DASSAULT SYSTEMES

FINDING THE BEST BALANCE: INNOVATE BY MASTERING QUALITY, REGULATIONS AND COST THROUGH SIMULATION

There's a paradigm shift underway in the automotive industry, one that is rapidly transforming how vehicle design and engineering are accomplished by automakers of every size. Simulation was once considered almost an afterthought, something only experts were qualified to employ for testing of finished designs or forensic examination of product failures. Today, simulation has become an integrated, core component of the product design and development process from beginning to end, becoming valued for being easy to use and enriching conversations and enhancing communication throughout the enterprise.

THE CHALLENGE OF CHANGE

The transportation landscape is changing, striving to push past the era of manually-piloted vehicles driven by internal combustion engines, and moving towards a new ideal of connected, autonomous, and electric vehicles.

This amounts to an almost complete overhaul of the nature of transportation. New vehicles will be revolutionary in nature, leveraging a wide range of new technologies and new materials.

While the nature of transportation may be changing, some significant factors are not. Engineers must necessarily consider safety, budgetary constraints, quality requirements, the competitive environment and multiple regulatory environments.

Companies that succeed in striking this balance will be optimally positioned to survive and thrive in the rapidly-changing transportation field.

The makers of the next generation of vehicles will have less time to successfully develop, test, and validate their ideas. As a result, they will increasingly turn to sophisticated simulation tools in order to meet their objectives.

The need to quickly adopt new technologies and processes pushes companies to expand collaboration and multi-disciplinary engineering while improving both knowledge capture and full traceability within their enterprises. They are turning to solutions such as the Dassault Systèmes **3D**EXPERIENCE® platform to provide comprehensive integrated simulation throughout the complete product chain, from ideation through design, validation and manufacturing.

Ashok Leyland Leverages 3DEXPERIENCE Platform to Optimize Development

Citing compressed development time frames, the need for optimal quality and the demand to contain costs, Ashok Leyland turned to the **3D**EXPERIENCE platform to cultivate collaboration and optimization across all strata of the development chain, as well as to manage multiple tiers of regulations. Learn more.

VIRTUAL TESTING OF EVERYTHING FOR EVERYONE

Simulation has evolved. What was once a complex, high-cost, narrowly-focused endeavor requiring highly specialized skills has become more affordable, more broadly applicable, and more approachable to users in other disciplines.

Through modern approaches such as the Dassault Systèmes **3D**EXPERIENCE platform, the rigid siloes separating simulation from processes such as design have been bridged; the power of simulation has been placed directly in the hands of designers—moving it forward to encompass even the earliest ideation stages of the product chain.

As embodied within the **3D**EXPERIENCE platform, simulation is more accessible and easier-to-use than in the past. **Delivered as a cloud-based or on-premise solution, it requires ownership of significantly fewer computing resources, reducing both the need for specialized equipment and capital expenditure.** It's also closely integrated with the design and engineering tools practitioners already use every day, so it can be seamlessly woven into existing practices, sharing a unified look and feel and a tailored feature set keyed to user needs.

Employed more broadly across an organization and at earlier developmental stages, simulation has the power to inform early decision making and to shape overall product development. Designers and engineers alike gain the opportunity to vet more concepts, earlier in the development process. This allows them to identify and discard impractical or unworkable ideas sooner, and apply their focus and resources on the most promising and highest value concepts.

SAFETY & QUALITY FIRST

Whether due to numerous past recalls or new safety regulations governing emerging technologies like autonomous driving, companies must prioritize safety and performance regardless of which mobility concepts they pursue. While this necessity is clear and non-negotiable, its pursuit creates practical difficulties within specialized disciplines. Attributes affecting a brake system, for example, such as thermal stresses, deformations, cooling, and durability are highly interdependent with other systems and cannot be accurately evaluated in a siloed engineering environment.

Differing regional requirements create additional complexity. Depending on where in the world products are made and sold, regulations can differ widely, creating varying effects on costs. Manufacturers are concerned about reducing risk and eliminating dead ends, as well as working to optimize quality, regulation and cost without compensating too far in any one direction. **Working on one platform allows all of the teams involved to make quick and agile changes using a single database model, and to test and validate it without compromising must-have targets.**

FULFILLING REGULATIONS, REDUCING EMISSIONS

The internal combustion engine, the mainstay of transportation for more than a century, is now facing challenges on multiple fronts. Government regulators and the marketplace alike are demanding new levels of fuel economy and environmental friendliness. At the same time, the emission-free electric motor is on the ascent, a development made possible by rapid advances in power transmission and storage technology.

Vehicle manufacturers have no choice but to aggressively tackle the emissions problem. Within the European Union, new passenger cars sold in the year 2025 will be required to demonstrate a 15% reduction in CO^2 emissions compared to current levels. This rises to a 30% reduction in the year 2030.

PUSHING THE LIMITS

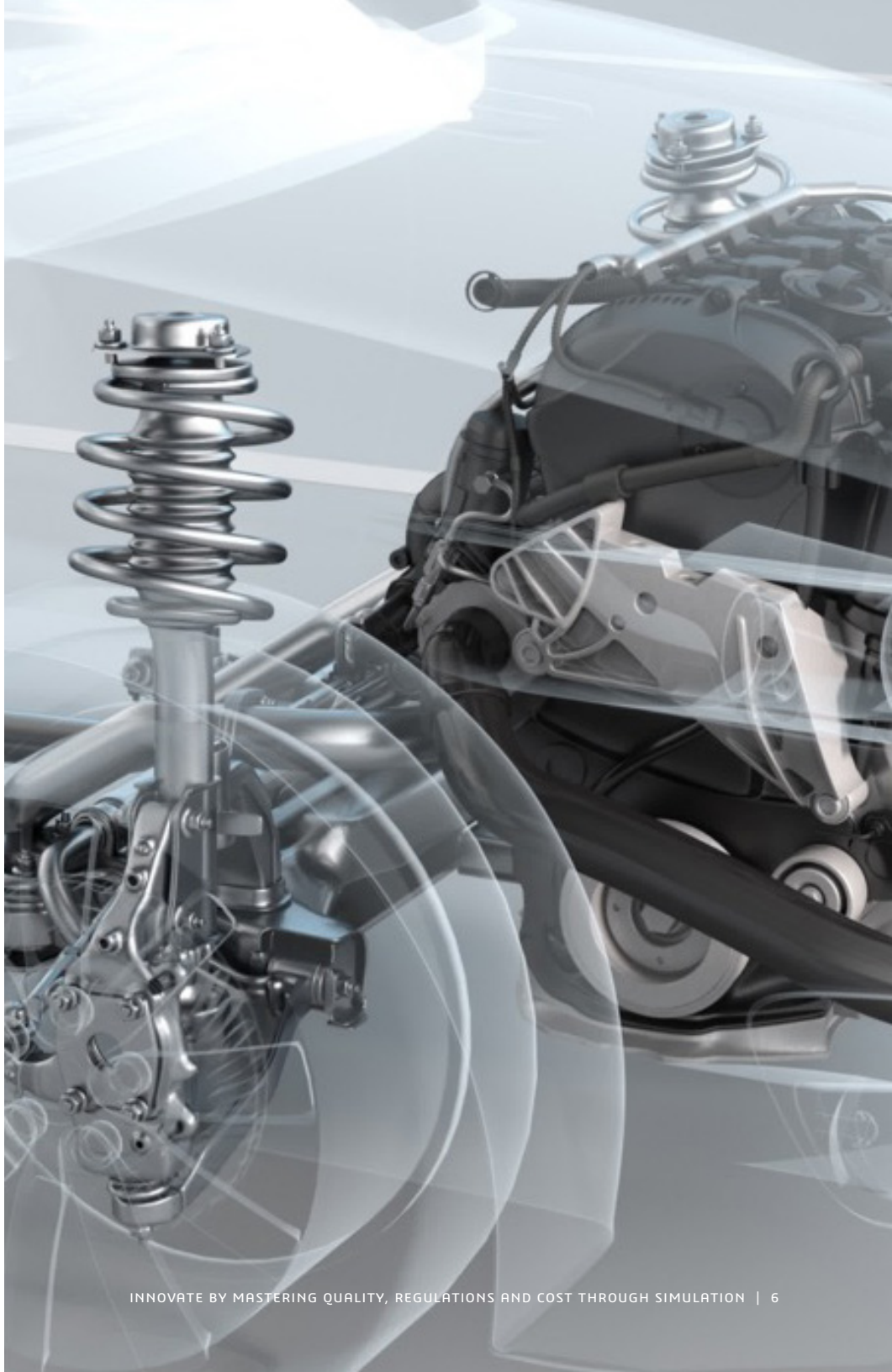
To achieve these targets, vehicle designers typically seek to improve aerodynamics, reduce vehicle mass, and improve powertrain efficiency. Development in each of these areas benefits strongly from the extensive use of simulation, starting in the early stages of the development process:

Aerodynamic performance of vehicles is a powerful determinant of overall operational efficiency and fuel economy. According to the Auto Research Center (ARC), a 10% reduction in aerodynamic drag results in approximately a 5% improvement in fuel economy during highway driving, and a corresponding reduction in vehicle emissions. Fully complex model geometry capabilities within the **3D**EXPERIENCE platform enable designers to optimize aerodynamic performance in the pre-prototype phases.

Reducing vehicle mass helps to increase vehicle performance, boosts fuel efficiency, and enhances compliance with increasingly strict C02 emissions standards. Simulation in the design phase enables engineers to experiment with lighter-weight materials such as composites, as well as the strategic reduction of materials, to reduce weight without compromising structural integrity and durability.

Improved powertrain efficiency can have a dramatic effect on fuel efficiency and emissions reduction; a 20% reduction in torque loss translates into a 5g/km reduction in carbon emissions. The ability to rapidly simulate the performance of multiple competing designs helps engineers to quickly optimize designs for maximum efficiency.

This requires the internal combustion engine to be examined in the greatest possible detail, enabled by high fidelity (larger, more accurate simulation models) and high performance (less time and resources consumed) computing.



Electric Drive Engineering: Complex Challenges Require a Unified Solution

Electric vehicles present designers and engineers with a range of critical challenges in virtually all aspects of product development; most notably the electric drive system itself. A unified simulation solution helps engineers to address these challenges in a coordinated fashion across disciplines and departments, accelerating product development. Learn more.

THE RISE OF THE eVEHICLE

Perhaps the most significant emissions-reduction initiative is the emergence of electrically-powered vehicles—arguably the most significant transformation the automotive industry has experienced to date. Many hurdles to electric vehicle viability have already been surmounted, but much more development is required to put them on a par with internal combustion-powered vehicles relative to a wide range of benchmarks. Current challenges include cost, vehicle range, vehicle performance, carrying capacity, safety, reliability, and durability.

Electrification of cars and trucks introduces new levels of complexity for designers and manufacturers. Complex electric drive, power management, and charging & battery systems create intricate new interdependencies which require effective evaluation and management, even as vehicle makers strive to achieve satisfactory performance benchmarks.

Successful development within a practical time frame again necessitates optimization across multiple, competing disciplines, as well as a mechanism for managing complexity across teams, departments, and developmental stages. At the same time, the need to maximize the potential of existing technologies—for example, the power delivery capabilities of a battery cell—requires ongoing precise refinement. Such factors virtually mandate the integration of simulation into all stages of development, within a platform which optimizes knowledge-building, knowledge-sharing and collaboration throughout the extended enterprise.

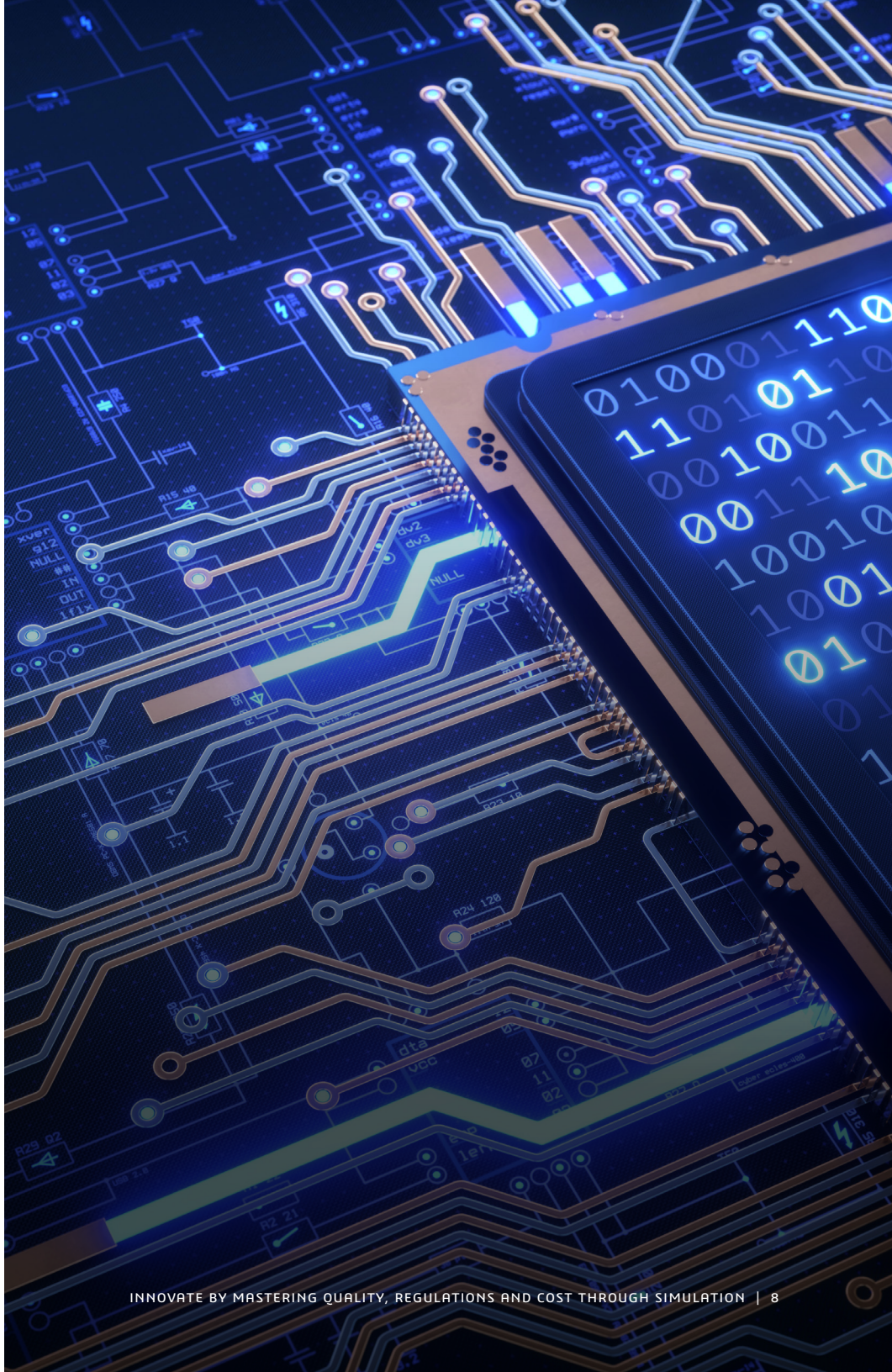
MANAGING THE COMPLEXITY OF ELECTRICAL AND ELECTRONIC SYSTEMS

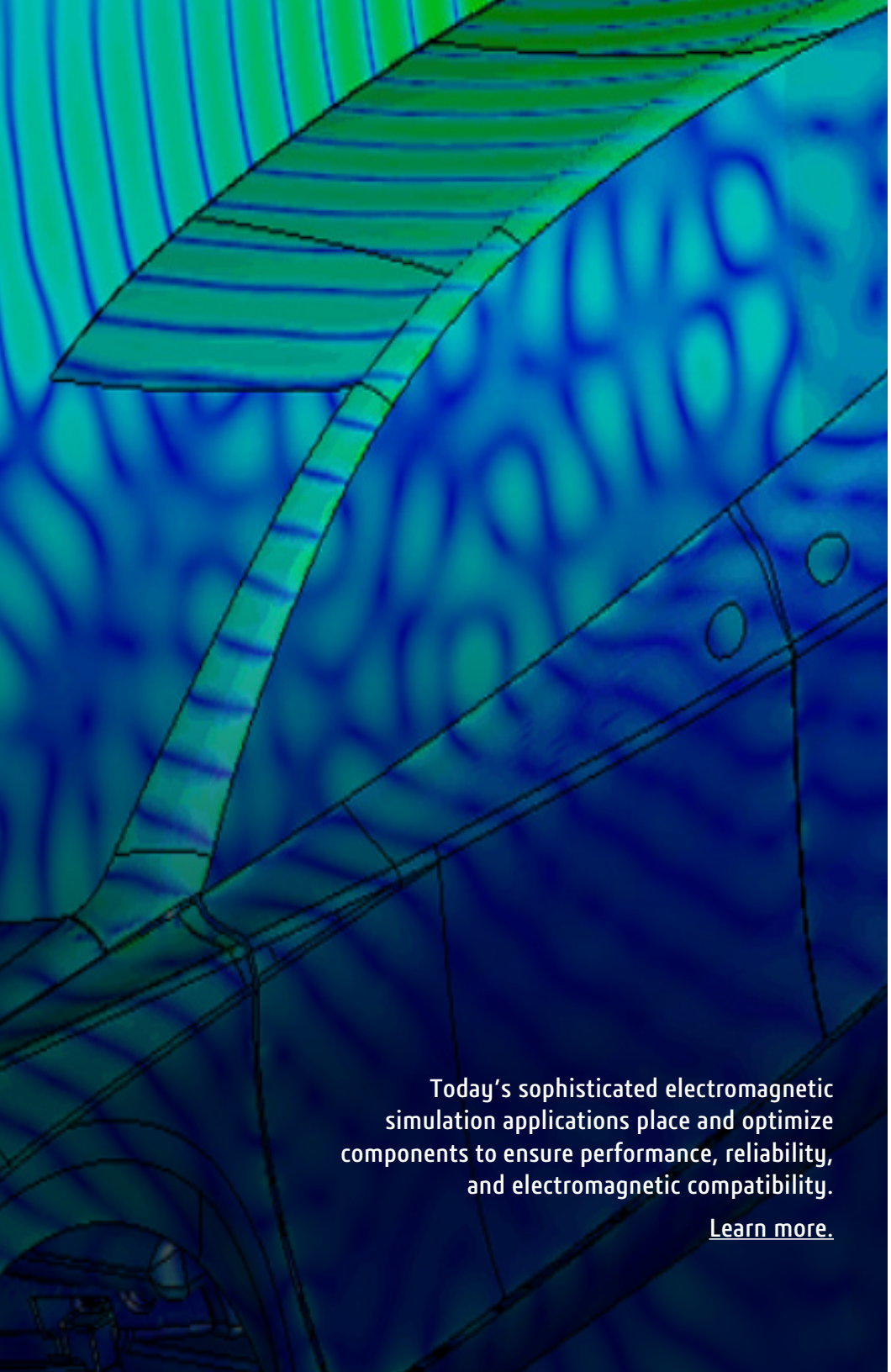
While we are accustomed to thinking of cars as primarily mechanical devices, even today's traditional consumer vehicles contain complex layers of electrical and electronic systems and computerized devices, ranging from critical ignition and braking systems to cabin lighting, comfort systems and radios. Apart from the fact that each of these systems must perform its designated functions flawlessly, they must also seamlessly interoperate with each other—all in the context of a moving, vibrating vehicle, and subject to widely varying climate conditions.

This complexity is exponentially compounded in the emerging class of electric, connected, and autonomous vehicles. Current projections hold that electric and electronic systems will become the primary cost driver for vehicles, amounting to approximately 50% by the year 2030. Next-generation vehicles under development contain a wide array of discrete but interdependent systems whose configurations vary for electric, hybrid, or traditionally-fueled vehicles. These include:

- **Electric powertrain, including motors, batteries, regulators, and onboard charging equipment**
- **Safety devices and sensors**
- **Proximity devices and sensors**
- **Communication and entertainment systems**
- **Navigation systems**
- **Actuators**
- **Antennae, cabling, ICs, PCBs and other elements/components**

To serve their intended purposes, all of these must perform effectively, interoperate seamlessly and efficiently within power consumption standards, and neither interfere with nor be subject to interference from other electrical or electronic systems and vehicles.





Today's sophisticated electromagnetic simulation applications place and optimize components to ensure performance, reliability, and electromagnetic compatibility.

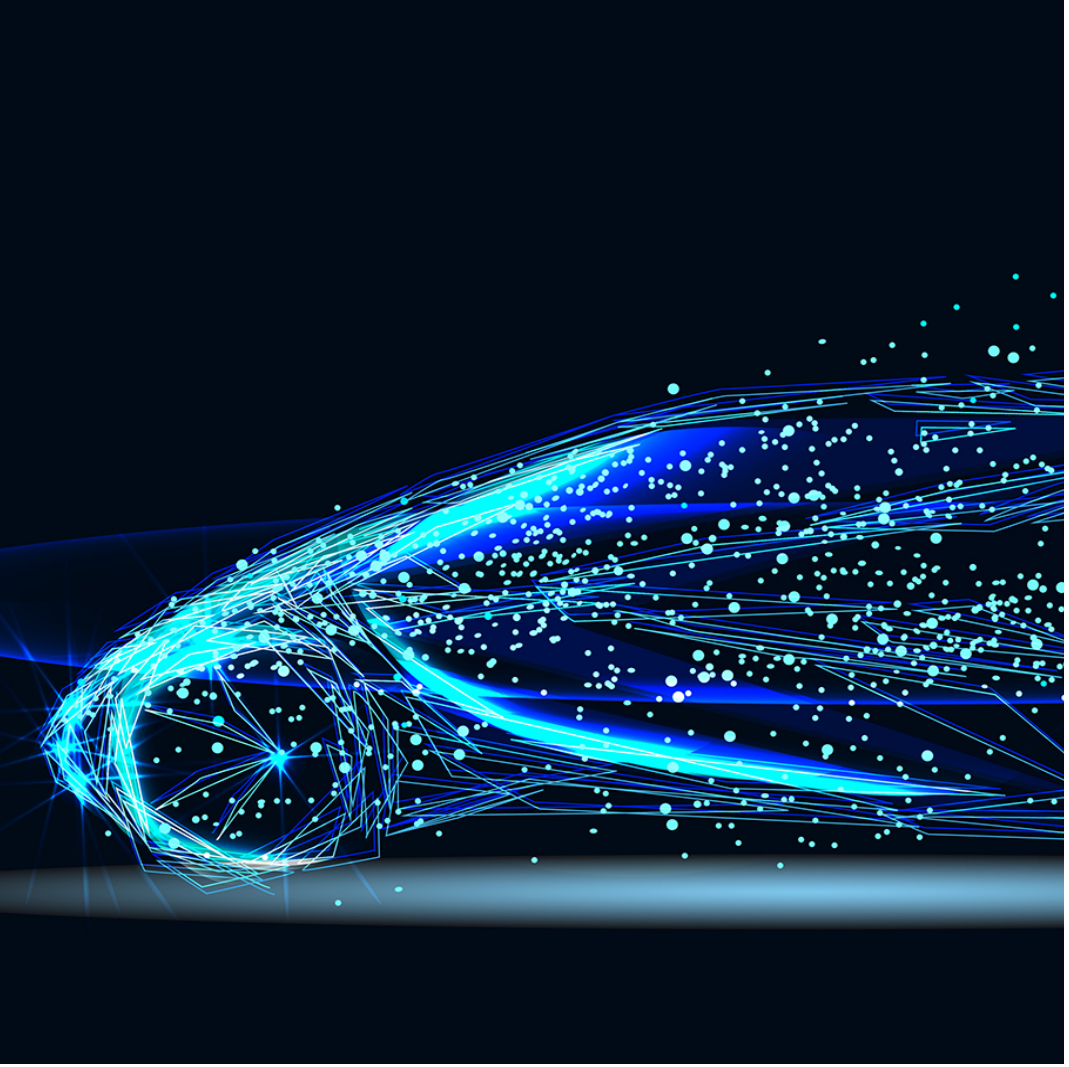
Learn more.

In addition, companies must meet a wide variety of regulatory standards governing electromagnetic interference, immunity, and emissions, all of which vary depending on jurisdiction. The complexity of these systems make it essentially impossible to effectively physically test all possible variables, owing to time and cost constraints. The specific testing requirements of different countries and jurisdictions compound this problem.

Effective simulation solutions provide a means of meeting this challenge. With more than thirty antennas and sensors, and as many as 100 actuators and controllers within a specific vehicle, a properly administered simulation solution must be capable of assimilating the full range of variables and interdependencies, modelling their interactions, and projecting likely outcomes. This must happen in a fraction of the time that would be required for physical testing—and with lower likelihood of error.

Sophisticated electromagnetic simulation applications, such as those within the Dassault Systèmes **3D**EXPERIENCE platform, enable developers to design, place and optimize components to ensure performance, reliability, and electromagnetic compatibility. Besides having the ability to accurately predict the behaviors of the systems themselves, advanced simulation enables engineers to contextualize testing, predicting performance in real-world operating conditions. This includes factors such as proximity to other vehicles, varying weather conditions, or changing ambient electromagnetic environments resulting from factors such as proximity to broadcast antennas or the interior of metal structures.

Today, simulation-based testing can be integrated at the earliest stages of development, enabling engineers to quickly identify emergent issues, contrast multiple design options, and compare a potentially limitless number of implementation scenarios. This provides development teams with a foundation for confident development and implementation, and a very high degree of certainty that systems will perform precisely as envisioned. **Besides helping to ensure the merchantability and reliability of vehicles, this prevents expensive late-stage redesigns and retrofits, as well as helping to prevent recalls or delays in releasing vehicles to market.**



CONCLUSION

Innovative vehicle development must be balanced with the real-world constraints of the global marketplace. Innovators that succeed in finding the **best balance of quality, requirements, cost and performance** will be optimally positioned to thrive in the rapidly-changing automotive and mobility industry.

Industry leaders have less time and resources to successfully develop, test, and validate their new vehicle concepts. Digital simulation and analysis helps them evaluate their best options quickly, and ensure that non-negotiable requirements regarding **safety, reliability, efficiency and environmental impact** are fulfilled.

Siloed development and production teams must be unified, collaborating together toward their common goals, on a centralized repository. The Dassault Systèmes **3D**EXPERIENCE platform provides a comprehensive, integrated solution, with digital simulation and analysis options throughout the development cycle, to ensure a better balance between quality, requirements, cost and performance.

For further details and resources go to: 3DS.COM/TRANSPORTATION

Our **3D**EXPERIENCE® platform powers our brand applications, serving 12 industries, and provides a rich portfolio of industry solution experiences.

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