SIMULIA

3DEXPERIENCE®

FASTER MODEL BUILD FOR ACCELERATED AUTOMOTIVE INNOVATION

3DEXPERIENCE® intertwines modeling and simulation capabilities for fast, collaborative vehicle design, modification and testing

Courtesy of PSA Peugeot Citroen

Inceptra

DASSAULT SYSTEMES

EXECUTIVE SUMMARY

Change in the transport and mobility industry is fast and furious. Growing demand for electric and autonomous vehicles has brought new opportunities for innovation, while customers are hungry for unique new designs that deliver an exciting driving experience. Meanwhile, every new vehicle must satisfy regulators so that it meets stringent requirements on safety, sustainability and performance—and as vehicle technology continues to advance, the number of regulations also increases.

As agile new market entrants emerge fully focused on the electric vehicle (EV) market, incumbent manufacturers must find way to speed up the design cycle and accelerate innovation so they can stay ahead. Digital modeling and simulation can help reduce the need to build and test physical models, but often the data behind these models resides in separate files and applications. Bridging those silos is often too time-consuming, labor-intensive and costly to support the rapid innovation they need.

There is only one way to overcome all these challenges and grasp the opportunities that today's markets present: unify and manage data across the design cycle to enable automated, simulation-ready vehicle modeling. This whitepaper will explain how a MODSIM approach—a combination of CATIA modeling and SIMULIA simulation capabilities powered by the **3D**EXPERIENCE platform—can be used to accelerate model building for simulation. As well as dramatically cutting the time and cost of getting new vehicles to market, reducing vehicle model build times can accelerate innovation by driving increased use of simulation to impact design.

THE CHALLENGE OF AUTOMOTIVE INNOVATION IN A TRANSFORMING INDUSTRY

A new frontier has opened in the automotive industry as the traditional manufacturing methods of internal combustion engine (ICE) vehicles give way to the new design possibilities of electric vehicles (EVs). Unconstrained by the design parameters that ICE drivetrains impose, this new generation of vehicles enables manufacturers to create innovative shapes and layouts that will capture customers' imaginations and deliver an unrivalled driving experience.

At the same time, organizations must make sure every new vehicle meets strict global and local regulatory requirements for sustainability and performance. As EVs continue to evolve and become more autonomous, the number of restrictions and regulations surrounding them will also grow. Testing of parts, configurations and design revisions must be rigorous and exact—but to get ahead of the market, it also needs to be fast and cost-efficient.

All of this must be achieved amid intense competition. New market entrants continue to arrive. They're sharply focused on delivering the EVs customers want and unrestrained by legacy technology and ideas. Meanwhile, existing manufacturers have a proud legacy of proven expertise that can help them to innovate in new directions—if they can ensure they are not weighed down by siloed data, outdated insights and cumbersome processes.

Modeling and simulation technology has enabled big efficiency improvements in vehicle design. It allows manufacturers to test digital models of their vehicles in the virtual world instead of building hundreds of physical versions to wear out and destroy in real-world performance and crash tests. Those digital models involve thousands of parts, and a change to just one of them potentially means that the entire model must be reassessed to see how other parts and fastenings will be affected. If those parts also need adjusting, the chain of amendments can seem never-ending.

A major challenge is that every part, and every design alteration, creates volumes of data that typically reside across separate computer aided design (CAD), computer aided engineering (CAE) and manufacturing process applications. To put that data together to build the model, engineering and simulation teams have to negotiate multiple interfaces, and it's common for manufacturers to devote an entire team full-time to maintain that tool chain and make sure it's error-free.

As a result, creating a simulation-ready model can take longer than building a physical vehicle for real-world testing. In fact, it typically takes around 60 days and up to 10 engineers to make a digital simulation model, and another 40 days to update it when design changes are made.

On one hand, vehicle manufacturers face intense pressure to bring exciting new designs quickly to market while reining in costs. On the other, modeling and simulation processes that could help

them test new ideas are adding significant time and cost to the design cycle. In the middle, design and engineering teams, already stretched to their limits, are forced to compromise by focusing on a few small changes, when they really need to be experimenting with multiple variants that could create the next market-leading model.

Today's automotive markets won't wait for slow innovators to catch up. Getting and staying ahead of the competition requires a fast, automated way to create simulation-ready, full-vehicle models with all the necessary detail to test for structural comfort, durability, crashworthiness and aerodynamic performance. To do that, manufacturers need a better way to manage and access all their data across the design cycle.

BENEFITS OF A MODSIM APPROACH

By integrating modeling and simulation throughout the design cycle, manufacturers can manage the complexity of vehicle modeling and testing and gain the speed and efficiency they need. This MODSIM approach, enabled by unified data, is especially important in a crowded and fast-moving automotive industry where time to market is increasingly tight and demand for innovative EVs is accelerating, while safety and performance standards continue to rise.

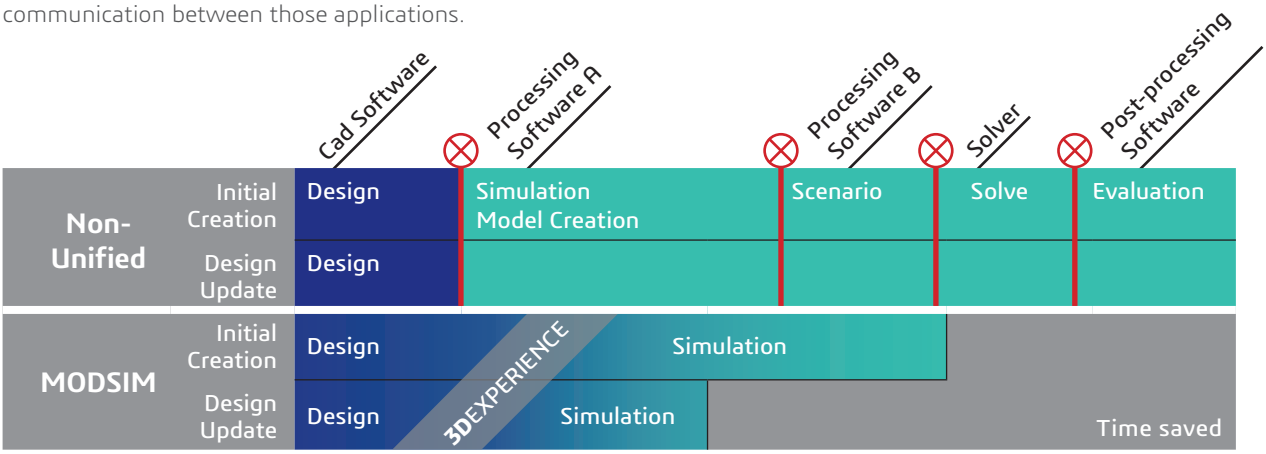
When all the design, simulation, and manufacturing data along the product lifecycle is harmonized on a single platform, there is no need to spend time moving between interfaces and transferring information from one file-based system to another. Instead, centralized data enables every role, from designers to engineers, analysts and testing teams, to bring their perspectives together on a single model, within the same platform. Instead of siloed CAD and CAE systems, this approach enables the shift to a CAx paradigm—bringing all the data, tools, functionalities and philosophies involved in product engineering together in one fluid process.

Continual integration of modeling and simulation enables iterative, synchronized changes across the vehicle's design cycle. That means whenever a change is made to any part of the model, automated adjustments make sure the rest of the vehicle—e.g. from rockers to panels, battery pack and spotwelds—follows suit. Designers, engineers and analysts can try new ideas and alter parameters to make sure they strike the ideal balance between crash performance, weight and cost, without causing delays. Ultimately, a MODSIM approach empowers them to experiment with innovative concepts, create finely detailed designs and meet performance targets from aerodynamic to crash performance while staying ahead of their competitors in the race to market.

THE 3DEXPERIENCE SOLUTION

All the challenges listed above can be addressed using a MODSIM approach enabled by Dassault Systèmes' **3D**EXPERIENCE platform.

3DEXPERIENCE provides a common framework to unify data and connect the geometry between design style and performance analysis across the development process. It provides a foundation to eliminate the silos and friction caused by working across CAD, CAE and other design-cycle systems. In turn, this removes the need to devote valuable resources to maintaining error-free communication between those applications.



A MODSIM approach, using the **3D**EXPERIENCE platform, removes silos to provide a unified, frictionless design and simulation modeling experience that boosts productivity and accelerates innovation.

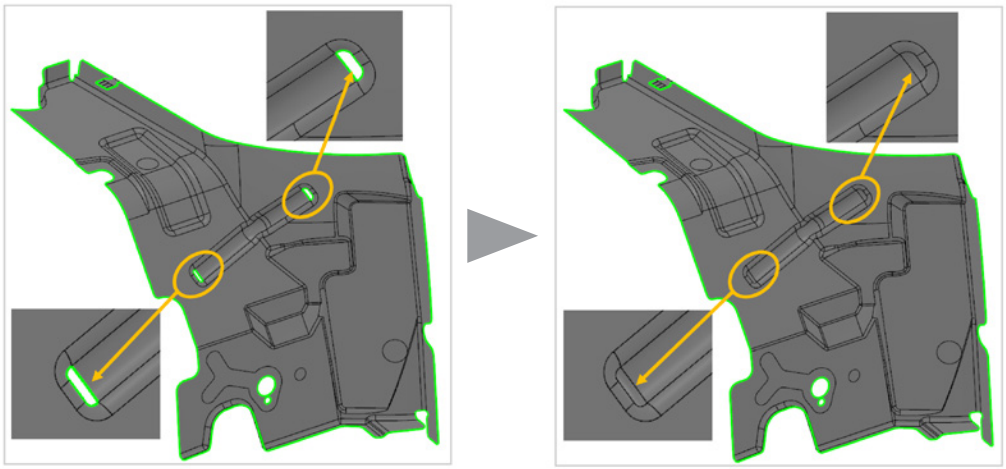
Resting on the **3D**EXPERIENCE framework, the modeling capabilities of CATIA and simulation functionality of SIMULIA can be intertwined to enable faster, simulation-ready model building and updates. It enables automated, associative adjustments after design updates, to ensure the entire model aligns with changes to individual parts. Crucially, it empowers vehicle designers, engineers and analysts to interactively explore the impact of changes early on, so they can create innovative vehicle styles while ensuring the best balance between performance, weight and cost.

Faster model build

Using this approach, faster model build enables a virtuous cycle: the ability to quickly build simulation-ready models drives more use of simulation, not only for performance testing but also to impact design decisions. That in turn empowers engineers to design vehicles using proven, predictive structural simulation solutions—both reducing the time and cost of development and accelerating innovation.

Let's look at the example of modeling and testing of a vehicle for body strength and durability. Creating a mesh—a discretized representation of the vehicle's shape and structure—is the first step. Traditionally, this involves many hours spent building well-structured meshes for each part, which then must be combined to create the full model.

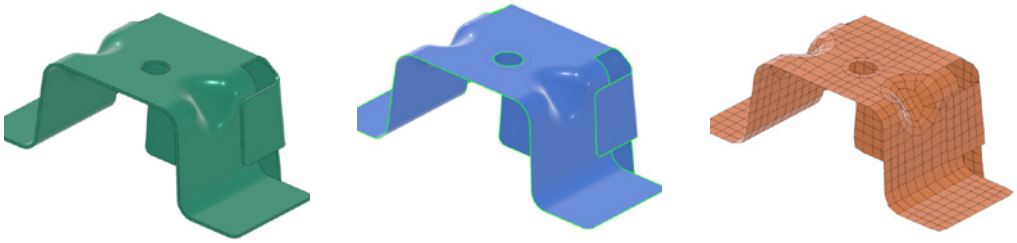
3DEXPERIENCE simplifies and speeds up the process by using native CAD data to automatically create the midsurface—a minimal-thickness representation of all the sheet metal parts for the mesh to be built on. By drawing directly on CAD data in this way it outclasses traditional automatic midsurfacing techniques, enabling much faster design changes, better traceability across CAD/CAE silos and exceptionally high accuracy across the hundreds of parts that make up the structural elements of the vehicle. If any irregularities do occur, these are flagged up to engineers who can assess and correct them to ensure a 100% sound foundation before continuing with the mesh.



Any issues with the midsurface are flagged so users can check and amend them to ensure 100% accuracy before the mesh is applied.

Once the midsurface is in created, the mesh is automatically built onto it. Because **3D**EXPERIENCE integrates modeling and simulation processes, it eliminates any need to bridge different system interfaces. It seamlessly connects the mesh with the vehicle's geometry within the same model—which means that if the design of one part is changed, the entire mesh will follow automatically.

The mesh then serves as a basis for a mathematical analysis of performance in crash conditions, as well as the assessment of the vehicle's stiffness and durability and the experience it delivers in terms of noise and vibration in different driving conditions.

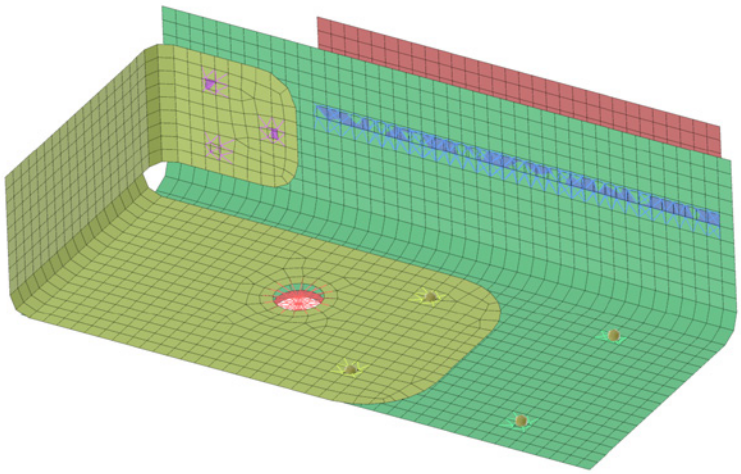


3DEXPERIENCE automatically creates a midsurface of every sheet-metal part, then applies a mesh based on rules defined by the user.

Associative alteration

Thousands of connections are involved in any vehicle design, and their type and positioning is critical both to the vehicle's performance and to the efficient design of automated manufacturing processes. Every time a design amendment is made, the number, shape and location of multiple spot welds, laser welds, bolt connections and adhesive lines must also be changed to reflect it. Using traditional methods, this is one of the most time-consuming processes in vehicle modeling and simulation.

3DEXPERIENCE changes that. It natively hosts all these connections in the same model, so their number, shape and positioning align with the shape of the mesh. Any alterations to the vehicle's design are automatically followed by associative changes to those connections in the simulation model, dramatically reducing the time and effort involved. At the touch of a button, the entire model is synchronized to accommodate design changes using a single tool.



Fastenings such as bolt connections, adhesives and spot welds are automatically changed to reflect any design alterations to the vehicle.

These automated processes are unique to the **3D**EXPERIENCE platform. They enable rapid calculations to support or guide design decisions, freeing designers and engineers from repetitive adjustments so they can focus on higher-value tasks. As a result, these tools drastically reduce simulation preprocessing times—e.g. from weeks to days for a full car crash simulation.

CONCLUSION

As trends accelerate and competition intensifies in the automotive industry, manufacturers are looking for ways to get new vehicle designs quickly to market while reining in costs. Rapid innovation is needed to stay ahead of the trends and deliver the designs and driving experience that consumers want, while proving the safety and performance levels that will satisfy regulators. Speeding up the modeling and simulation process is key to accelerating innovation.

With the **3D**EXPERIENCE platform and the intertwined capabilities of CATIA and SIMULIA, automotive manufacturers can integrate modeling and simulation across the entire design cycle. By harmonizing their data and providing a single platform for collaboration, **3D**EXPERIENCE empowers vehicle designers and engineers to quickly build and adjust models for fast, accurate simulation that will minimize time to market. This gives them the insight to make design decisions that balance cost, development speed and complexity, ultimately empowering them to innovate more and deliver new vehicle designs that excite and delight consumers and regulators.

North America Headquarters
1900 N. Commerce Parkway,
Weston, Florida, 33326 USA
Phone (954) 442-5400
Inceptra.com

Our **3D**EXPERIENCE® platform powers our brand applications, serving 11 industries, and provides a rich portfolio of industry solution experiences.

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Americas
Dassault Systèmes
175 Wyman Street
Waltham, Massachusetts
02451-1223
USA

Europe/Middle East/Africa
Dassault Systèmes
10, rue Marcel Dassault
CS 40501
78946 Vélizy-Villacoublay Cedex
France

Asia-Pacific
Dassault Systèmes K.K.
ThinkPark Tower
2-1-1 Osaki, Shinagawa-ku,
Tokyo 141-6020
Japan