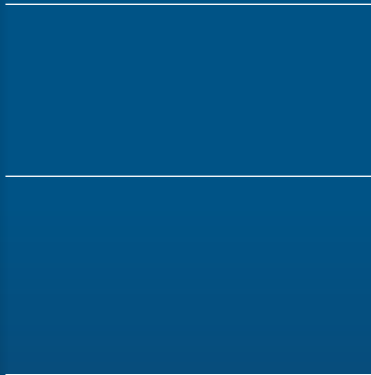


TRANSPORTATION & MOBILITY

THE VIRTUAL TWIN STRATEGY FOR END-TO-END SUSTAINABLE MOBILITY

Discover the science-based integrated platform that connects your complex automotive ecosystem for greener outcomes



MEET OUR EXPERTS



ALICE STEENLAND
Chief Sustainability Officer

With over 20 years of experience in sustainability, finance and innovative business models across all sectors of the economy, Alice has held full-time and advisory positions in large multinationals, NGOs, rating agencies, consulting firms, startups and multilaterals in the US and Europe.



LAURENCE MONTANARI
Transportation & Mobility Industry
Vice President

Equipped with nearly 30 years of automotive engineering and business experience, Laurence spearheads initiatives that help automotive companies leverage the **3DEXPERIENCE®** platform to adapt and thrive in a market-changing era defined by mobility-as-a-service, sustainability priorities and new consumer experiences.



FREDERIC MERCERON
Transportation & Mobility
Solutions Director

Frederic is responsible for delivering innovative solutions to automotive manufacturers and suppliers, helping them create innovative consumer experiences. In his previous roles at Dassault Systèmes, he was instrumental in developing simulation lifecycle management solutions and generative body design methodologies.

MEET OUR EXPERTS



AJAY PRASAD
ENOVIA Industry Process Expert

Ajay leads initiatives focused on project management on the **3DEXPERIENCE** platform. With nearly 20 years of experience, he is part of the worldwide ENOVIA Industry Process Success team that works across industries to demonstrate how ENOVIA applications can help customers solve their business challenges on the **3DEXPERIENCE** platform.



RAJANI JAYAKUMAR
ENOVIA Industry Process Expert

With over 15 years of experience at Dassault Systèmes, Rajani helps automotive OEMs and suppliers worldwide with optimal PLM data management. She also provides training and technical support to business partners. Previously, she worked directly with OEMs to develop engineering software and ensure quality standards in projects.

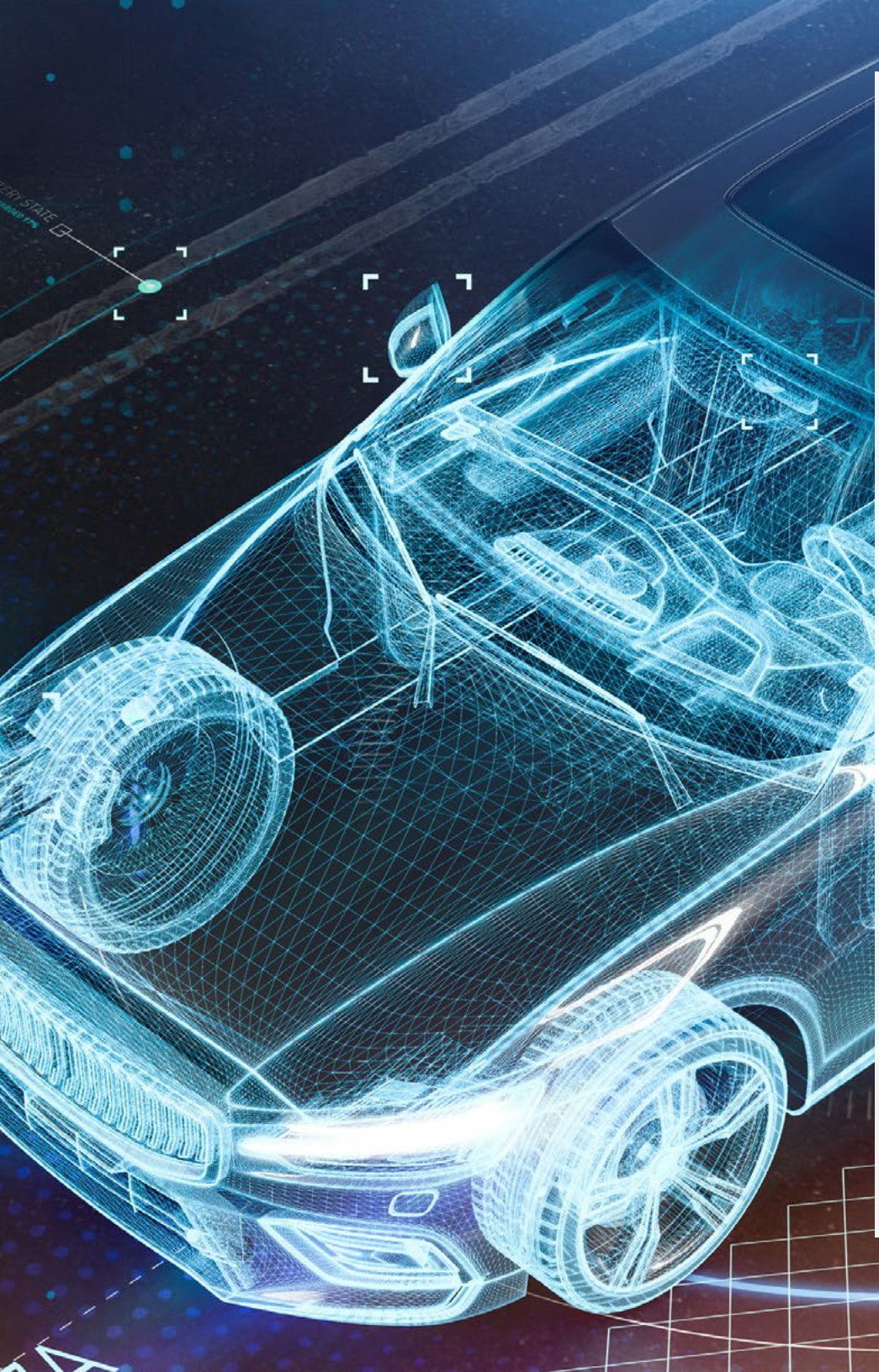
THE NEED FOR END-TO-END SUSTAINABLE MOBILITY

As the effects of climate change continue to deepen, the automotive industry players are under pressure to transform the way they work.

With over a billion passenger vehicles currently on the streets across the world, strict regulations have now been put into place to minimize greenhouse gas (GHG) emissions and increase vehicle recyclability.

“ Road transportation accounted for [12% of global GHG emissions in 2020](#). This doesn't include the impact from production, only the vehicle use. There's an enormous opportunity for sustainable innovation in the mobility space, which can be enabled and accelerated by technology. The innovation ranges from researching new recyclable and lightweight materials to simulating new forms of batteries in virtual environments.”

Alice Steenland
Chief Sustainability Officer, Dassault Systèmes



At the same time, more consumers and cities are looking for innovative and greener transportation experiences.

How can automotive manufacturers get on track to deliver sustainable mobility that complies with regulations and satisfies regional market needs?

Connect a siloed ecosystem

For manufacturers, creating sustainable vehicles is challenging due to a complex and siloed ecosystem with thousands of participants scattered worldwide.

“Automotive manufacturers need to bring together thousands of parts to be assembled into a complete vehicle. It’s crucial to get all stakeholders involved in the process as early as possible to boost innovation and mitigate risk.”

Laurence Montanari

**Transportation and Mobility Industry Vice President,
Dassault Systèmes**

ACTIVE LANE ASSIST

Apart from facilitating cross-functional collaboration within the organization, manufacturers will also benefit from working closely with external stakeholders such as parts suppliers, cities, infrastructure owners, shared mobility operators and technology providers supporting autonomous, electric and connected vehicles.

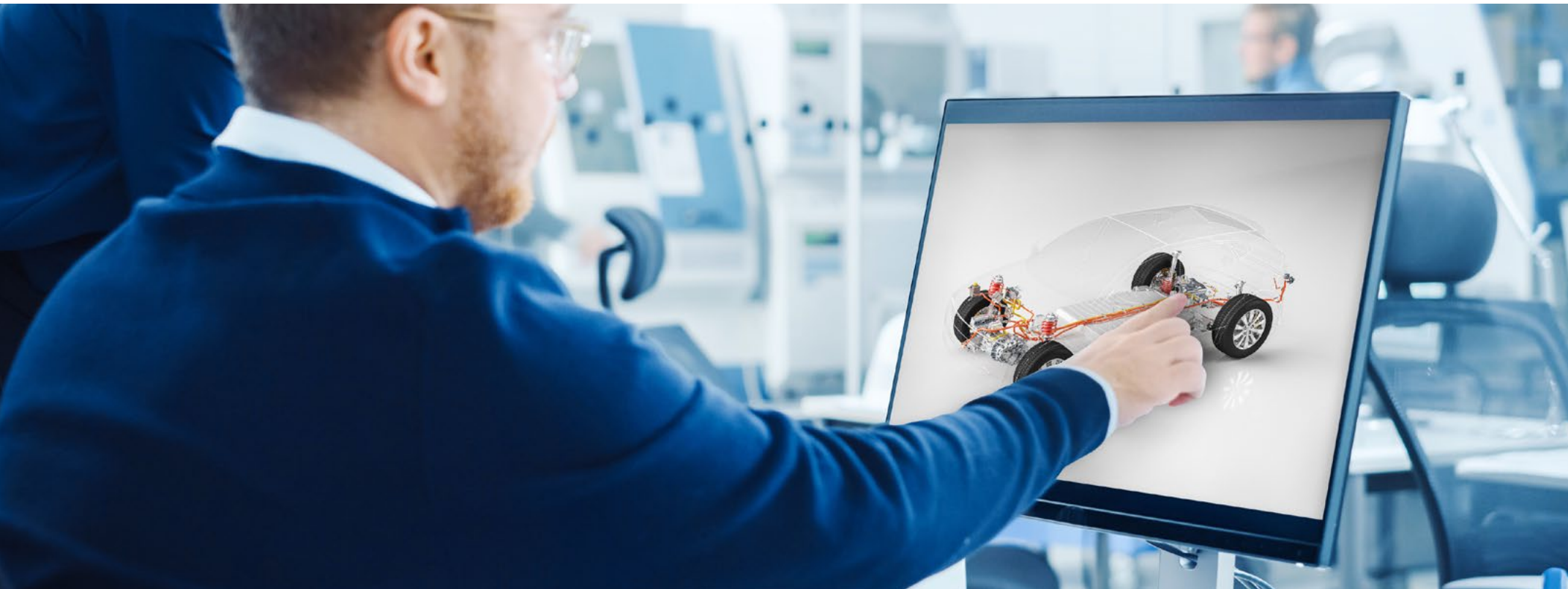
“The optimal platform unites diverse stakeholders in one collaborative environment. With complete visibility, manufacturers gain valuable insights to optimize the vehicle at every lifecycle stage,” said Frederic Merceron, Transportation & Mobility Solutions Director at Dassault Systèmes.

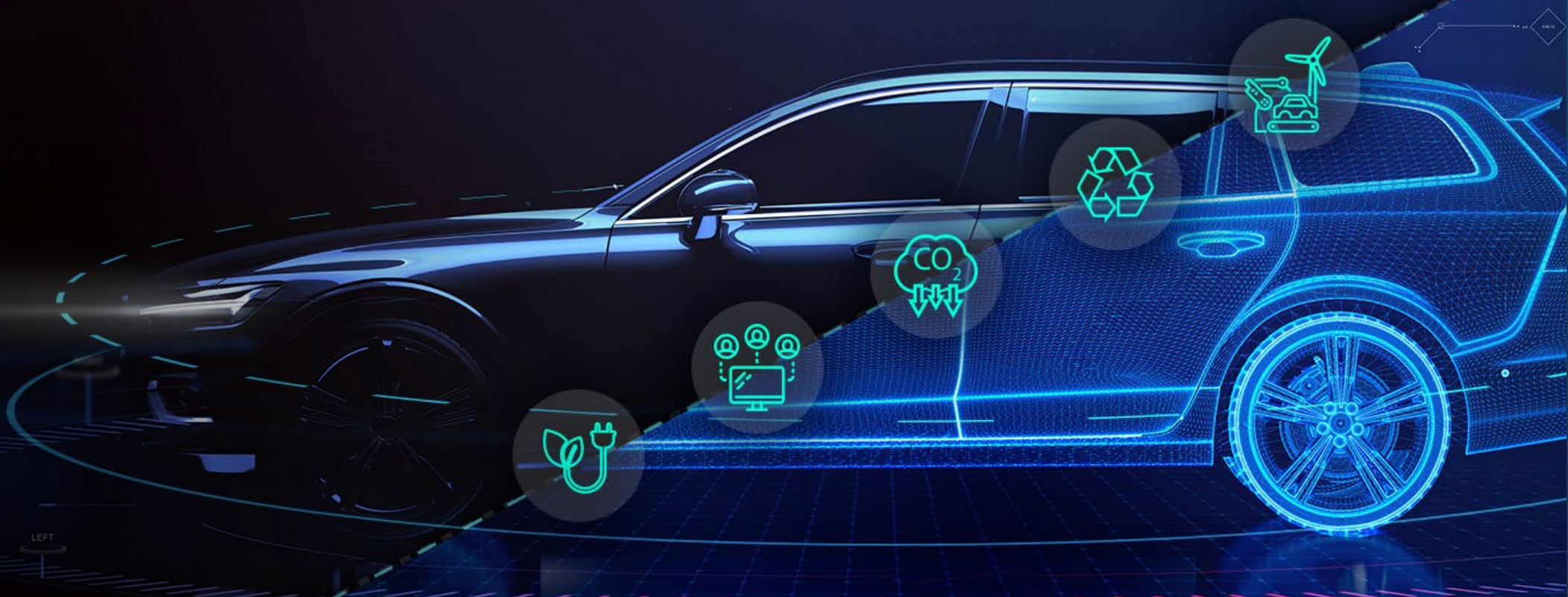
More than that, the platform needs to integrate digital capabilities that use scientific principles, enabling manufacturers to make accurate decisions that align with their sustainability goals.

A key capability is the virtual twin. Built on mathematical and physical laws, it represents an accurate and dynamic model of an entire vehicle, process or environment.

“The virtual twin is extremely helpful for building and operating complex systems. It allows thousands of stakeholders to test a 3D replica in different simulated scenarios to optimize the design for sustainability and performance,” said Alice.

Read on to discover how an integrated platform with science-based capabilities can help drive end-to-end sustainable mobility by enabling ecosystem participants to develop and deliver greener vehicles together.





CHAPTER 1
**SUSTAINABLE AUTOMOTIVE
DEVELOPMENT**

Sustainable mobility begins with linking global automotive stakeholders together for collaborative vehicle development.

ACCURATE DESIGN, ENGINEERING, SIMULATION AND TESTING RESULTS

Traditional vehicle development is typically carried out in silos and reliant on physical prototypes to improve the outcome.

By using a single, integrated platform automotive manufacturers connect all stakeholders to foster innovation and minimize late issue discoveries.

This platform needs to integrate modeling and simulation, supporting manufacturers to create the virtual twin of a new vehicle for full analysis of its design, behavior and manufacturability early in the process.

As a result, manufacturers can design zero-emission vehicles with high performance, recyclability and ease of disassembly at end of life.

“The virtual twin contains the complete definition of the new vehicle design including its geometry, electronics and software. Throughout development, the virtual twin provides a consistent and consolidated view of information.”

Frederic Merceron
Transportation & Mobility Solutions Director, Dassault Systèmes



Better battery performance

Batteries are the new fuel tanks in electric vehicles. They need to store as much energy as possible to minimize range anxiety and maintain safety during unexpected events.

Virtual simulation helps manufacturers improve battery strength, stiffness and safety in abuse test scenarios. Battery packs integrated into full vehicle models can also be simulated for realistic test conditions.

To optimize battery design materials for aging, manufacturers need chemistry modeling capabilities. With them, manufacturers can model, simulate and validate molecular level characteristics so that the individual cell's mechanical, thermal, diffusion and electrical behaviors are all optimal.

Intelligent electric drive engineering

The electric drive constitutes a critical component for the electrification of vehicles. A complex system in its own right, the electric drive needs to be integrated into both the electric powertrain and the full vehicle.

However, making the best trade-off decisions is a challenge. Manufacturers need intelligent insights through virtual simulation

that simultaneously considers thermal and mechanical requirements, durability, electromagnetic performance, noise, vibration control and lubrication requirements.

This multi-physics simulation enables manufacturers to predict and verify the system performance across multiple design objectives and in all possible scenarios.

WLTP compliance

Virtual simulation ensures that manufacturers are better equipped for the Worldwide Harmonized Light Vehicles Test Procedure (WLTP), which guides manufacturers on evaluating vehicle emissions and consumption, and reporting the expected range for electric vehicles.

Meeting the stringent limits on emissions is easier through virtual simulation. Manufacturers can optimize vehicle and component designs by analyzing the interactions between different parts and verifying emissions, substantially reducing the risk of failing WLTP testing.

Additionally, virtual prototyping reduces the number of physical tests, avoids the backlog at wind tunnel facilities and can substantially cut development cycle time and costs.



DIGITAL COMPLIANCE MANAGEMENT

The automotive industry is governed by strict sustainability-related regulations. For example, manufacturers need to adhere to Europe's End of Life Vehicles Directive that limits the amount of lead in steel materials because it harms the environment.

Vehicle recyclability is another key focus area for regulators.

“If your vehicle isn't 95 percent recyclable, you can't sell it in Europe. Manufacturers are not only obliged to follow these regulations – they also need to prove their compliance.”

Laurence Montanari
Transportation and Mobility Industry Vice President,
Dassault Systèmes

As such, manufacturers seek ways to design more recyclable products and avoid hazardous properties that require special waste-handling processes.

Through a platform that offers a digital compliance management capability, manufacturers can work with suppliers to aggregate information that includes component breakdown of individual materials of construction and the chemical substance formulation of each material of construction.

The platform's intelligent system can read the information, compare it to industry regulations and alert the manufacturers if any material or component is not compliant with regulations in various global regions.

To manage regulations that constantly grow and change, manufacturers can rely on integrated compliance management capabilities to:

- Swiftly generate the documentation required by legal authorities
- Manage products' compliance with the latest requirements
- Implement an effective flow of up-to-date information among ecosystem participants

Quicker regulatory approval equates to quicker product launches, which are critical in the competitive automotive industry.

SMART CONFIGURATION, PROGRAM AND PROJECT MANAGEMENT

Manufacturers can further optimize the development of sustainable vehicles by relying on smart configuration and program management capabilities.

With smart configuration management, manufacturers can define all of a vehicle's variants in a configured product structure. They're able to develop multiple variants at the same time to address various regional market requirements sustainably.

“Manufacturers will benefit from the ability to define a configured product structure containing 150 percent definition — an overlay of multi-faced information — that can be used as a template to generate a family of product variants. The sharing of a single configured structure across multiple variants will optimize reuse while driving on-time delivery to market.”

Rajani Jayakumar
ENOVIA Industry Process Expert, Dassault Systèmes





When it comes to global program and project management, manufacturers must ensure that vital information is available throughout the organization.

“Often, a program’s critical project information, like requirements, deliverables, schedule and resources, is managed in different and siloed enterprise systems. All this information has to be updated and manually reconciled frequently to understand the true project status, which leads to inefficiency.”

Ajay Prasad
ENOVIA Industry Process Expert, Dassault Systèmes

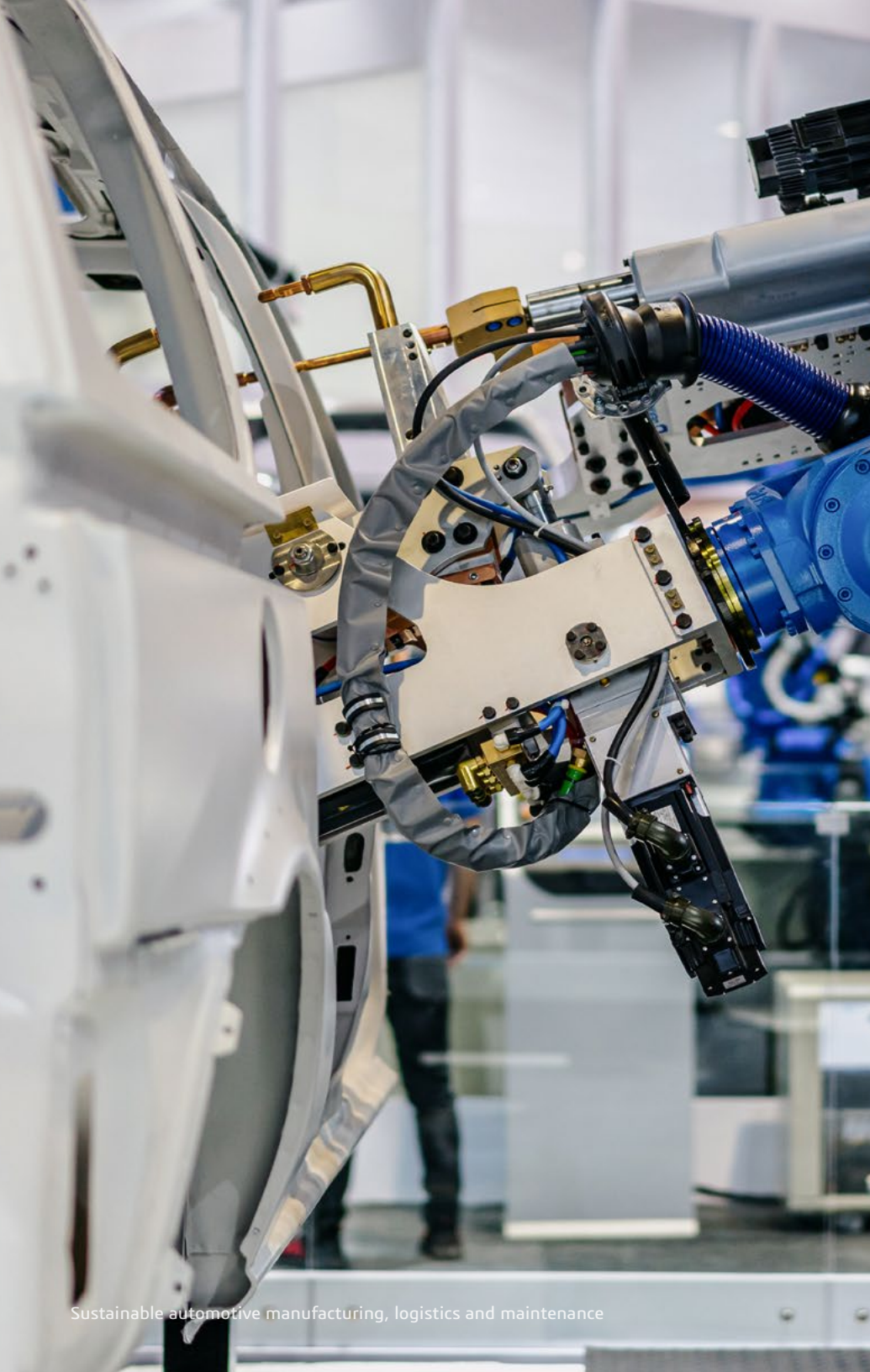
Equipped with smart program and project management capabilities on a connected platform, manufacturers gain a holistic view and traceability of the current portfolio.

End-to-end information visibility enables collaborative decision-making for results that meet KPIs including sustainability goals. Duplicate efforts are minimized and existing data can be used in new programs to reduce time, costs and waste.

CHAPTER 2

SUSTAINABLE AUTOMOTIVE MANUFACTURING, LOGISTICS AND MAINTENANCE





Once the vehicle development has been finalized, automotive manufacturers must extend their collaborative approach to producing, distributing and maintaining their vehicles to close the loop on sustainable mobility.

FIRST-TIME-RIGHT MANUFACTURING

Automotive manufacturing is usually complex, and energy/resource intensive.

To better design zero-carbon and zero-waste factories, manufacturers need science-based decision support on a virtual twin-enabled platform.

“ Making complex automotive processes more sustainable can seem like an impossible task due to the number of inputs and outputs that need to change, but this is precisely the kind of challenge that the virtual twin can help solve.”

Alice Steenland
Chief Sustainability Officer, Dassault Systèmes

While manufacturers can use special assembly lines to test new configurations, it isn't ideal as manufacturers will need to suspend production and incur unnecessary costs and waste.

Manufacturers should instead leverage virtual twin capabilities to collaboratively find the optimal production configuration and drive first-time-right outcomes.



The virtual advantage

As a replica of the physical factory, the virtual twin allows stakeholders to run what-if experiments and explore different configurations to arrive at an optimal plan together.

“By validating decisions through the virtual twin, manufacturers have the confidence to set up their production without trial-and-error,” said Laurence.

Manufacturers can gain insights through the virtual simulation of planning scenarios such as those related to plant layouts, production schedules, worker movements and machine placements.

By reviewing the outcome and perfecting the plan, manufacturers can minimize energy consumption, waste and emissions while meeting other KPIs such as maximized throughput and on-time delivery.

Manufacturing plans that have been validated in the virtual world can be automatically shared with teams in charge of execution on the shop floor. This creates a responsive environment for much quicker implementation of sustainable processes.

“It’s crucial to optimize production planning and detect any issues before manufacturing starts. Every issue that manufacturers find after that will have high cost and environmental impacts.”

Frederic Merceron
Transportation & Mobility Solutions Director,
Dassault Systèmes

Better visibility and standardization

A digital, integrated platform equips manufacturers with the ability to collaborate virtually in one place. This way, stakeholders worldwide can easily contribute insights into manufacturing operations and find innovative solutions based on the virtual twin's visualized data.

This platform strategy breaks silos and enables secure manufacturing information flow across the organization. As a result, manufacturers have complete visibility and control across disparate processes including component operations for in-car entertainment and electric vehicle batteries, fabrication, paint and final assembly.

With this shared and up-to-date view of operations, manufacturers can also better effect continuous improvements to reduce waste and inefficiency.

Meanwhile, standardization is required to drive sustainable operations. Without synchronization on a single platform, it's hard to be consistent – inevitably, some facilities will generate more waste than others.

Integrated operations help enforce standard quality processes, support global and local regulatory requirements and manage all quality management events, such as corrective and preventive actions, product nonconformance and audits.

By putting in place streamlined processes and best practices, manufacturers can also increase their product's first pass yield.

Furthermore, in today's data-rich environment, manufacturers must retain knowledge from the current workforce to create sustainable and innovative experiences for future workers. An integrated platform helps capture and share all of this valuable information in a connected and easily accessible environment.



EFFICIENT DISTRIBUTION LOGISTICS

As an integral part of the sustainability equation, distribution logistics must be planned accurately to lower manufacturers' carbon footprint.

"In distribution logistics, the science-based virtual twin provides manufacturers with a mathematical and agile-based model to optimize planning," said Frederic.

A platform that integrates all logistics planning components can help manufacturers optimize decisions for reduced transportation vehicles and distance traveled.

By incorporating logistics optimization technology, the platform's system determines the best decision among a large set of logistics options related to routes and resources.

Manufacturers can review the suggested plan and further refine it by running the virtual twin through simulated what-if scenarios of their shortlisted options. It's also possible to quickly explore the impact of alternative moves such as switching to another route or increasing the transportation fleet.



OPTIMIZED AFTER-SALES PERFORMANCE

Manufacturers can ensure sustainable vehicle servicing and maintenance by using the virtual twin as a complete information model.

“The virtual twin can continue to be a dynamic and full 3D representation of actual vehicles on the road. For those managing a fleet, they’re able to swiftly find out vital information such as vehicle modifications and parts that have been replaced.”

Frederic Merceron
Transportation & Mobility Solutions Director, Dassault Systèmes

Use case: The critical role of virtual twins in accelerating sustainability

This [Accenture use case](#) focuses on virtual twin applications for better vehicle reliability.

Once on the road, the physical vehicle remains connected to its virtual twin, feeding it data on use patterns, performance, driving conditions and servicing requirements. This improves the predictive capabilities of the virtual twin over time.

The virtual twin also feeds back software updates based on the vehicle’s needs. It makes prescriptive recommendations for maintenance that prevents inefficient resource use.

Based on these applications, the virtual twin is reported to boost vehicle life by up to 30 percent thanks to timely software and hardware interventions. Additionally, the data insights gathered over the life of a vehicle can improve iterations in the future.

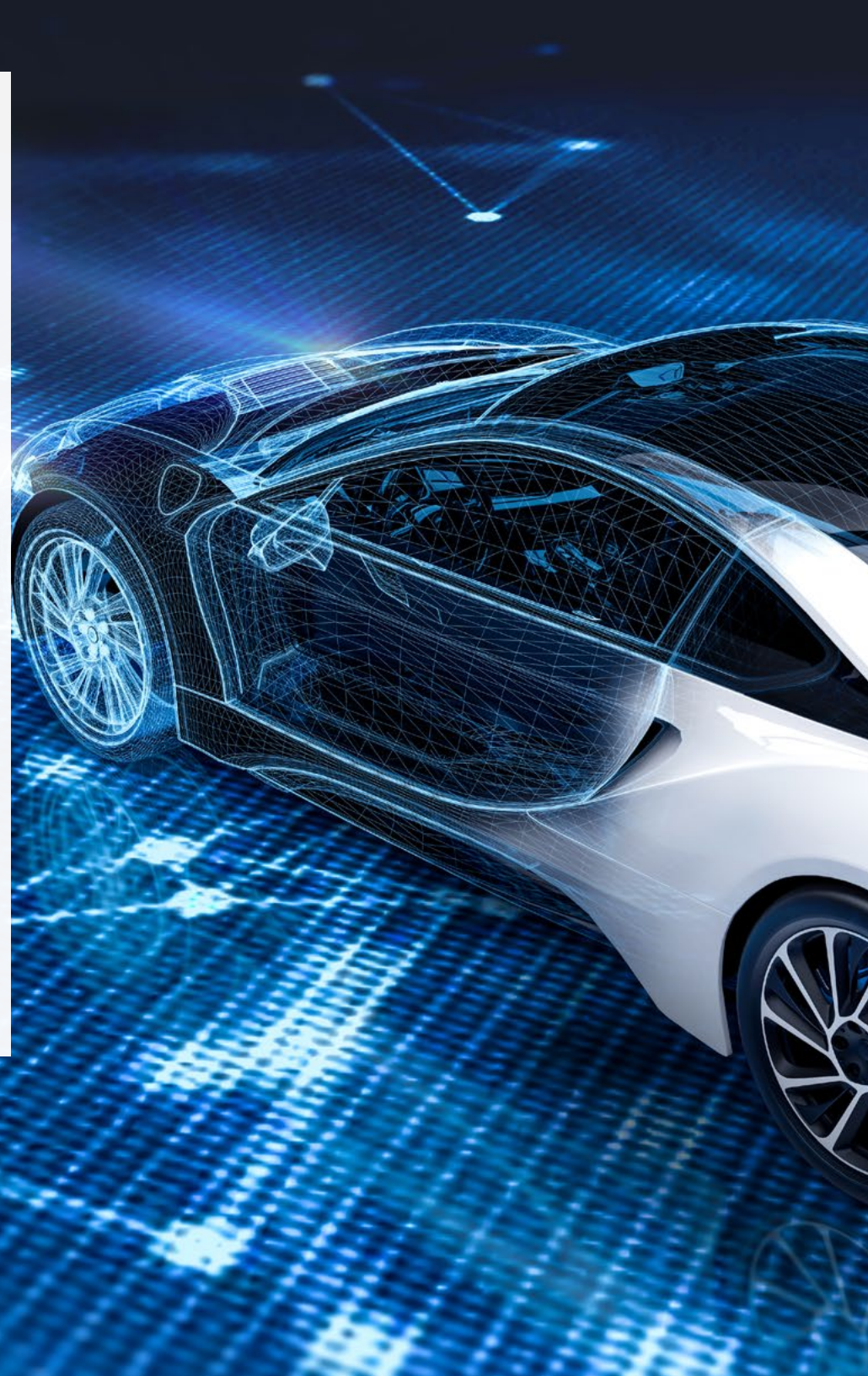
THE OPTIMAL PLATFORM FOR END-TO-END SUSTAINABLE MOBILITY

The right platform strategy for end-to-end sustainable mobility can be found in Dassault Systèmes' **3DEXPERIENCE** platform, allowing automotive manufacturers to connect their complex ecosystem in a centralized and collaborative environment.

Through the platform's suite of science-based capabilities including the virtual twin, manufacturers can model, simulate, build a [system of systems](#), and aggregate data to better develop and deliver sustainable vehicles.

“85 percent of the electric vehicles in the market today were designed with Dassault Systèmes' virtual twin technology. The virtual twin speeds up sustainable innovation by providing ecosystem participants with a virtual universe to develop greener mobility systems together, even at city and regional levels.”

Alice Steenland
Chief Sustainability Officer, Dassault Systèmes



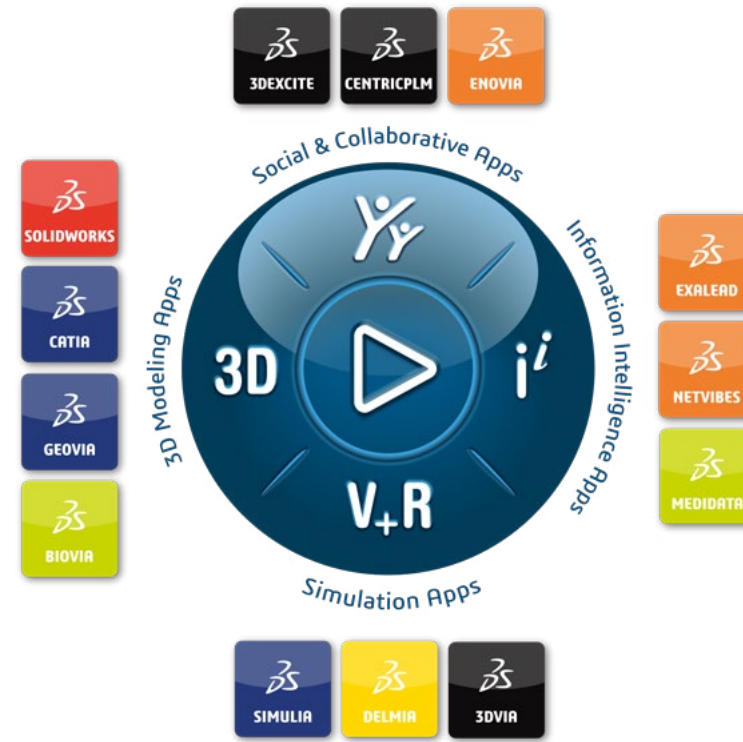
By integrating all ecosystem participants, the **3DEXPERIENCE** platform equips manufacturers with complete visibility that drives collective decision-making and effective lifecycle assessment.

“It’s a new way to collaborate with the virtual twin at the center of it all. We call this a virtual enterprise where manufacturers are not limited by physical factors and silos. Instead, they can easily work with diverse stakeholders for the most sustainable results,” said Laurence.

Frederic added, “At Dassault Systèmes, we’re able to make use of our extensive experience in other industries that link to mobility. For instance, we work with energy and materials businesses that produce hydrogen, electricity, nuclear and so on. We also have customers in the cities and territories industry that manage energy production and storage infrastructure including smart grids. It makes great sense to involve these companies in the automotive ecosystem.”

With the **3DEXPERIENCE** platform’s cradle-to-grave approach, manufacturers can bring together mobility and energy systems for optimized management – ultimately contributing more meaningfully to a sustainable mobility future.

Ready to build a sustainable mobility future? To move forward, discover the latest automotive insights and business transformation strategies [here](#).



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

Dassault Systèmes, the **3DEXPERIENCE** Company, is a catalyst for human progress. We provide business and people with collaborative virtual environments to imagine sustainable innovations. By creating ‘virtual experience twins’ of the real world with our **3DEXPERIENCE** platform and applications, our customers push the boundaries of innovation, learning and production.

Dassault Systèmes’ 20,000 employees are bringing value to more than 270,000 customers of all sizes, in all industries, in more than 140 countries. For more information, visit www.3ds.com.

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