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 has expanded globally, with operations in Europe, China, Korea, Japan, and India. DEP employs an accelerated and transformed product development process, facilitated by our proprietary platform, DEP MeshWorks, which significantly reduces the development time of products across various industries.

In the realm of two and three-wheeler services, design, and product development, the focus lies on ensuring safety, efficiency, and customer satisfaction. Innovative design solutions are continuously explored to enhance comfort, aesthetics, and fuel efficiency across both vehicle types. Additionally, product development efforts integrate advanced technologies such as electric propulsion systems and smart connectivity features to meet evolving market demands for eco-friendly and digitally enhanced two and three-wheelers, fostering efficiency and safety in urban mobility.

Equipped with cutting-edge capabilities, DEP's product development team is poised to tackle challenges in the 2 and 3-wheeler domains. Leveraging enhanced engineering methodologies and a commitment to reliability and innovation, we provide comprehensive support for e-scooter and three-wheeler projects. As a trusted partner, we offer tailored solutions for the entire modeling process, from fundamental components like batteries, motors, and controllers to testing and validation. Our modular-based design services, rooted in frugal engineering principles, enable us to deliver exciting technology at affordable prices. By adopting robust and efficient methods, we streamline development stages, saving significant time and resources while ensuring overall effectiveness.

DEP

Smarter solutions. Realized.

2-WHEELER AND 3-WHEELER SOLUTIONS

Product Development Process

Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7
Product Specification	Concept Development	Detailed Engineering	Prototype Build	Tool Kick-off	Physical Validation	SOP Support

Powered by

DEP MeshWorks

Product Specification/Target setting

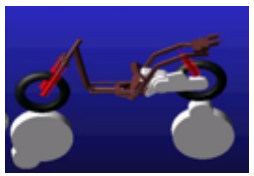
- General benchmarking to understand competitor vehicle geometry, performance, and durability
- Ergonomics to understand rider comfort
- RLDA (Road Load Data Acquisition) to set target

Concept Development:

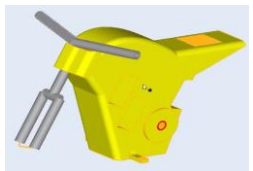
Design feasibility:

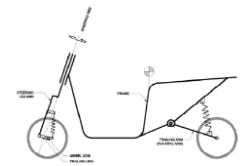
- New layout concepts
- Motor and battery sizing and finalization(1 D Systems model simulation)
- Chassis and swing arm finalization (MBD based loads and FE analysis to validate concept)
- Suspension/Brakes finalization (MDB model to finalize suspension stiffness and damping characteristics)
- Class A surface finalization
- Mule vehicle built to verify the concept and performance
- Split lines, styling, homologation
- Design For Manufacturability **:** Ergonomics

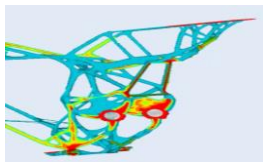
Vehicle dynamics (Loads Generation)



Topology Optimization



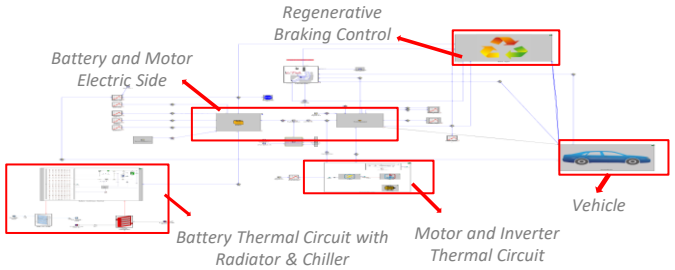




Vehicle concepts

Detailed Engineering

1D –systems Modelling for Motor and Battery sizing



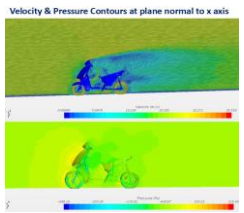
- Electro - Magnetism analysis(EMA)
- High-frequency noise analysis of driver unit
- Shock & Vibration analysis of Batter/Invertor

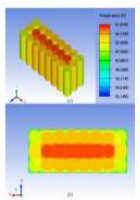
Full vehicle dynamics:

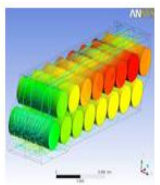
- Study suspension, ride quality, and handling for 2W and 3W vehicles.
- Use supplier-provided suspension parameters and vehicle mass to build an initial dynamics model.
- Refine design iteratively to enhance ride comfort and handling precision.
- Validate durability by extracting real-world loads from vehicle dynamics data.

CFD Analysis:

- Conduct CFD analysis for optimized thermal packaging of controller and battery.
- Explore battery placement options through baseline aerodynamic analysis.
- Determine optimal orientation and packaging via thermal flow CFD simulations.
- Iterate CFD for design modifications in subsequent milestones.







Detailed Engineering of Chassis and Mechanisms:

- Chassis & Mechanisms Engineering:
- Detailed design of chassis, Swing Arm, and mechanisms.
- Regular design review meetings.
- Designing automated mechanisms for vehicle mounting.
- Packaging powertrain components for integration.
- Empirical design calculations for component selection.
- Packaging and integrating vehicle components.
- Developing a modular platform.
- Considering wiring harnesses and bracket design.

Prototype Build

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

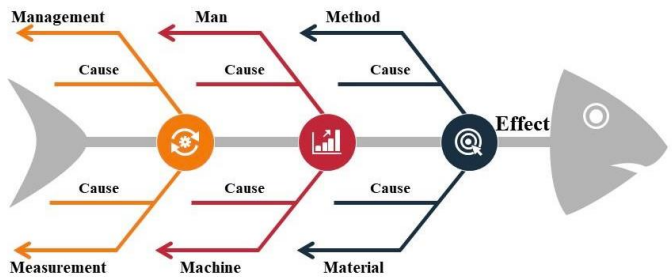
Final CAD Model for Tool Kickoff

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

Physical Validation

- Vehicle durability, ride, handling, and performance parameters are verified.
- A complete design verification plan is made, and the vehicle is validated

SOP-Support, Production, Market Issue Closure



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