

**About DEP:** Detroit Engineered products (DEP), is an engineering services, product development, software development, consulting and talent acquisition company. Since its inception in 1998 in Troy, USA, DEP is now a global company with footprints in Europe, China, Korea, Japan, and India. DEP uses the 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's Electric Two Wheeler Solutions:** Looming environmental concerns has accelerated the use of alternative solutions in the automotive field, with technologies like multiple-fueling, hybridization and electrification. The EV/HEV initiatives are facing lots of design challenges because of increasing dependency on electrical components and overall complexity, coupled with short design cycles. DEP's product development team is equipped with capabilities to address these issues, and by using enhanced engineering methodologies coupled with reliability & innovation, the team at DEP can support any e-scooter project.

DEP's Design Development team has developed a technology prototype of an electric scooter, which displays our various engineering capabilities for the electric scooter market. DEP's design team has used an existing conventional vehicle, retrofitted with an electric powertrain. The exterior body panels have been restyled for aerodynamic performance and has been given a styling and engineered design which is optimized to give the lowest drag. Frugal engineering principles have been used to ensure that an electric scooter can be developed at the same price as a conventional one while delivering optimal performance in the shortest possible time.

As a reliable partner, we tailor customer-specific solutions for the complete 2-wheeler modeling process. Starting with principle features of batteries, motors, controllers, alternators, and wiring harnesses to testing, analysis, verification and validation we provide a wide array of customizable solution packages. DEP's modular-based design services aid customers in their product design projects by using frugal engineering principles making exciting technology available to the users at affordable prices. Our robust and comprehensive methods save an immense amount of time during developmental stages thus contributing to overall efficiency.

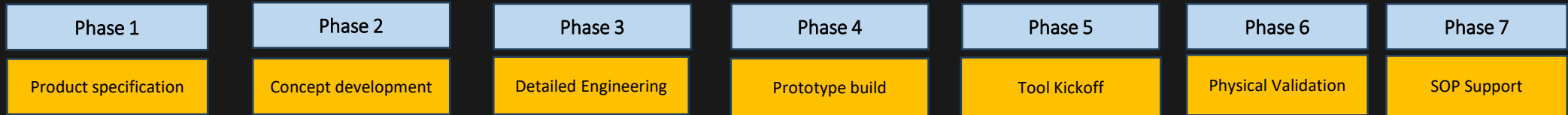


Smarter solutions. Realized.



## ELECTRIC TWO WHEELER

### 2-Wheeler Product Development Process



## Product specification/Target setting

- General bench marking to understand competitor vehicle geometry, performance and durability
- Ergonomics to understand rider comfort
- RLDA (Road Load Data Acquisition) to set target

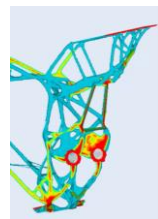
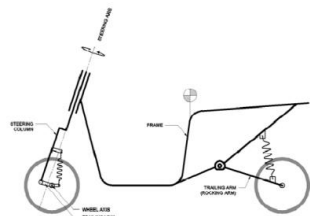
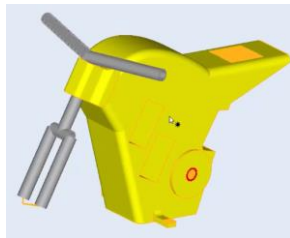
## Concept Development

- New layout concepts
- Motor and battery sizing and finalization (1D Systems model simulation)
- Chassis and swing arm finalization (MBD based loads and FE analysis to validate concept)
- Suspension/Brakes finalization (MDB model to finalize suspension stiffness and damping characteristics)
- Class A surface finalization
- Mule vehicle build to verify the concept and performance

Vehicle dynamics  
(Loads Generation)



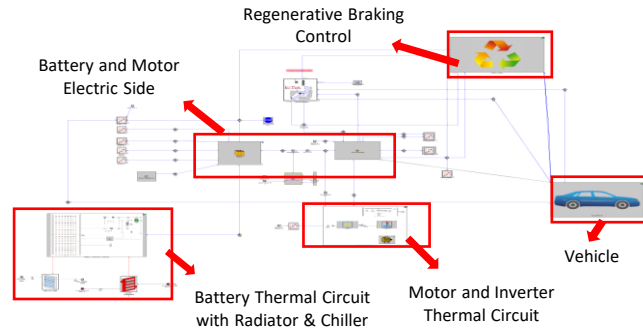
Topology Optimization



Vehicle concepts

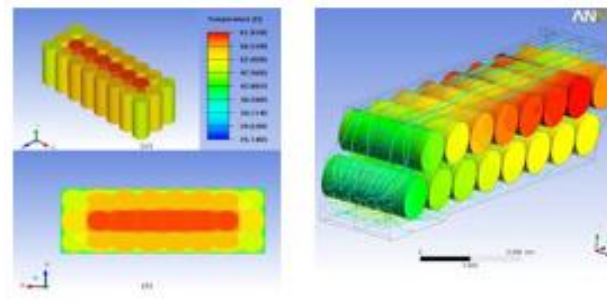
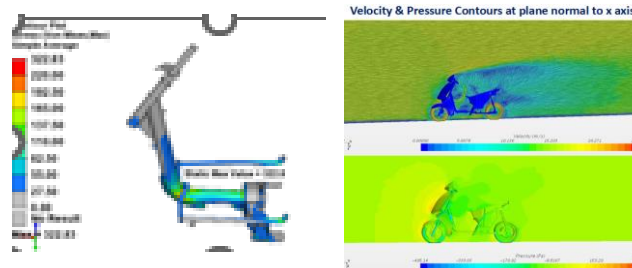


## 1D-systems Modelling for Motor and Battery sizing



## Detailed Engineering

- Detailed Engineering of 2w And 3w Chassis
- Steering, Axle, Suspension, Packaging and Mechanisms
- Detail CAE analysis
- Electro - Magnetism analysis (EMA)
- High frequency noise analysis of driver unit
- Shock & Vibration analysis of Batter/Invertor
- DFMEA, 2D, STACK UP



## Proto Build

- Packaging and functionality verified in the prototype build
- Updating CAD and drawings are done based on proto test results

## Final CAD Model for Tool Kickoff

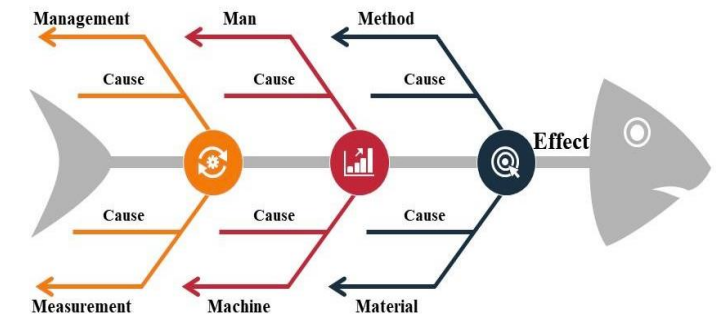
- Final 3D CAD
- Final production drawings
- Stack up, DFMEA reports
- Final CAE reports
- Final BOM

## Physical Validation

- Verification of Vehicle durability, ride, handling, and performance parameters
- A complete design verification plan is made, and vehicle is validated



## SOP-Support, Production, Market Issue Closure



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