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Motor Vehicle Structures: Concepts and Fundamentals Jason C. Brown, A. John Robertson Cranfield University, UK
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Automobile Engineering [edit] Automobile Engineering is a branch study of engineering which teaches manufacturing, designing, mechanical mechanisms as well operations of automobiles. It is an introduction to vehicle engineering which deals with motorcycles, cars, buses, trucks, etc. It includes branch study of mechanical, electronic, software and safety elements. Some of the engineering attributes and disciplines that are of importance to the automotive engineer and many of the other aspects are included in it: Safety engineering is the assessment of various crash scenarios and their impact on the vehicle occupants. These are tested against very stringent governmental regulations. Some of these requirements include: Assessments are done with various methods and tools, including Computer crash simulation typically finite element analysis , crash test dummy , and partial system sled and full vehicle crashes. Visualization of how a car deforms in an asymmetrical crash using finite element analysis. Fuel economy is the measured fuel efficiency of the vehicle in miles per gallon or kilometers per liter. Emissions testing includes the measurement of vehicle emissions, including hydrocarbons, nitrogen oxides NO_x , carbon monoxide CO , carbon dioxide CO₂ , and evaporative emissions. NVH engineering noise, vibration, and harshness: While sound can be interpreted as a rattle, squeal, or hot, a tactile response can be seat vibration or a buzz in the steering wheel. This feedback is generated by components either rubbing, vibrating, or rotating. NVH response can be classified in various ways: Note, there are both good and bad NVH qualities. Automotive electronics is an increasingly important aspect of automotive engineering. Modern vehicles employ dozens of electronic systems. It would not be possible for automobiles to meet modern safety and fuel economy requirements without electronic controls. Performance can also reflect the amount of control in inclement weather snow, ice, rain. This is influenced by the powertrain engine , transmission , and the vehicle driveline, suspension , engine and powertrain mounts, etc. Shift feel is both a tactile felt and audible heard response of the vehicle. Shift quality is experienced as various events: Transmission shifts are felt as an upshift at acceleration $1\hat{e}^{-2}$, or a downshift maneuver in passing $4\hat{e}^{-2}$. Shift engagements of the vehicle are also evaluated, as in Park to Reverse, etc. Durability and corrosion engineering is the evaluation testing of a vehicle for its useful life. Tests include mileage accumulation, severe driving conditions, and corrosive salt baths. Cold starts and stalls, RPM dips, idle response, launch hesitations and stumbles, and performance levels. The cost of a vehicle program is typically split into the effect on the variable cost of the vehicle, and the up-front tooling and fixed costs associated with developing the vehicle. There are also costs associated with warranty reductions and marketing. To some extent programs are timed with respect to the market, and also to the production schedules of the assembly plants. Any new part in the design must support the development and manufacturing schedule of the model. It is easy to design a module that is hard to assemble, either resulting in damaged units or poor tolerances. Quality control is an important factor within the production process, as high quality is needed to meet customer requirements and to avoid expensive recall campaigns. The complexity of components involved in the production process requires a combination of different tools and techniques for quality control. This standard defines the design, development, production, and when relevant, installation and service requirements. Since the s, the comprehensive business approach total quality management , TQM, helps to continuously improve the production process of automotive products and components. Much like the Systems Engineer , the development engineer is concerned with the interactions of all systems in the complete automobile. While there are multiple components and systems in an automobile that have to function as designed, they must also work in harmony with the complete automobile. Along with this, it must also provide an acceptable level of: An example of this is the trade-off between engine performance and fuel economy. While some customers are looking for maximum power from their engine , the automobile is still required to deliver an acceptable level of fuel economy. Engine performance is looking for maximum displacement bigger, more power , while fuel economy is looking for a smaller displacement engine ex: The engine size

however, is not the only contributing factor to fuel economy and automobile performance. Different values come into play. Other attributes that involve trade-offs include: The development engineer is also responsible for organizing automobile level testing, validation, and certification. Components and systems are designed and tested individually by the Product Engineer. The final evaluation is to be conducted at the automobile level to evaluate system to system interactions. As an example, the audio system radio needs to be evaluated at the automobile level. Interaction with other electronic components can cause interference. Heat dissipation of the system and ergonomic placement of the controls need to be evaluated. Sound quality in all seating positions needs to be provided at acceptable levels. Manufacturing Engineer[edit] Manufacturing Engineers are responsible for ensuring proper production of the automotive components or complete vehicles. While the development engineers are responsible for the function of the vehicle, manufacturing engineers are responsible for the safe and effective production of the vehicle. Design for Manufacturability in the automotive world is crucial to make certain whichever design is developed in the Research and Development Stage of automotive design. Once the design is established, the manufacturing engineers take over. They design the machinery and tooling necessary to build the automotive components or vehicle and establish the methods of how to mass-produce the product. It is the manufacturing engineers job to increase the efficiency of the automotive plant and to implement lean manufacturing techniques such as Six Sigma and Kaizen. Other automotive engineering roles[edit] Other automotive engineers include those listed below: Aerodynamics engineers will often give guidance to the styling studio so that the shapes they design are aerodynamic, as well as attractive. Body engineers will also let the studio know if it is feasible to make the panels for their designs. Change control engineers make sure that all of the design and manufacturing changes that occur are organized, managed and implemented Configuration and performance optimization, system integration, control, component, subsystem and system-level validation of the intelligent systems must become an intrinsic part of the standard vehicle engineering process, just as this is the case for the structural, vibro-acoustic and kinematic design. This requires a vehicle development process that is typically highly simulation-driven. In this V-approach, system-level requirements are propagated down the V via subsystems to component design, and the system performance is validated at increasing integration levels. It lets design continue after product delivery. That is important for development of built-in predictive functionality and for creating vehicles that can be optimized while being in use, even based on real use data. This approach is based on the creation of a Digital Twin , a replica of the real product that remains in-sync. Manufacturers try to achieve this by implementing a set of development tactics and tools. Critical is a strong alignment of 1D systems simulation, 3D CAE and physical testing to reach more realism in the simulation process. This is combined with intelligent reporting and data analytics for better insight in the vehicle use. By supporting this with a strong data management structure that spans the entire product lifecycle , they bridge the gap between design, manufacturing and product use. International automotive electronics congress.

2: Motor Vehicle Engineering

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