engineering arm / R&D center, DEP aims to support various customers with tailored solutions integrated with value engineering techniques, making the products "manufacture-ready". As a technology-driven company, we leverage industry-best practices to innovate design, automate processes, & accelerate time to market for complex products in different industry segments.

The robust portfolio of our product development services includes research, benchmarking, reverse engineering, design and styling, detailed engineering (CAD/FEA/CFD/CHT), design for manufacturing, and prototyping. Our exceptional experience and vast expertise in the engineering domain made us 'the' trusted partners for many automakers, OEMs, Tier 1 & 2 suppliers, and various other organizations in multiple industry segments. The unique combination of efficient processes, advanced tools, & the right expertise at DEP helps deliver the most client-specific service at all times and at any stage of your project lifecycle. Our product designers and engineers know how to design an optimized product in terms of engineering and production while at the same time considering other aspects like innovation, scale, skills, cost, etc. With DEP's assistance, one can bring innovative & high-quality products to market efficiently and at a rapid rate, meeting and exceeding customer expectations.



BATTERY MANAGEMENT SYSTEM

Battery Solutions: Pathway to Green Mobility

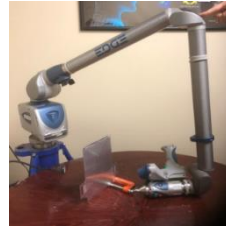
Battery solutions in the automotive industry are critical for advancing electric and hybrid vehicles. These solutions encompass various aspects such as battery management systems (BMS), system-level modeling, thermal management, and structural analysis. BMS ensures efficient monitoring, control, and protection of the battery pack, while system-level modeling enables accurate performance prediction and optimization. Thermal management systems regulate battery temperature, ensuring optimal operation and longevity. Structural analysis ensures the structural integrity and safety of the battery pack. By integrating these battery solutions, automakers can enhance the performance, efficiency, and reliability of electric and hybrid vehicles, driving the transition toward a sustainable and greener automotive future.

<p>Exploratory Technology Research</p>	<p>Applied Battery Research for Transportation</p>	<p>Battery Development</p>	<p>Battery Testing, Design and Analysis</p>
<p>Novel Materials, R&D, Diagnostics and Modelling</p>	<p>Next Generation Cell R&D</p>	<p>Battery Development and Cost Reduction</p>	<p>Standardized Testing Life/Cost Projections Design Tools</p>

System Level Modelling

Cell and Module Level Analysis

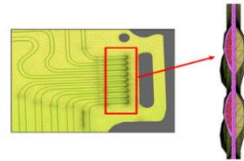
- Newman Electrochemistry
- Electrochemistry
- Lithium Plating
- Cell Ageing
- Cell Crush
- Thermal Runaway
- Cell Charging and Discharging
- Cell Over Discharging



3D laser scanning at DEP



CAD of cold plate (after scanning)



Meshing in DEP's MeshWorks

Battery Pack Analysis

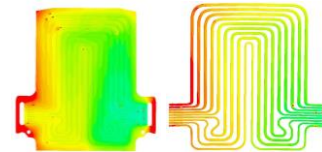
- Equivalent Circuit Modelling
- Thermal Runaway-Damaged Cell
- Bus bar- Heat Generation
- Battery Pack Aging analysis

Thermal Analysis

- Hard short
- Ripple and Electro-Thermal
- Pressure drop
- Battery Pack Thermal analysis

Battery Management System (BMS):

- Battery Structural Analysis
- Optimization
- Reverse Engineering
- Testing and Certification of Batteries as per standards.



Battery management systems do not have a fixed or unique set of criteria that must be adopted. The technology design scope and implemented features generally correlate with:

- BMS design considers battery pack costs, complexity, and size.
- Application-specific factors like safety, lifespan, and warranty impact BMS design.
- Compliance with government regulations is crucial for functional safety and avoiding penalties.
- BMS incorporates features such as battery pack protection management and capacity management.
- Battery pack protection management includes electrical and thermal protection.
- Electrical protection prevents battery damage by limiting usage beyond the safe operating area (SOA).
- Thermal protection controls temperature passively or actively to keep the battery pack within its SOA.

Battery Thermal Testing (Experimental and Simulation)

- IR Imaging of the battery cell.
- Thermal Simulation of the Battery pack
- Electro-Chemical simulation of battery chemistry.
- Battery aging test

Battery Structural Analysis

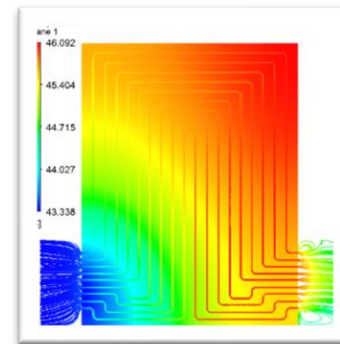
Battery packs experience diverse loads from external and internal factors. Structural components must withstand these loads for the safety of occupants and battery modules. Safety is crucial to endure internal gas pressure in various conditions. Durability analysis via virtual simulations predicts real-world load handling before prototyping. Virtual simulations optimize battery pack design for structural performance in operations, assembly, and transportation.

Reverse Engineering

It is a process of deconstructing an EV battery or any product, to understand its inner workings. DEP is equipped with a 3D laser-scanning facility. Destructive testing (tear down), Non-destructive testing techniques like 3D scanning followed by CAD creation and simulation, which can be applied to a battery.

Typical parameters extracted from tear-down and reverse engineering :

- Number of cells
- Number of anode and cathode and separator sheets
- Cold plate design
- Layer unit stack resistance
- Thermal conductivity of +ve and -ve electrode
- Material properties
- 3D scan of battery pack level thermal management system



Cell level cooling analysis

