

Mobility Experiences Are Going Through a High-Tech Revolution

Key Takeaways

Engineering becomes comprehensive when it learns from contextual experiences, earning the needed trust for frequent mobility product upgrades.

Mechanical, electrical, electronic, and software engineers need to see what their changes will affect in the product and within the ecosystems in which they operate.

Virtual engineering ecosystems should keep regulations and safety standards visible assuring compliance throughout the complete lifecycle—from ideation through trade studies, to delivery, and use by the customer.

Enormous product and service complexity needs vertical integration of multi-scale systems: from chips and battery; to connected objects including cars and phones; up to city infrastructure such as telecom network, data centers, and car charging grid. All are key enablers of new mobility experiences. The ability to manage mobility systems of systems is key.

Dassault Systèmes' **3DEXPERIENCE** platform includes capabilities for mobility systems modeling using virtual twins from the start and throughout a product's lifecycle. This fosters multi-discipline collaboration, improving earlier design decisions.

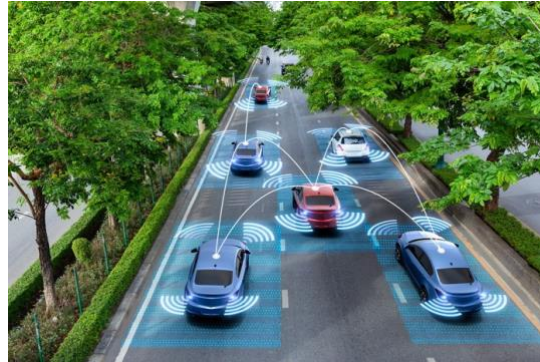
Introduction

How can OEMs deliver trustworthy and compliant mobility systems that function effectively in the widest possible range of conditions? There are many elements making the mobility experience safer and easier for the customer. With connected vehicles exchanging and learning from each other within a city's and suburban's environments, many systems (from each vehicle, to the communications grid, to traffic monitoring and weather databases, to traffic incident monitoring) are cooperating, providing real-time insights and guidance to vehicles in motion. Engineering future mobility experiences is more than the engineering of the vehicle itself. OEMs need to simulate the technologies that will be embedded within their vehicle to provide the experiences their customers want. Simulation must expand to handle the complexity of experiences when operating the latest advanced driver assisted system (ADAS) features or an AV in a connected, monitored, managed ecosystem (see Figure 1). And, of course, this ecosystem likely will differ by community, region, country, and topology.¹

¹ Research for this paper was partially funded by Dassault Systèmes.

**AUTONOMOUS
DRIVING**

CONNECTIVITY



SHARED MOBILITY

ELECTRIFICATION

Figure 1—Expanding Experiences Driven By Emerging Technologies
(Courtesy of Dassault Systèmes)

A systematic approach when developing and validating the functionality and safety of mobility systems as they evolve is essential to remain competitive. Deploying new features to existing products requires full confidence of engineering. Confidence grows when using a virtual engineering ecosystem to comprehensively evaluate actual usage patterns (aka experiences). Google, Sony, Huawei, and many other connection and entertainment platforms are becoming integral within vehicles. The intelligence behind these services is in external, network connected clouds. With their skills and resources, some of these Consumer Electronics companies have already become mobility players, some are even OEMs, redefining the mobility experience for consumers as part of their overall connected lifestyle experience. The ease of seamless and reliable software upgrades, a combination of on-board capabilities coordinated with cloud applications, services, and databases, will keep the safety, entertainment, and connections interfaces in a single, seamless user experience.

This commentary explores these challenges and explains why mobility engineering needs powerful engineering solutions to meet customer desires while system performance evolutions and in-the-field upgrades proceed. Historic vehicle development methods and processes are too slow. Systems are becoming broader than single vehicles. This system expansion drives new development and validation cycles that are continuous, even occurring during product use, well after mass production. Virtual feature exploration driven by systems engineering and accurate behavioral modeling must be embraced to keep up with speed of innovation. Mobility is an emerging and fast evolving industry with new value networks derived from combinations among consumer electronics, mobility, energy, and infrastructures delivering new, innovative solutions.

Virtual Multi-Discipline Engineering Accelerates Feature Ideation

Dassault Systèmes has identified six points that illustrate the breadth of the **3DEXPERIENCE** platform's capabilities including:

1. Product Line Engineering driven by model-based systems engineering (MBSE)
2. Requirements and MBSE-centric approach
3. Software engineering and development

4. Continuous simulation and integration
5. Integrated downstream disciplines engineering
6. End-to-End traceability (for compliance and regulations)

Each of these six items are crucial in the development of mobility systems of systems. Concurrent development and operational processes identify the need for interactive collaboration. Enabling and encouraging the different engineering disciplines, from mechanical to electrical to electronic and software, to work collaboratively drives the need for a development environment where each discipline can see and query other disciplines' work as engineering proceeds. Keeping requirements, both desired and mandated by regulations, visible in the context of the evolving designs, speeds the process. Modern development practices rely on lots of simulation. Simulations at architectural and multi-physics level faithfully model experiences. Influences from use and operation drive the desire for upgrades and discovery—How are customers using mobility products and services? MBSE must evolve to manage these growing business needs.

Example 1—Chips to Digital Infrastructure

Consider what happens inside the chips within a product when communicating with the digital infrastructure where a mobility product operates. There is a merger of consumer electronics and mobility systems that support integrated systems from embedded computers, aka microchips, to connected devices (cars and cell phones and tablets), to infrastructure. These must integrate and deliver consistent services and consumer experiences, seamlessly. The **3DEXPERIENCE** platform for engineering products during their use, and being upgraded often, has grown over the past decade into a development and operational environment for mobility products enabling better and better mobility experiences.

Figure 2 shows spheres of high-tech systems which co-exist, cooperate, and encapsulate broad systems with many individual semiconductors. Software in all these domains implements algorithms within the computer systems and networks to yield a single desired experience.

The need for rapid adoption of advancements like 5G, AI, AR/VR, and cloud solutions is a must to stay ahead of the game on rapidly moving markets. As global demand, political climates, and value chain dynamics shift unpredictably, enterprises must exhibit unprecedented agility. Virtual twin technologies

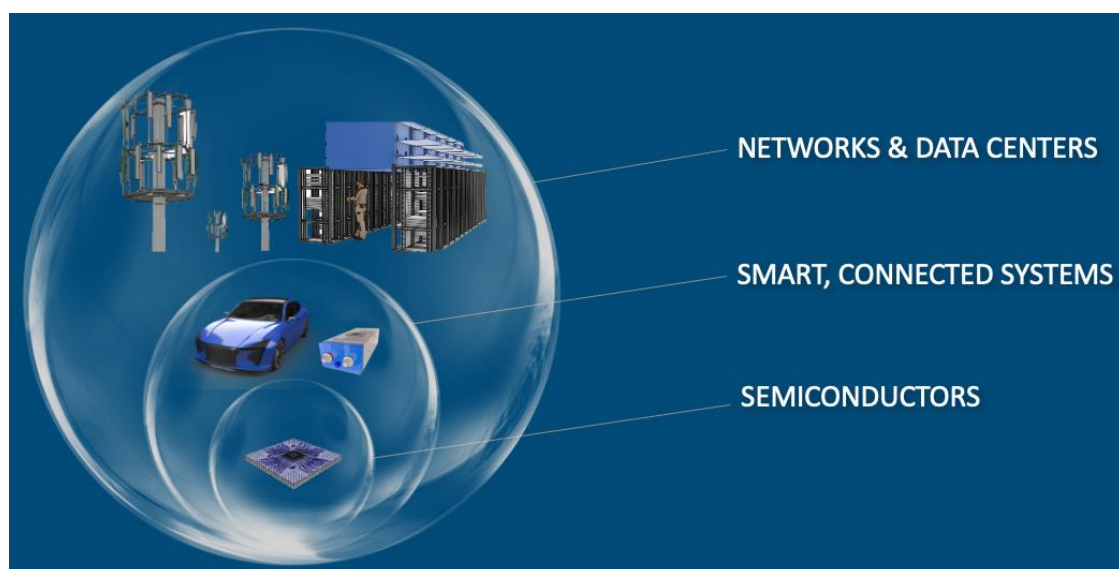


Figure 2—Expanding Experiences Driven By Emerging Technologies
(Courtesy of Dassault Systèmes)

are required to model and simulate mobility experiences that are delivered by systems of systems—from chips to digital infrastructures

Our world is evolving, with new business paradigms emerging from the desire to use rather than own, evolution to circular economies, and orchestrated digital services reshaping the landscape. Virtual twin technology empowers innovation by bringing visionary precision to digital strategies and operations.

Dassault Systèmes delivers functional virtual twin technologies to enable breakthroughs across the board—from mastering complex chip and connected systems engineering, to delivering scalable, high-performance networks and digital services for both consumers and enterprises.

Dassault Systèmes summarizes the power of virtual twins at every level of connected mobility systems in Figure 3.



Figure 3—Mobility Experiences Rely On Expanding Cooperating Domains
(Courtesy of Dassault Systèmes)

It is the ability to simulate and explore how systems interoperate as they evolve which is now needed for mobility engineering. Software and electronics are everywhere and require configuration management and release coordination across systems. It is likely the development of these systems spans OEMs and the environments where mobility products operate. Different locations may well have different capability levels which then will affect the degree of autonomous operation that can be supported. Mobility engineering must comprehend and accommodate these potential overlapping domains.

Example 2—Software Defined Vehicle

Mobility products operating within transportation systems (roads, cities, traffic management, etc.) are always learning new experiences that provide new scenarios for ongoing feature enhancements whose impacts are broader than just the vehicles. It is the high-tech enablement of power computing and software with machine learning and upgrade adaptability that yields a Software-Defined Vehicle (SDV). SDVs can provide OEMs with new lifecycle revenue sources, just like applications on a cell phone. The connectivity and ease of information access make the mobility experience better, e.g., less wasted time stuck in traffic. The target is to maximize the possibility of mobility systems changes during the ownership of a vehicle, well after its mass production.

The competitive benefits of having virtual engineering techniques and processes that allow grading candidate features implemented in alternative ways without expensive physical prototypes is obvious, assuming simulations and models are trusted. Virtual engineering's promise is that systems algorithmic development has fewer and fewer physical prototype learning cycles as virtual builds and performance assessments become more trusted, accelerating product development and improving safety compliance. Trust comes from experience driving model correlation, aka model learning. Refined models reflect the latest field experience measurements. These more accurate models create an environment where new ideas can be assessed faster.

TRACEABILITY CHALLENGES



Traceability Challenges

- **Certification & Regulation** : Demonstrate effective integration of regulatory and safety requirements throughout the development process, ensuring product compliance
- **Risk & Impact Analysis** : Effectively address and mitigate the risks & impacts of changes in system specification, design, or implementation.
- **Collaboration** : Facilitate collaboration among interdisciplinary teams handling diverse documents from various sources



Figure 4—Traceability Challenges
(Courtesy of Dassault Systèmes)

What is needed is to assure compliance through comprehensive traceability at the start by keeping safety awareness and compliance visible (see Figure 4). Meeting all the requirements, standards, and performance objectives as mobility products and services design evolves is needed by the OEMs. Trusted systems models that evolve as experiential knowledge is discovered makes engineering more responsive to the market and changing operating requirements. Robust, compliant products with reliable upgrades are becoming the hallmark for great companies, keeping customer safety and satisfaction in the forefront. Making requirements traceable while assessing the mobility systems' ability to meet them is essential. Advances in computing power and databases continue to make virtual engineering more and more affordable and faster—making collaborative mobility engineering possible. Balancing priorities as new ideas are refined into realistic mobility features is needed as early as possible to both optimize the design and establish trust in that design. This massive number of user experiences needs to be managed. This is a key solution capability that enables mobility OEMs to remain competitive as consumer demands evolve.

The **3DEXPERIENCE** platform enables better early trade studies correlated to the latest product use. Dassault Systèmes has built functioning prototypes by collaborating with embedded electronics controls system leader Bosch and the leading in-vehicle electronics instrumentation leader, ETAS, to perfect their virtual engineering offerings supporting mobility controls systems development. Mobility developers should evaluate this prototype by asking Dassault Systèmes for a demonstration.

Conclusion

Multi-discipline engineering is best done collaboratively. The **3DEXPERIENCE** platform enables collaboration by providing data integration and synchronization across multi-discipline modelling, and data intelligence applications. These capabilities can help drive fast paced mobility features development and optimization. Earlier, comprehensive engineering that learns from consumer experiences establishes the needed trust for digital mobility solutions and their frequent upgrades. Systems engineering using broader simulations of the complete ecosystems as they evolve is needed for competitive collaboration. The OEMs and cities which master these virtual twin tools and methods will be the leaders in the mobility experiences marketplace. Keeping and building trust with customers and across connected mobility systems is crucial.

Keeping safety requirements and regulations visible from inception through production enables the ability to perform continuous safety assessments. Safety awareness from the start keeps new mobility features viable within the product's capabilities and the city ecosystems in which they operate.

Dassault Systèmes' **3DEXPERIENCE** platform supports the complete mobility lifecycle across all systems noted in Figure 2. Dassault Systèmes has capabilities that support the continuous nature of learning from experiences and adjusting features whenever needed. Experiences management combined with interactive requirements coverage made contextually visible within the 3D product mockup enables faster learning and thus faster engineering. The experiences database expands as new data comes from usage in the physical world. New, measured data augments the original assumptions, often leading to new insights based on coupled physics. Being able to expand simulation of these new phenomena builds trust in the predictive performance models. Compliance, through comprehensive requirements traceability, is always visible. The value this provides OEMs is clear—optimized products that meet and possibly anticipate mobility market desires.

CIMdata encourages prospective customers to ask Dassault Systèmes for the same overview CIMdata saw to show how their solution addresses all six points that illustrate the breadth of the **3DEXPERIENCE** platform. Keeping and building trust with customers is crucial for mobility developers, wherever they are in the chip to networks ecosystems.

About CIMdata

CIMdata, a global strategic management consulting firm, provides services designed to maximize an enterprise's ability to design, deliver, and support innovative products and services. For more than forty years, CIMdata has provided industrial organizations, providers of digital technologies and services, and investment firms with world-class insight, expertise, and best-practice methods on a broad set of product lifecycle management (PLM) topics and the digital transformation they enable. CIMdata also offers research, subscription services, publications, and education through certificate programs and international conferences. To learn more, visit www.CIMdata.com or email info@CIMdata.com.