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Smart Solutions
for the Innovation Race

LMS®
A Siemens Business

Our new future sharing a common vision

Dream. Design. Develop. Delight.

"We want our customers to delight their customers. Technology aside, our goal is to help our customers dream of a world of new possibilities as early as possible in the engineering process. Being able to try out new ideas and concepts without slowing down the market-critical design and development schedule will revolutionize the pace of innovation."

Dr. ir. Jan Leuridan
Chief Executive Officer

Today, as a business segment within Siemens PLM Software, LMS is entering an exciting new era. Together, we will continue to drive the industry forward with our shared passion for engineering innovation and our common vision for product development excellence in all our customers' industries.

LMS' unique test and mechatronic simulation product portfolio provides answers to the most pressing engineering challenges. Our highly acclaimed engineering services, our direct sales force and our expert customer service staff are a familiar and welcome sight at our customers' offices around the world.

Our strong foundation is our key advantage. Each and every LMS product consists of layers of accumulated know-how based on more than thirty years of research and technology, engineering expertise, and state-of-the-art software and hardware development practices. Frequently collaborating with our customers and innovation partners, we have developed a technology foundation that is second-to-none in our key engineering disciplines. In-house teams from LMS Engineering Services work with leading manufacturers worldwide to gather a practical understanding of market requirements while our global, direct sales force and customer support teams keep us in touch with our customers' latest challenges. Customer feedback is the basis for our software and hardware solutions, aligning them to the latest requirements and market trends.

The LMS Innovation DNA. Knowledge, like constantly staying abreast of emerging technology and understanding customer requirements and market trends, is packaged into our market-leading test and mechatronic simulation applications to help engineers around the world put top-level brand performance in their products. This is all part of the LMS Innovation DNA. This is what we will build on further within Siemens PLM Software.

The customer-centric LMS innovation engine will continue to push forward. As a business segment within Siemens PLM Software, we are confident that we will continue our success story. As a part of the PLM market leader, we will be well positioned to further expand our presence

in our strategic market areas, like automotive, aerospace and other high-tech industries. In combination with Siemens PLM Software, we will further expand our footprint in a wide variety of industries, including energy, high-tech applications, consumer markets and shipbuilding. We are excited to be able to leverage this and position our solution portfolio in a much broader context.

Our customers will guide our vision to implement a comprehensive solution set supporting closed-loop, systems-driven product development. Engineers are facing more and more complexity when it comes to product development. It is not uncommon to juggle thousands and thousands of functional requirements and specifications per product development cycle. The overwhelming need to manage this is driving the trend towards systems engineering. For more than 10 years, LMS has pioneered a vision to conquer this complexity by supporting the paradigm shift towards model-based systems engineering (MBSE) with our simulation and test solutions for systems verification and validation. With Siemens PLM Software, we can now combine our portfolio with other solutions for systems engineering and help our customers conquer the complexity factor in product development using closed-loop, systems-driven product development. This is a common vision that we share with Siemens PLM Software, and one that will advance the evolution of our products and services portfolio.

We want our customers to delight their customers. Technology aside, our goal is to help our customers dream of a world of new possibilities as early as possible in the engineering process. Being able to try out new ideas and concepts without slowing down the market-critical design and development schedule will revolutionize the pace of innovation. Model-based systems engineering concepts and systems-driven product development will help engineers design essential brand performance traits with confidence. In essence, our solutions will help our customers conceive, design and develop products to truly delight their customers.

Dr. ir. Jan Leuridan
CEO
LMS, A Siemens Business

Major industry challenges

Engineering opportunities

Opportunities are arising as never before. By 2015, a billion new consumers from emerging economies will have entered the world market. Consumers have access to nearly an endless stream of choices, yet are demanding more sustainable, energy-efficient, next-generation products and services. To lighten the load on our limited energy resources and meet consumer demand, product innovation must be smarter and faster than ever.

A sustainable future

Fossil fuel is no longer the only answer. With long-term sustainability in mind, governments are taking regulatory measures to create a balanced energy mix that combines both conventional and renewable sources.

By 2030, global energy use will double, but CO_2 emissions will have to be reduced by 80% to 95% by 2050. The race to reduce global warming while achieving greater energy efficiency is one of the most challenging engineering opportunities in decades.

The eco-revolution has forced engineers to rethink the traditional product and fundamentally transform every aspect of the traditional engineering process, creating a whole new eco-engineering agenda with next-generation products and new players.

Manufacturers and suppliers are answering this call with a variety of new electric and hybrid vehicles, including prototype hydrogen fuel cell and autonomous cars. As a result, there is an increased demand for complex electronics and high-voltage fuel cells. Engineers are also downsizing conventional powertrains, developing advanced fuel efficiency programs and integrating composite materials in all types of vehicles, including unmanned vehicles. New fuel requirements, advanced extraction techniques and the eco-evolution are changing the face of the energy sector as well.

Smart systems for intelligent vehicles

Engineers in the automotive, aerospace, railroad, shipbuilding and other high-tech industries are challenged by consumer demand for more comfort, performance and safety. Smart products and intelligent systems are the answer. Recent surveys show that approximately 80% of next-generation products and systems will be derived from smart systems. Intelligent systems clearly are essential when designing competitive, cost-efficient products with higher productivity levels and superior reliability.

Integrating smart systems with more complex electronic control units will improve product performance and deliver an unprecedented number of new functions. Developing a flawless integration of all these smart systems remains one of the biggest industry challenges.

Advanced drive, fly and navigation assistance systems and electronic control units are taking over. One finds everything from start-stop systems, active-lane keeping, collision avoidance, automatic parking to advanced in-vehicle telematics, GPS and integrated internet for cars, trains, airplanes, satellites, and ships. Intelligent active systems are running everything from key operating and safety mechanisms in the latest vehicles to smart packaging machines, hyper-speed printing presses, power-packing excavators and highly efficient wind turbines.

A winning brand identity

Clearly, markets are growing in size and sophistication. There are more product drivers than ever before: new regions of the world, new regulations, new sensitivities, more communication among buyers and heightened awareness of what everyone else has. The result is more product choices and more competition. Differentiation has become more nuanced, making branding and brand value more important.

The green revolution offers some of the best examples of brand value. Consumers and legislation are driving this green and smart revolution, putting traditional brand values under pressure. How do you combine the passion for driving or the fun of flying while remaining committed to sustainability? How do you create product passion and unforgettable experiences tailored to an eco-friendly society? How do you guarantee the future of a distinctive brand sound or brand performance without compromise?

To successfully translate, empower and even enhance brand definitions into functional performance criteria, engineers require experience and know-how, dedicated transformative tools and solutions, and the courage and passion to pioneer.

Winning products will differentiate through appealing brand values. Brand-related emotions and experiences will be one of the most decisive factors in the customer decision-making process. This will have to be captured early in the design process.

Products and services based on brand performance

With the new emerging markets, the global demand for products and services will be unprecedented. In 2012, the automotive industry peaked, manufacturing 60 million cars or 165,000 new cars daily. The same is true in aerospace, where long-term forecasts point to the need for over 34,000 new planes.

Operating in a globalized world will not create one global customer. The opposite is true. Manufacturers throughout all sectors will be challenged to diversify to meet a multitude of local preferences and an increased palette for personalized products and customized services. As a result, manufacturers and their suppliers have created an enormous segmentation of products and services based on distinctive brand performance and value.

Emerging next-generation products often create a whole new set of product and price expectations in the global market. To match market demand, automotive manufacturers are producing models from small city cars and electric vehicles to luxury, high-performance sedans and SUVs. There is choice enough to meet any dream from snappy 2-cylinder engines and powerful V12s to pleasant-to-drive hybrid, electric and other eco-friendly motors.

The new engineering agenda

New smart products will require a next-generation engineering process that supports the optimization of mechatronic systems.

Products will continue to evolve from purely mechanical devices into a combination of mechanical parts, electronics, controllers and software. New smart products will be mechatronic.

"By designing the ideal architecture upfront and optimizing its functional performance, even before geometry is available, engineers can even further frontload the development process, minimize risks and avoid late stage changes."

ir. Dirk Van den Berghen
Chief Operations Officer

Merging two worlds

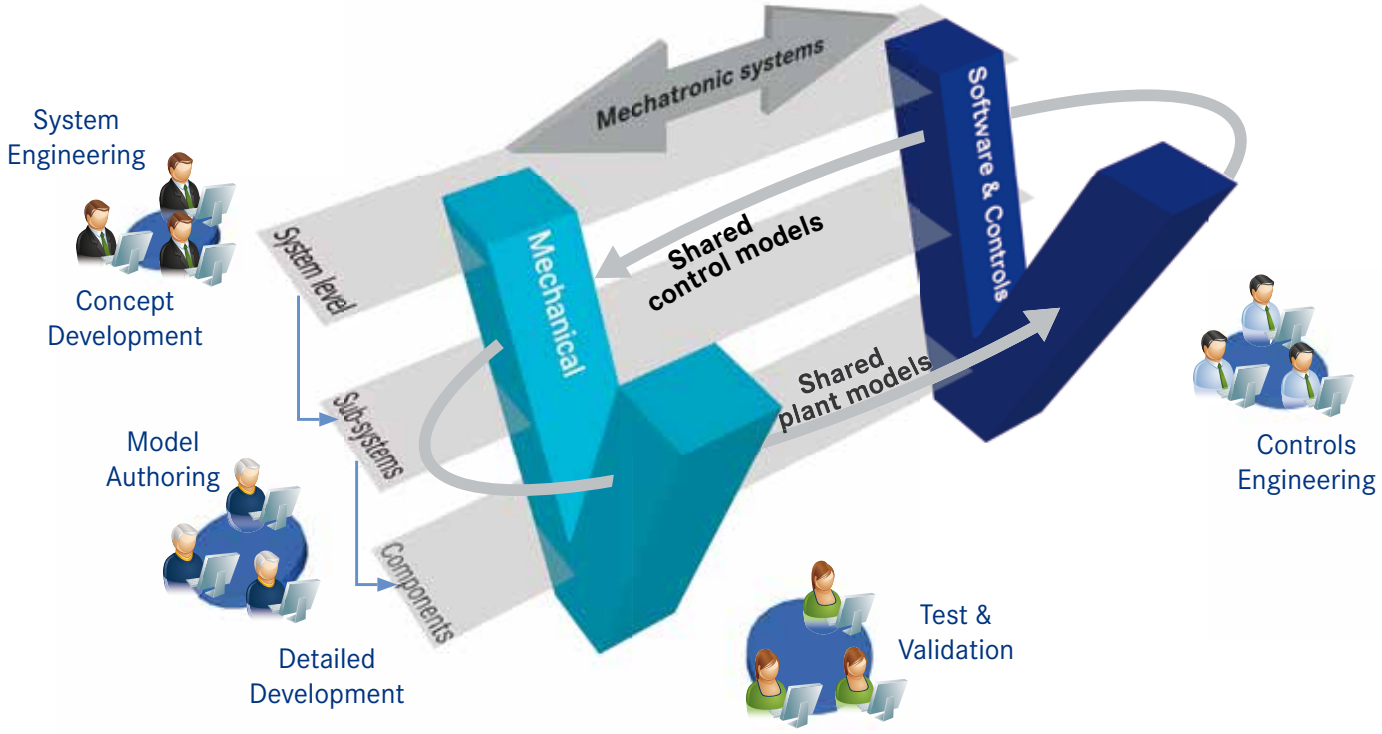
The more features a product requires to remain competitive, the greater the control burden becomes. Design-Test-Fix has long been replaced with a simulation-driven process based on new product geometry and CAD and CAE technology.

Mechatronic products present a new challenge; the mechanical, electronics and software design worlds must be brought together. Early attempts at a systems engineering approach have not been a viable option for the innovation pace required for new product development.

This is changing rapidly. A new level of understanding is emerging: an evolution from rapid prototyping, using physical hardware, to a model-based systems engineering approach, based on existing plant models, using simulation models representing the controlled systems.

The competitive pace of innovation will not allow manufacturers to eliminate complexity by simply deleting product attributes. Launching immature products on the market can be disastrous with expensive recalls and long-term brand reputation damage.

The traditional engineering process is under scrutiny after major problems led to program delays, cost overruns and cancellations in every industry. More often than not, the issues lie with unanticipated interaction between elements that are only discovered during integration, testing and, in the worst-case scenario, during service.



Model-based systems engineering

The risk of high-profile program failure can be avoided in every industry.

The problem is that most products in most industries are based on the continual development and refinement of well-established concepts using a familiar linear process. Fundamental product and process innovation is rare in most companies, but it is exactly what is required – a change to a model-based systems engineering process or MBSE.

MBSE involves deconstructing a design into separable elements, characterizing the intended relationships, and verifying the system is built and operates as intended, to minimize risks and avoid late stage changes.

Models will offer contextual information on different degrees of freedom and interaction. Fully understanding the dynamic behavior of every interaction in every implemented system is crucial.

By analyzing and designing the ideal architecture upfront, even before the concept phase, engineers can manage time better and minimize risks during the development process. This requires high-fidelity models or plant models for control model development, control software development and actual controller validation.

A call for profound innovation

New, more robust engineering platforms should permit validation without several prototype rounds. If we want our customers to leapfrog in terms of innovation, we need to help them redesign the end-to-end development process. By aligning test engineering and 1D and 3D simulation into a new framework of model-based systems engineering, together we will realize quantum leaps.

Integrating modularized subsystems and components is well underway. We all realize the need to frontload vehicle systems engineering to deliver superior brand performance and brand value. Model-based systems engineering is the answer to modern development and design challenges, like calibrating controls and software to balance upfront conflicting attributes for simultaneous mechanical, thermal, electronic and controls development.

In the new model-based systems framework, engineers now have to integrate traditional test and simulation engineering into this platform. It includes domain-specific data management that can be federated with the new model-based systems-level PLM backbones.

Our solutions strive for an “open for business” approach to innovation with extensions for supply chain and life cycle management. As the way manufacturers and suppliers work together fundamentally changes, companies will need to manage engineering data and intellectual property differently as well as developing new approaches to warranty and in-service issues.

Leading partner in Test & Mechatronic Simulation

A clear vision and passion for innovation

LMS has spent over 30 years developing its successful portfolio of products and services. Today, LMS will continue to further enhance its presence in the world of engineering innovation as a business segment within Siemens PLM Software.

1980

Market-reference LMS Test.Lab

Since 1980, LMS has pioneered multi-channel, computer-based testing systems. Innovative software and hardware applications cover a full set of NVH, structural, acoustic, modal, durability, and rotating machinery applications delivered in an integrated hardware and software platform. Today, with LMS Test.Lab, LMS is a market reference for best-in-class hardware and software for test engineering.

1995

Hybrid engineering LMS Virtual.Lab

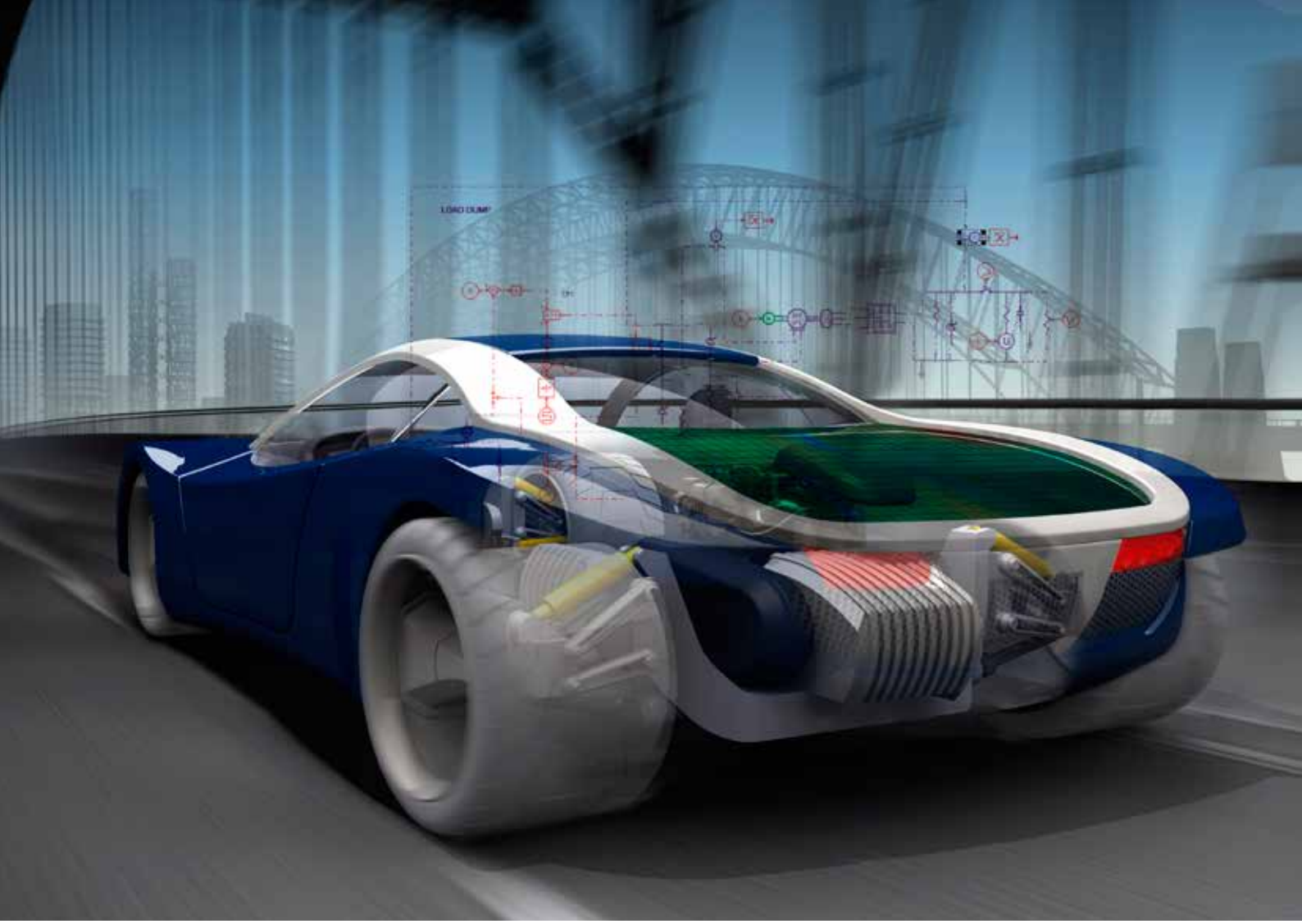
By 1995, it was clear that manufacturers had to shorten time-to-market drastically to stay competitive and that rounds of prototype testing were a serious bottleneck. LMS continued to invest significantly in testing innovation while, at the same time, expanded its development work in virtual simulation. This introduced a unique hybrid engineering approach, combining test and simulation solutions that leveraged the best of both worlds.

With a series of acquisitions and cutting-edge partnerships, LMS drove the engineering world towards reducing late-stage prototype testing and trouble-shooting by frontloading the design process using virtual simulation. In 2000, LMS introduced the LMS Virtual.Lab platform, which, today, can simulate a variety of multi-physics, multi-attribute applications.

2007

Smart solutions for smart products LMS Imagine.Lab

To accurately simulate multi-domain intelligent system behavior and predict multi-disciplinary performance prior to the CAD geometry stage would be a serious process improvement. This is why LMS acquired Imagine in 2007. Still cutting-edge, this know-how is found in the LMS Imagine.Lab suite for 1D multi-physics simulation.



2010

Pioneering work in model-based systems engineering

Three years later in 2010, LMS acquired Emmeskay to solidify its MBSE expertise. At the time, the market was battling with complexity: mechatronic products, controls and mechanical design could no longer proceed independently or in parallel. There was a need for an interlocked approach. MBSE creates the ideal product development architecture to design, test and validate controls and controlled systems together in a simulation environment. With MBSE, the dynamic interactive behavior found in the ever-increasing number of in-product controls and software can be validated before physical prototyping.

2011

Enhancing hybrid engineering and MBSE portfolio

In 2011, LMS acquired a 60% controlling majority position in Samtech. This Belgian CAE and structural analysis software company increased LMS' footprint in aerospace with a number of complementary simulation solutions, for example, in the area of composite analysis. LMS Samtech has already expanded its European market to an international level by approximately 40% in 2012.

2013

Siemens acquires LMS

In January 2013, LMS was acquired by Siemens and became a business segment within Siemens PLM Software. Siemens will become the first product lifecycle management (PLM) software company to provide a closed-loop systems-driven product development solution extending all the way to integrated test management. The integrated solution will increase simulation accuracy, which improves decision-making and enhances the customers' ability to design the product right the first time. The decision making process is underpinned by a deep and accurate virtual analysis linked to the physical world.

Conquering complexity: a portfolio aligned to the market

LMS is a leading provider of test and mechatronic simulation software and engineering services in the automotive, aerospace and other advanced manufacturing industries. As a business segment within Siemens PLM Software, LMS provides a unique portfolio of products and services for companies to manage the complexities of product development by incorporating model-based mechatronic simulation and advanced testing in closed-loop systems-driven product development.

A worldwide leader in engineering innovation

Based in Leuven, Belgium, LMS has more than 30 years of solid engineering experience with an unrivaled track record in developing and marketing innovative technology that addresses very real customer challenges. From its roots as a high-tech spin-off from the University of Leuven in Belgium, LMS has grown to become a worldwide leader in engineering innovation with mechatronic simulation software, testing systems and engineering services.

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Excellence in test-based and hybrid engineering

As an industry leader in test-based engineering, LMS has pioneered many innovative techniques in high-end structural and NVH testing over the years. The full portfolio of LMS testing solutions includes transfer path analysis, rotating machinery, structural and acoustics testing, environmental testing, vibration control, report and data management. On the hardware side, the new patented SoundBrush solution is a revolutionary tool that helps engineers actually see what they hear while the well-known LMS SCADAS family data acquisition range continues to perform in a variety of test situations – from compact mobile units, autonomous smart recorders, dedicated durability solutions up to high-channel count laboratory systems. All hardware and software systems are tightly integrated to tune into the specific needs of practically any testing engineer across a variety of industries.

Pioneering real-world performance simulation

Over the last decade, LMS International has developed an integrated hybrid process solution – simulation enhanced by test. With LMS Virtual.Lab, LMS Imagine.Lab and LMS' mechatronic solutions, critical functional performance attributes are simulated and designed upfront in the product development process. This process has enabled LMS customers to slash development times by 30-50%. This is not only a tremendous advantage in terms of faster time to market; it also significantly reduced risks and costs.

With the acquisition of a 60% stake in Samtech in 2011, LMS was able to integrate a number of complementary simulation solutions into the LMS Virtual.Lab portfolio. Bundling years of accumulated know-how in 3D finite element, multi-body modeling and process analysis, the complete LMS 3D simulation solution helps engineer the right product while accelerating the development process. Combining various products from the LMS Virtual.Lab and LMS Samtech software suites, engineers can simulate real-life behavior to address product-critical performance attributes. Every LMS 3D simulation solution can be tailored to precise industry and application requirements in areas such as acoustics and vibration, mechanisms, automotive and aerospace simulation process integration, structural analysis and wind turbine development.

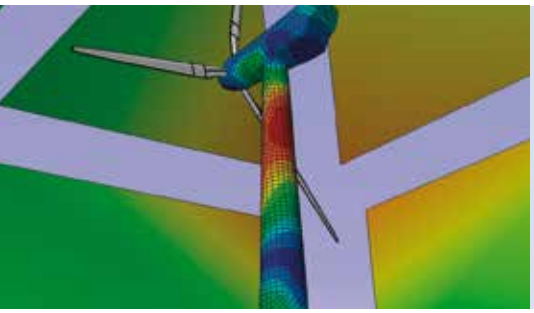
Towards closed-loop systems-driven product development

Engineers are facing more and more complexity when it comes to product development. It is not uncommon to juggle thousands and thousands of functional requirements and specifications per product development cycle. The overwhelming need to manage this is driving the trend towards systems engineering. For more than 10 years, LMS has pioneered a vision to conquer this complexity by supporting the paradigm shift towards model-based systems engineering (MBSE) with our simulation and test solutions for systems verification and validation.

With Siemens PLM Software, we can now can combine our portfolio with other solutions for systems engineering and help our customers conquer the complexity factor in product development using closed-loop, systems-driven product development. This is a common vision that we share with Siemens PLM Software, and one that will advance the evolution of our products and services portfolio.

A unique portfolio of products and engineering services

Engineers appreciate the seamless integration of the LMS products, backed by expert service and support. LMS delivers a unique combination of virtual simulation software, testing systems, and engineering services. We are focused on the mission critical performance attributes in key manufacturing industries: structural integrity, system dynamics, handling, safety, reliability, comfort and sound quality. LMS has the experience, unique competences and award-winning solutions that empower an innovative way of engineering.



LMS 3D Simulation Solution Portfolio

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LMS Imagine.Lab platform for Mechatronic System Simulation

A complete 1D system simulation platform, this solution lets users model and analyze multi-domain, intelligent systems and predict multi-disciplinary performance. Model components are described using validated analytical models that represent the system's actual hydraulic, electric or mechanical behavior. An open system development platform, LMS Imagine.Lab frontloads mechatronic system simulation for multi-physics, multi-domain modeling and system synthesis and analysis.

LMS Test.Lab platform for Test Engineering

This integrated platform offers a complete software and hardware portfolio for noise and vibration testing including solutions for acoustic, rotating machinery, and structural testing, environmental testing, vibration control, reporting and data management. With its unified interface and seamless data-sharing capability between different applications, LMS Test.Lab offers users tremendous efficiency gains and ease-of-use.

LMS Engineering Services

LMS engineers work with customers to solve their most critical problems and often make the difference between successful product launches and costly repairs or even failures. Experienced in critical performance attributes, LMS Engineering Services experts offer a unique balance of skills, engineering experience and process know-how to turn attribute engineering into a strategic competitive advantage.

LMS Virtual.Lab platform, CAESAM and SAMCEF suite

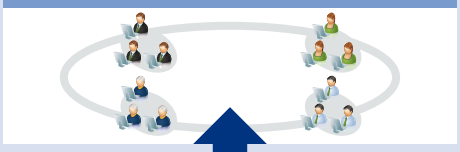
Design - CAD

Controls

LMS Imagine.Lab

System Synthesis

System Data Management



Multi-physics Modeling

LMS Test.Lab

Laboratory Testing

LMS SCADAS Data Acquisition Systems

Mobile Testing

LMS Customer Services

LMS supports its customers with engineers who not only understand the hardware and software, but also master the related engineering applications. Extensive training, seminars, and on-site services help our clients' technical staff gain and maintain their software and system know-how. LMS offers a complete portfolio of professional services, including full installation management, on-site training and support, and continuous knowledge transfer.

Automotive brand engineering
The new age of NVH and driving dynamics

The pressures on NVH engineering are enormous and increasing constantly. Legislation continuously revises and dictates tougher noise and vibration limits; hybrid and electrical vehicles introduce an entirely new noise environment; fuel efficiency dictates new, lighter structures with unique load paths and smaller, quieter engines no longer mask noises from other sources. Of course, customer expectations with regards to driving dynamics and comfort are rising. This means that NVH and driving dynamics as differentiating brand values have become more important than ever.

New NVH opportunities

Optimizing fuel economy strongly impacts NVH behavior. Fuel economy is directly influenced by weight reduction. The focus on new materials in vehicles, such as composites and bonding agents, as well as weight reduction throughout the chassis and powertrain components, all influence NVH and acoustic performance. Better fuel economy improvements can cause degradation in vibration behavior and acoustic performance. Weight reduction programs can affect transfer paths causing driveline-induced booming issues. Driveline-induced transient vibrations can also generate particular transmission gear whine and rattle issues.

Electric and hybrid vehicles are changing the world of NVH as well. Without low frequency interior engine noise, the interior sound quality of electrical vehicles is dominated by high frequency sounds. Auxiliary noise coming from small-motorized parts, the HVAC system, power inverters and battery cooling systems creates different sound signatures and makes noise and transmission whine all the more prominent. Road and wind noise can deteriorate the interior sound quality more in the absence of interior engine noise.

When it comes to hybrid and electrical vehicles, the industry is just beginning to develop significant expertise and databases for NVH benchmarking, sound quality and target-setting. This is one of the challenges and opportunities for NVH development in the future.

LMS solutions

LMS is working with leading OEMs and transmission manufacturers to develop upfront hybrid test and 1D and 3D simulation analysis to address the increased dominance of transmission gear whine, rattle and transient drivability issues.

This continuous work in test-based and hybrid methods for low-frequency driveline-induced booming and higher frequency road noise prediction helps leading OEMs address the pressure on NVH brand performance.

LMS follows pass-by noise regulations closely and develops easy-to-use solutions for this type of NVH engineering as well. LMS also develops leading technology for frontloading pass-by-noise simulation and addressing regulatory pedestrian safety trends for electric vehicles.

Customer benefits

Along with customers, LMS successfully developed an integrated approach to NVH engineering:

- Pioneering and implementing a hybrid test-analysis development process
- Considering NVH challenges in a multi-disciplinary context
- Delivering the power of an integrated solution platform
- Leveraging the best of simulation and testing
- Providing a unique combination of engineering skills and vehicle development experience

A proven track record

"We are developing Model S to deliver a refined driving experience and LMS Test.Lab delivers the breadth of test capability our NVH engineering team needs."
Peter Rawlinson, Vice President of Engineering at Tesla Motors

"We looked for a supplier with a solid experience in NVH engineering and with a strong offering in virtual simulation for NVH. Taking all of this into account, LMS represents the best choice."
Dr. Ralf Kunkel, Head of the Acoustics Engineering Department at Audi

"Thanks to the know-how and pragmatic attitude of LMS Engineering Services experts, the technology transfer from the study will enable Jaguar engineers to leverage this leading-edge work in future development projects."
Faruk Turgay, Manager Vehicle NVH at Jaguar Land Rover

Engineering sustainable products
Vehicle Energy Management

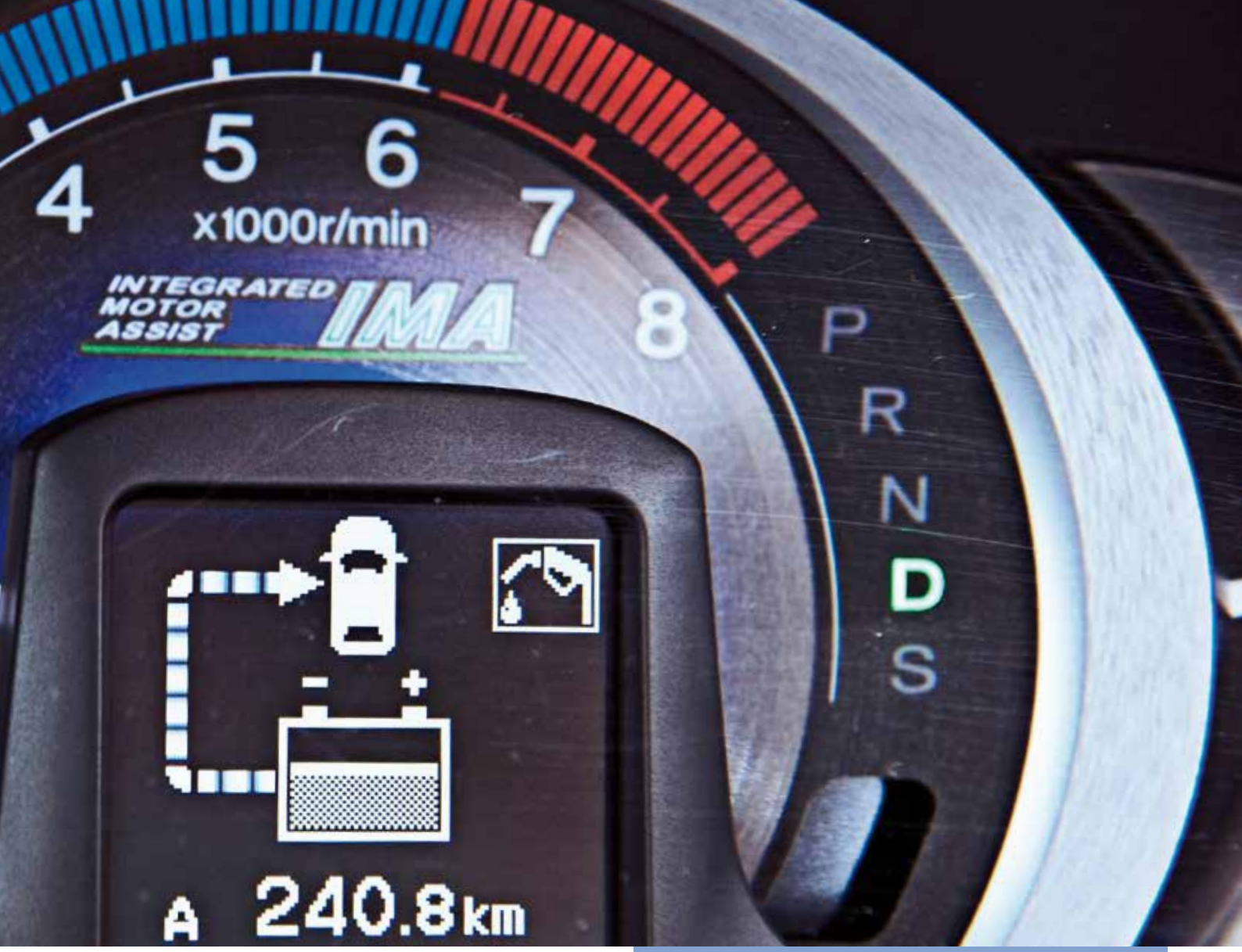
Vehicle Energy Management or VEM is a global approach to optimize energy flows. It is a proven LMS solution that remedies the problems of integrating sustainability engineering into the current development process while improving vehicle comfort, performance and fuel economy.

Building efficient systems

VEM can be integrated into existing vehicle development processes and combines mechanical, thermal, electrical and control engineering in one software environment. This pioneering systems engineering platform provides modeling simulators at the system and component level, meta-modeling at a full vehicle level as well as the necessary support for company-wide data and model management solutions.

From full vehicle modeling to detailed component design

New vehicle architecture, such as electric vehicles and hybrids, are equipped with ever more complex control and electric and electronic systems. This has impacted the traditional vehicle development process. How can complexity controlled while new innovative solutions are deployed? VEM permits important design decisions that impact emissions and fuel consumption early in the development process, while improving drivability and passenger comfort. Early concept analysis at a system level allows trade-off studies for complex driving cycle parameters like auxiliary electrification, hybrid control systems, break energy and exhaust heat recovery, HVAC and start/stop systems.



Customer benefits

LMS unites the very best engineering expertise, deployment experience and software platforms to provide a complete solution for automotive customers. Every customer need is different and each vehicle development process is unique. This know-how is found in the easy-to-implement Vehicle Energy Management solution.

- Delivering the best eco-performance while balancing driving dynamics and comfort
- Controlling complexity through a VEM systems engineering approach
- Reducing time-to-market
- Facilitating collaboration within and between OEMs and suppliers

A proven track record

"LMS Imagine.Lab AMESim enables us to assess different hybrid technologies and their specific capabilities, especially heat recovery systems, early in the design process."
Sebastian Knirsch, Engineering Services at Voith Turbo

"Simulation lets us reduce development time by almost 50% and create AMT designs that exactly meet target performance requirements."
Edouard Négre, Powertrain Control Engineering Division at Renault

"This solution estimates the potential of a new product to reduce CO_2 emissions for a given configuration, bringing a crucial answer to customers."
Thiery Bourdon, Powertrain Engineering Group at Continental Automotive

The next breakthrough in aircraft engineering Virtual Integrated Aircraft and Virtual Iron Bird

Environmental issues have an enormous impact on today's aerospace market. From noise regulations and carbon footprints to fuel efficiency and alternate fuels, manufacturers are faced with a staggering number of new design considerations.

Achieving early maturity

Complex, integrated, multi-domain systems engineering must be applied from the very beginning of the design process to adequately address these challenges as, unfortunately, a number of substantial recent program delays have demonstrated. Although the aerospace industry has practiced systems engineering longer than many other industries, there is still a need to transform internal processes into a true model-based process.

LMS MBSE solutions to transform the process

Based on the LMS simulation platforms for multi-physics modeling and system synthesis, individual aircraft systems can be precisely modeled and analyzed. The integrated operations of such systems for nominal, abnormal and failure mode use cases can be simulated, as a Virtual Integrated Aircraft, in the early concept phase of the aircraft program. These simulations support early concept studies and trade-offs, validate aircraft functions early in the life cycle, and optimize overall performance of different mechanical, hydraulic, electrical and electronic systems. The LMS solution portfolio includes a dedicated data management application for both multi-physics and control models, and is, therefore, a critical enabler for productive collaboration between different engineering departments for subsystem and system engineering.

Virtual Integrated Aircraft analysis also provides the necessary insight into the aircraft systems dynamic interactions, leading to a better definition of technical requirements for subsystems and more clarity for the entire supply chain. Evolving system and subsystem designs can be monitored for requirement compliancy for proper interaction with other aircraft systems.

With the LMS solution, multi-physics subsystem and system models can be reduced to high-fidelity, real-time simulation models to frontload the testing of certain physical subsystems in combination with other virtual subsystems in a Hardware-in-the-Loop (HiL) test set-up. This helps virtualize an aircraft's Iron Bird into a Virtual Iron Bird, making it possible to frontload the validation of integrated aircraft systems, and speed up controller, subassembly and full scale Iron Bird testing.

Customer benefits

- Improved efficiency of aircraft system design and integration
- Compare functional performance of alternative architectures and technologies
- Deeper insight in system performance (electrical, thermal, mechanical, hydraulic, pneumatic) of components and subsystems, including dynamic interactions
- Better validation of integration of aircraft systems from the early design stages onwards
- More efficient test preparation and testing using virtual testing

A proven track record

"Simulation enabled us to anticipate and reduce the inherent development risks of a new technology by incorporating an upstream validation regarding the technical choices. Simulation results obtained in the early project stages using LMS Imagine.Lab were later confirmed on test benches with a very good accuracy."
Michael Benmoussa, Senior Design Engineer at Messier-Bugatti

"Thanks to LMS Imagine.Lab, we managed to reduce the test rig development time by 25% and since we were able to perform part of the tests via simulation, the availability rate of the physical testing platform increased by approximately 60%."
Mr. Debiane at Certia

"We have been extremely impressed by the flutter analysis and the way LMS Test.Lab can handle the immense amount of Airbus A380 in-flight data during off-line analysis."
Jean Roubertier at Airbus

Delivering industry-leading innovation through mechatronic systems design

Product innovation is increasingly dependent on controlled or mechatronic systems, requiring a fast expansion of electronic control units and flawless integration with the underlying mechanical subsystems.

MBSE: the route to closed-loop systems-driven product development

Traditional mechanical engineering processes do not support the optimization of mechatronic systems within an acceptable quality and time to market. Instead, mechatronics mandates the adoption of a development approach where mechanical and controls engineering are interlocked throughout the design process, in order to frontload design validation. More specifically, it requires an evolution from rapid prototyping, using physical hardware to model-based engineering with simulation models representing the controlled system.

The automotive and aerospace manufacturing industries need to adopt an upfront virtual design and testing approach that combines simulation models of control software with the underlying physical systems, while securing comprehensive testing in view of functional, structural and safety requirements. Testing is performed virtually as much as possible, breaking the traditional build-test-redesign pattern. This approach is called model-based systems engineering or MBSE.

LMS delivers proven solutions

Working with industry-leading OEMs, LMS has developed an innovative, comprehensive solution to support MBSE development based on LMS' market-leading, multi-physics simulation applications and engineering expertise. It is applicable for every phase of the development process, from upfront concept analysis to detailed design and validation.

With a proven track record in engineering services, LMS provides automotive manufacturers and suppliers with insight into industry best practices, processes and methodologies.

It allows customers to define a roadmap for a company-wide introduction of the new development approach while taking current practices and tools into consideration. Furthermore, LMS provides physical plant modeling as well as control system development and validation with a specific focus on technology transfer, development process improvement, deployment support and on-the-job training.

Customer benefits

The scope of the LMS MBSE portfolio is unmatched in the industry:

- A wide range of validated, automotive-specific, multi-physics simulation libraries for scalable, multi-disciplinary design optimization with appropriate accuracy and ease-of-use. These multi-physics subsystem and system models can be made available as real-time-enabled plant models to frontload controls engineering.
- A collaborative platform facilitating a company-wide, consistent implementation of system simulation technology, capitalizing on previous investments.
- MBSE system synthesis for meta-modeling and co-simulation, providing an architectural synthesis environment for multi-physics system models and related controls models for full vehicle-level system engineering.
- A scalable, 3D geometry-based modeling capability, supporting a wide range of applications including multi-body dynamic simulations.

A proven track record

"We implemented the LMS solutions smoothly in the LH 120 C Litronic development process without the need for prototypes, saving a serious amount of time and money."
Martin Bueche, Head of the Calculation and Simulation Department at Liebherr

"LMS Imagine.Lab AMESim is a necessary tool for decision-making processes since we must assess every system and concept as quickly as possible. It enabled to make savings or at least to prevent making huge losses."
Pascal Menegazzi, Systems Simulation Manager at Valeo

"Due to LMS Imagine.Lab AMESim's unique multi-physics approach and excellent local support, we choose LMS as our simulation partner."
Vincent Pommé, Aircraft Systems Manager at Daher Socata

Optimizing energy production for safety and reliability

With the global hunger for energy steadily increasing, both traditional and renewable energy sources must run at optimal production to meet demands for a cleaner, safer and more reliable energy mix for future generations.

Energy for future generations

With a global population of 7 billion and rising, energy consumption is on the upswing and energy efficiency is essential. In order to guarantee energy resources for future generations, we all need to rethink how we use and obtain our energy. International and European policy makers have already set targets to combat energy efficiency issues and reduce CO_2 emissions. More and more countries will begin to regulate the need for less fossil-fuel dependency and better use of existing fossil fuel and nuclear energy resources. Like the European Union, which requires 20% renewal energy by 2020, other nations around the world will begin to put in place a long-term policy of renewal energy and optimized production to guarantee energy resources for future generations.

Energy optimization

LMS has a long tradition of helping manufacturers optimize energy production facilities. LMS offers a variety of services, software and hardware solutions to help power generation companies meet the most stringent engineering and regulatory targets. The LMS tools can help create the highest efficiency rate and maximize produced power levels while ensuring system and component reliability. LMS experts can help tailor a program to help comply with safety and noise regulations.

Energy solutions

LMS strives to help power generation companies engineer top class products and services. We provide a unique combination of testing systems and engineering services to support a large range of power generation applications, including wind turbines, gas and steam turbines, nuclear power plants, electricity transformation and distribution, power generation accessories, electricity generating sets and oil and gas.

Safety and reliability

Mechanical failures can lead to environmental and economic disasters. The energy production industry has some of the most stringent quality standards and safety regulations. Mechanical integrity and correct functionality must be fully guaranteed. Pumps, turbines, valves, switches and robots are just some examples of mechatronic systems that must be engineered with optimal structural performance and reliability while minimizing radiated noise and transmitted vibrations.

Customer benefits

LMS simulation and testing solutions play a key role in designing and testing these critical parts and systems:

- Create the highest efficiency rate and maximize produced power levels
- Ensure system and components reliability
- Comply with safety and noise regulations
- Withstand the extreme time pressure without compromising on quality
- Support for a large range of power-generation applications including wind turbines, gas and steam turbines, nuclear power plants, and oil, gas and electricity generation, transformation and distribution

A proven track record

"... simply put, because of LMS' technical strength, professionalism, and customer centricity, GE-Hitachi has succeeded."
Daniel Sommerville, Technical Lead at GE-Hitachi Nuclear Energy

"Not only do we expect LMS Virtual.Lab Motion to deliver a 50% gain in model creation time, we also expect dramatic time gains in modifying existing designs and analyzing multiple design alternatives."
Mr. Ohda, Power and Industrial System R&D Center at Toshiba

"The major value of LMS technology in our testing operations is that we can operate more efficiently and cost-effectively, providing high-quality data and greater insight into the vibration characteristics of next-generation wind turbines that will serve the nation's energy needs in the coming decades."
Richard Osgood, Test Engineer at NREL's National Wind Technology Center (NWTC)

Global talent for global customers

More than anything else, LMS is a dedicated group of talented people, driven by a passion for engineering and professional excellence. Our continuous focus on our customer is the foundation of our culture. As part of Siemens PLM Software, LMS experts will continue to be a familiar and welcome sight at our customers' offices around the world. Together, we will continue our commitment to innovative engineering technology to help our customers conceive, design and develop products that delight their customers.

"Placing the partner's interest at the heart of everything we do is the foundation of our culture. Simply expressed, anything we do must ultimately contribute to the success of our clients."

Bert Van Grinderbeek
Vice President HR

Passionate about customer success

Everyone at LMS is fully committed to helping customers apply innovative engineering technologies to address product and process challenges today and tomorrow. We help our customers turn product innovation and superior process efficiency into a strategic, competitive advantage. Close, personal contact with our customers is actively encouraged at all levels. We want our customers to see us as proactive and creative experts in our field. Our objective is to exceed customer expectations not only in terms of technology innovation, but also commercial delivery and user satisfaction.

First-class support

Placing our partner's interest at the heart of everything we do is the foundation of our company culture: anything LMS does must ultimately contribute to customer success.

From pre-sales engineering advice to after-sales support, first-class service and support is equally as important to us as first-class products.

Our passionate, talented and best-in-class experts' thoughts and actions concentrate fully on this dedicated business approach. Our worldwide presence allows us to serve our global customers locally.

Teaming up for open innovation

From Europe to the US to Asia, we invest 25% of our budget annually in our 11 LMS R&D centers, developing competitive advantages and breakthrough technologies for our partners. We focus research into those areas critical to our customers' success. We develop high-level relationships with our user community and form industry-wide associations to shape our strategy. We partner with complementary hardware and software suppliers to enhance our joint offerings. We team up with leading research institutes and universities for joint success. We inspire and learn from each other, fostering the creativity and passion in our engineers and encouraging everybody in the company to go the extra mile.

análisis y simulación

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LMS is a leading provider of test and mechatronic simulation software and engineering services in the automotive, aerospace and other advanced manufacturing industries. As a business segment within Siemens PLM Software, LMS provides a unique portfolio of products and services for manufacturing companies to manage the complexities of tomorrow's product development by incorporating model-based mechatronic simulation and advanced testing in the product development process. LMS tunes into mission-critical engineering attributes, ranging from system dynamics, structural integrity and sound quality to durability, safety and power consumption. With multi-domain and mechatronic simulation solutions, LMS addresses the complex engineering challenges associated with intelligent system design and model-based systems engineering. Thanks to its technology and more than 1250 dedicated people, LMS has become the partner of choice of more than 5000 manufacturing companies worldwide. LMS operates in more than 30 key locations around the world.

LMS®

A Siemens Business