

Introduction to Problem Solving in

Introduction to Problem Solving in Automotive Engineering

Automotive Engineering

Designed as a quick-reference guide for students and professionals

1. Why Problem Solving Matters in Automotive Engineering

Aspect	Reason
Safety	Faulty designs can lead to accidents, injuries, or recalls.
Performance	Optimizing power, efficiency, handling, and emissions requires iterative solutions.
Cost & Time	Early detection of issues reduces rework, tooling changes, and warranty expenses.
Regulation	Vehicles must meet ever-tightening standards (e.g., Euro6, FMVSS).
Innovation	New propulsion (EV, fuel cell) and autonomous systems demand fresh solution approaches.

2. Core Problem-Solving Process (Adapted from the “Engineering Design Cycle”)

1. Define the Problem

- Clarify *what* needs to be solved, *why* it matters, and *who* is affected.
- Example: “Excessive brake fade under repeated hard braking on steep descents.”

2. Gather Information

- Collect data: test results, customer feedback, standards, OEM specifications.
- Use tools: literature review, FMEA, cause-and-effect (Ishikawa) diagrams.

3. Generate Concepts

- Brainstorm multiple solutions (no judgment at this stage).
- Apply creativity techniques: TRIZ, SCAMPER, morphological analysis.

4. Select a Concept

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- Evaluate against criteria: performance, cost, manufacturability, reliability, sustainability.
- Use decision matrices, weighted scoring, or rough comparisons.

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5. Develop & Analyze

- Create detailed designs: CAD models, schematics, simulation setups.
- Perform analysis: finite element (FEA), computational fluid dynamics (CFD), multi-body dynamics (MBD), thermal, electrical.

6. Prototype & Test

- Build physical or virtual prototypes.
- Conduct bench, chassis?dyno, and vehicle?level tests. Record data for validation.

7. Iterate

- Compare test results with predictions.
- Identify gaps ? refine model or redesign. Repeat until targets are met.

8. Implement & Document

- Finalize production drawings, process plans, and quality?control procedures.
- Capture lessons learned in a **Design Review Report**.

3. Common Automotive Engineering Problem Types

Category	Typical Issues	Representative Tools
Powertrain	Low torque, high emissions, thermal runaway	Engine mapping, combustion simulation, dynamometer testing
Chassis & Suspension	Unstable handling, noise, vibration	Multi?body dynamics, modal analysis, NVH testing
Braking & Safety	Brake fade, pedal feel, ABS malfunction	Brake system modeling, CFD for cooling, hardware?in?the?loop (HIL)
Electrical/Electronic	Wiring harness failures, sensor drift	Circuit simulation (SPICE), CAN bus analysis, reliability block diagrams

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Category	Typical Issues	Representative Tools
Thermal Management	Overheating problems, coolant leaks	CFD (Computational Fluid Dynamics) models, infrared thermography
Manufacturing/Process	Tool wear, assembly errors, cost overruns	DOE (Design of Experiments), statistical process control (SPC), value analysis

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4. Key Analytical & Computational Methods

Method	What It Solves	Typical Software
Finite Element Analysis (FEA)	Stresses, deformation,	