Model-based systems engineering for automotive electronics and software

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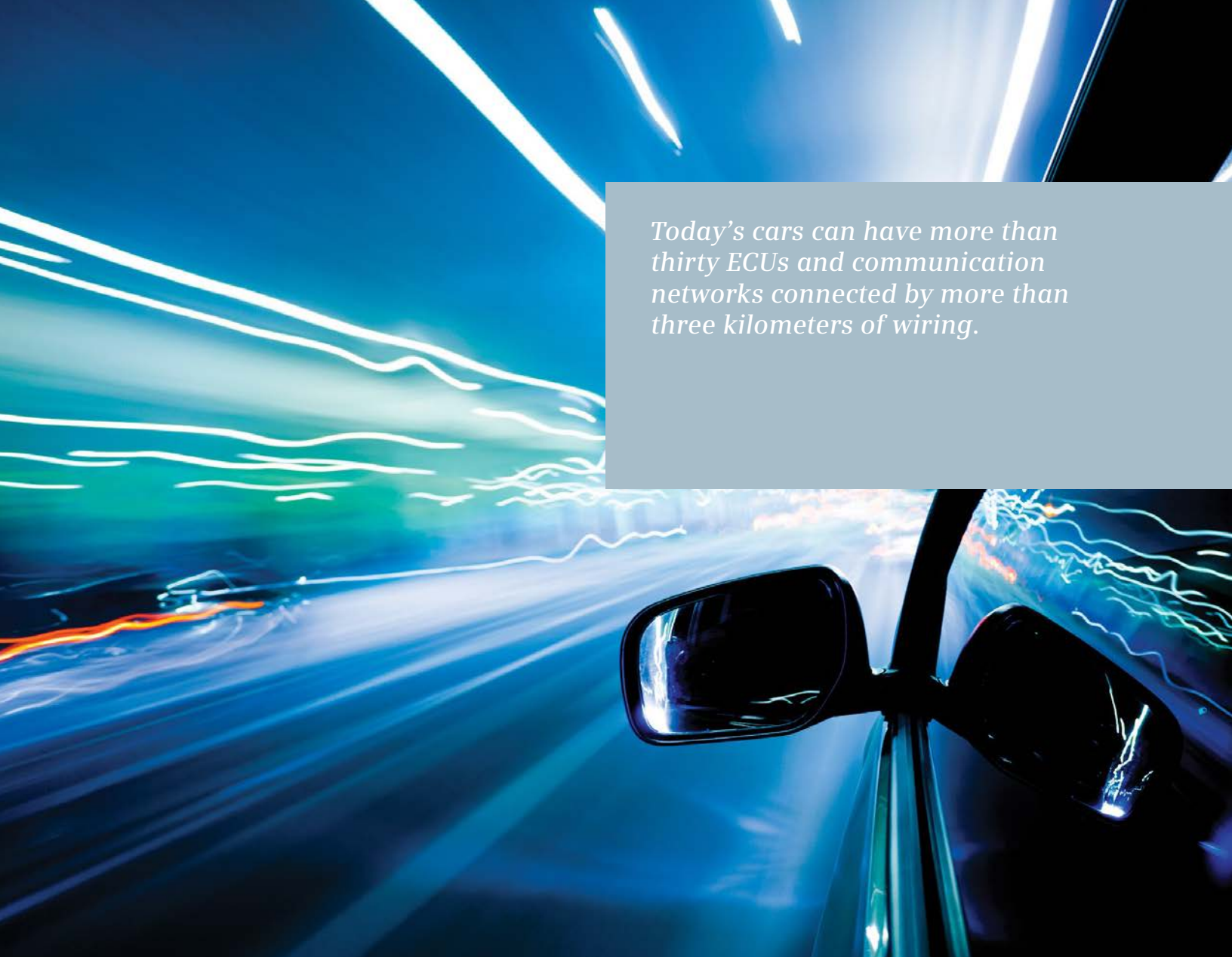
Today's cars can have more than thirty ECUs and communication networks connected by more than three kilometers of wiring.

Cars are better and more complex than ever

Today's automobiles are better than ever – more reliable, safer, smarter, more eco-friendly and increasingly equipped with state-of-the-art technology. In fact, as much as 70 percent of a modern car's content is a complex matrix of electrical, electronic and software components.

Automakers work closely with hundreds of suppliers to produce millions of vehicles, controlled by tens of millions of lines of software code. Today, an average vehicle can have more than 30 electronic control units (ECU) and communication networks connected by more than three kilometers of wiring. For premium vehicles, the ECU count is even higher.

Electrical/electronic/software systems are answering consumer demands for improvements in performance, infotainment, comfort, connectivity and safety, as well as responding to government regulations for fuel economy and sustainability.

Operating on a global scale requires automakers to build cars that delight consumers throughout the world, while also taking into account local market conditions.

Balancing all of these often conflicting factors is a staggering challenge for automakers, yet today's cars really are better than ever.

Meeting the challenges of the automotive industry

Automakers face increasing pressure to be more sensitive to environmental concerns and to incorporate increasingly complex information technology while operating in a global marketplace. Electronics and software are increasingly used to enhance the overall value and quality of the vehicle.

Electronics and software play key roles in addressing the challenges in today's automotive industry.

Meeting increasingly stricter regulatory requirements for reduced emissions and improved fuel economy, as well as the overall efficiency of combustion engines and electric propulsion, are some of the industry's major challenges.

There is also the need to support the constant connectivity today's customers demand for their mobile devices and for communications within each vehicle through features such as adaptive cruise control.

Increasingly, cars will need to be able to communicate outside the vehicle with new infrastructure such as smart grids, compressed natural gas filling stations, electric charging stations and more.

OEMs also must continuously stay ahead of their competitors with new technology that improves the driving experience for consumers in different countries with local regulations. There is also the constant push to increase safety for drivers, passengers and pedestrians.

Bringing a new car to market to satisfy all of these requirements can be seen as the cumulative result of thousands – if not millions – of decisions. How should the system be modeled? Which supplier should we choose? Can we/should we re-use this software code in other vehicles?

Automakers and their suppliers can make smarter, more informed decisions if they can access the most up-to-date and accurate information they need – precisely when they need it.
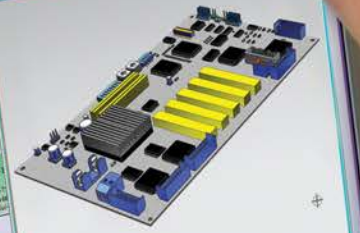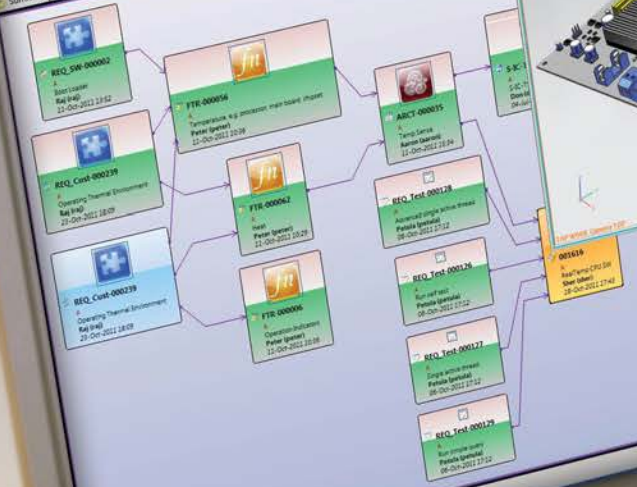
Siemens PLM Software provides solutions to help automakers and suppliers build an environment in which information is quick and easy to find by those who need it, when they need it.

Adapt and grow with high definition PLM

Just as HD-TV delivers a much higher definition viewing experience, Siemens PLM Software's collaborative decision support platform, HD-PLM, brings high definition to the electrical/electronic/software product development experience because it is built on an architecture that continuously adapts and grows.

HD-PLM is comprised of three core concepts:
1. Intelligently integrated information
2. Future-proof architecture
3. High-definition user experience

To create an intelligently integrated information environment, PLM must provide a consistent process framework across all domains. By intelligently organizing and integrating systems engineering, providing an integrated definition of the product and closing the loop between product and production, HD-PLM drives real step change in vehicle development and production, improving productivity, time-to-market and first time quality – helping you build the right product and build it the right way.

To effectively support decision-making, the Siemens PLM Software HD-PLM architecture will never become obsolete. It will remain upgradeable and expandable to permit the introduction of new technologies and innovations, to easily integrate with other business systems and adapt to changes in your business. This environment provides a future-proof architecture to ensure your IT investment will continue to evolve in concert with ours.

Siemens PLM Software is "open for business," which means we subscribe to open standards, and provide a set of APIs that allow others to integrate with our solutions. Siemens PLM Software solutions are scalable to serve the needs of users in any company, from a single person business to multi-thousand person enterprises. You will have the flexibility to configure the solutions to your business needs without building customized, in-house solutions.

The HD user experience is all about personalizing the information context to the role and task at hand – clarifying rich product information so that you can understand the data more easily and make smarter decisions.
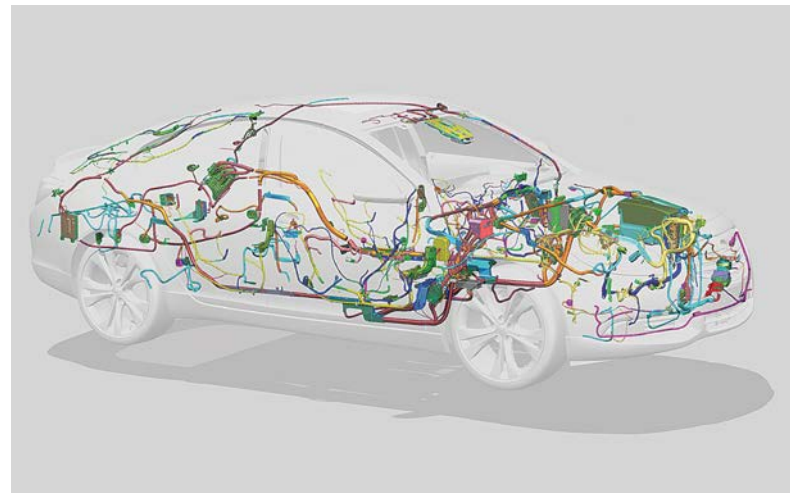
Model-based systems engineering – enabling smarter decisions, better products

Product development is accelerated by reducing re-work, scrap and duplication of effort.

Electrical and electronics architecture contributes as much as 25 percent of total vehicle cost in today's vehicles. As a result, OEMs and their suppliers can benefit from a shared, comprehensive understanding of the entire vehicle, including how it is designed, manufactured, assembled, serviced and, eventually, recycled. This shared knowledge and expertise across the entire supply chain can help avoid integration and incompatibility issues that can lead to expensive re-work.

Further, the complexities of global product variations are managed by developing and sharing a detailed and accurate bill of materials (BOM) – including not only every part, but also all of the software and electronics for all product configurations.

This enables automakers to balance and manage safety compliance, product liability and functional complexity associated with the increasing consumer demand for personalization and product innovation.

Armed with this information, automakers and suppliers can make smarter decisions, which lead to better products.

Siemens PLM Software provides OEMs and suppliers with a complete solution for model-based systems engineering, from design through production planning through manufacturing and post-sales support. This solution helps automakers orchestrate the end-to-end electrical, electronic and software automotive lifecycle, driving global development across systems and domains.

Product development is accelerated by reducing re-work, scrap and duplication of effort. For example, instead of creating multiple unique implementations of the same feature, a sunroof controller's mechanical components, wiring harness and software code developed for one vehicle can be re-used in another vehicle, with little or no adjustments.

Quality and reliability improve because system and product interfaces can be standardized and integration issues are found – and fixed – early in the development process when the cost of change is minimal.

Re-using best-in-class carryover content in a vehicle and having ready access to corporate knowledge (product information, specifications, lessons learned) from previous development programs helps new product teams ramp up quickly, requiring less development time and testing, thereby lowering the final product cost and investment needed.

Siemens PLM Software solutions help you capture lessons learned and avoid repeating mistakes in future development, eliminate information barriers by providing a single source of data every member of the product development team can tap into across domains, and maintain a complete understanding of the voice of the customer throughout the value chain.

These solutions mitigate new product development risks by enabling your entire value chain to understand and align product requirements, program constraints, engineering concerns, compliance issues and manufacturing considerations. Just as importantly, you can use Siemens PLM Software solutions to combine systems-level understanding with requirements understanding to make better trade-off decisions.
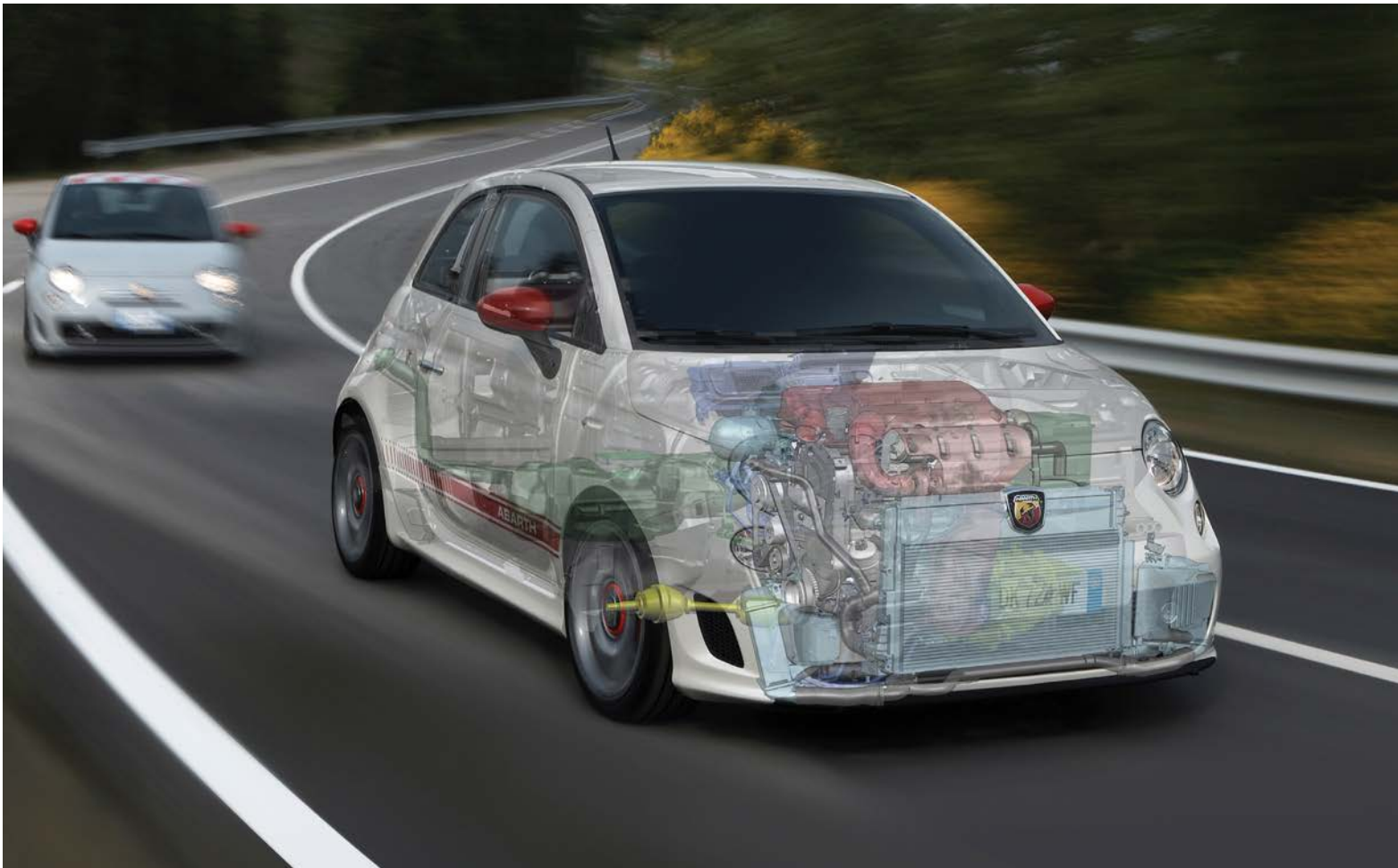
Solutions for the end-to-end lifecycle of automotive electrical, electronic and software systems
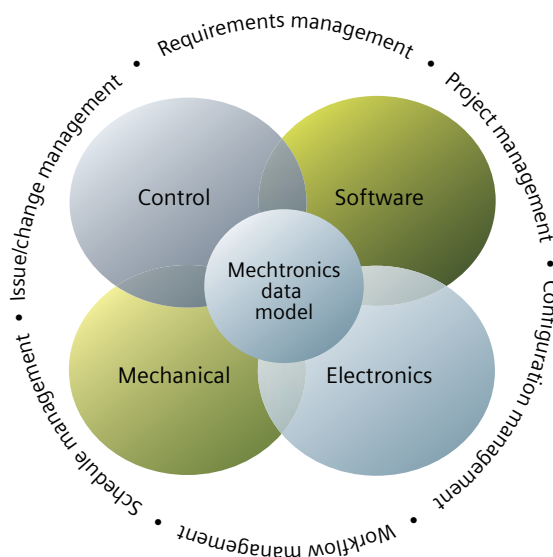
Enabling communication among multiple software modules and electronic sub-systems requires flexible electrical interconnect designs.

An overwhelming majority of automotive OEMs and Tier 1 suppliers use Siemens PLM Software for vehicle development. The complete suite of solutions and services Siemens PLM Software offers provides you with built-in tools and integrations developed as a result of the company's extensive automotive experience. This experience has helped develop a host of best practices that automakers can leverage to their advantage.

Requirements-gathering activities and a systems engineering approach to product development are two of the strongest discriminators in determining marketplace success. A study by the Aberdeen Group found that best-in-class companies are 4.5 times more likely to work closely with customers to identify needs and problems than poorer performing peers. To turn an idea into a profitable reality you must align final implementation with functional requirements and customer needs, while balancing other factors such as safety, regulations, quality, cost, capacity and more.

Requirements management naturally leads to vehicle architecture definition and validation using feature, functional and logical modeling to refine each vehicle's overall design.

Embedded software management is a crucial challenge. You must know exactly what software configuration is programmed into each car by vehicle identification number. If a software update is required, you can then be sure that each vehicle gets exactly the portions of the update needed. Embedded software is tracked and managed as if it is a "part."

Requirements management • Project management • Configuration management • Workflow management • Schedule management • Issue/change management

Control
Software
Mechtronics data model
Mechanical
Electronics

Mechanical components place multiple constraints on the design of electronic and electrical interconnections. Electronic subsystems require collaboration and optimization among multiple disciplines, from design and sourcing though manufacture, which must also include early consideration of environmental compliance issues that affect the product's end-of-life.

Enabling communication among multiple software modules and electronic subsystems requires flexible electrical interconnect designs that can be used across multiple product configurations and platforms.

All of these different types of data, as well as their change processes, must be managed and shared – not just within your own company, but also with your suppliers participating from all over the world. This takes the demand for product lifecycle management (PLM) to a whole new level.

Best-in-class automakers and suppliers can work together collaboratively with a Siemens PLM Software-enabled decision support platform with cross-domain integration to drive model-based systems engineering for automotive electronics and software.

Improve vehicle quality with best-of-breed solutions

Automobile buyers are increasingly demanding more personalization in terms of innovative features and functions. Automakers must balance these demands against the need to manage safety compliance, product liability and functional complexity.

To prevent integration issues, the automotive supply chain must have a complete understanding of system definition and behavior across all domains. Here, the key is to manage the complexity of global product variations by accurately representing software and electronics in the bill of materials (BOM) for all product configurations.

The business benefits that accrue from this type of holistic, systems engineering based approach are profound, including faster time-to-market, reduced costs, optimized efficiency, and improved quality.

Siemens PLM Software not only provides a vast array of capabilities from design through manufacturing, but also protects your investment in specific applications for circuit board or software design, or to accommodate a multi-CAD environment.

Siemens PLM Software embraces openness as a core strategy in its PLM platform and provides the necessary integrations with many of these existing tools to build the cross-domain knowledge together into a single, logical location along the development process. This includes openness in terms of standards, semantics, integration architecture and API's, but also openness and flexibility when it comes to integrating and adapting existing and best-in-class business processes.

Why do most leading automakers and suppliers use Siemens PLM Software?

Siemens PLM Software provides a cross-discipline automotive electronics solution for developing software-driven systems comprising mechanical functions, electrical wiring and electronic controls.

You can work from an intelligently integrated semantic model of each vehicle to define and validate the entire electrical/electronic/software architecture throughout the entire lifecycle.

You can exploit a breadth and depth of solutions for the modeling, design and manufacturing of these systems from conceptual design through planning, manufacturing and customer support.

You can leverage integrations with best-in-class tools for modeling and software, electrical, electronic and mechanical design. Your engineers can work with familiar toolsets while capturing information in a single location for re-use and improved productivity.

Reduced warranty costs
Automotive programs are highly iterative, requiring your entire value chain to assess and execute engineering changes on an ongoing basis. By integrating your product development and production lifecycles, you can flexibly and systematically manage change across all of the disciplines in your value chains.

A major U.S. automotive company used Siemens PLM Software solutions to manage its in-vehicle software process as part of its overall product lifecycle, saving more than $100 million in warranty costs over three years.

Meet innovation challenges
Using Siemens PLM Software's Teamcenter® software, a leading domestic supplier of automobile electronics products in China integrates mechanical structure design, electronic circuit design and software design into a common information platform. This resulting shared knowledge base has enabled the company to achieve significantly improved design efficiency and quality, realize a 30 percent reduction in warranty claims and increase new business orders by more than 10 percent.

About Siemens PLM Software
Siemens PLM Software, a business unit of the Siemens Digital Factory Division, is a world-leading provider of product lifecycle management (PLM) software, systems and services with nine million licensed seats and 77,000 customers worldwide. Headquartered in Plano, Texas, Siemens PLM Software helps thousands of companies make great products by optimizing their lifecycle processes, from planning and development through manufacturing and support. Our HD-PLM vision is to give everyone involved in making a product the information they need, when they need it, to make the smartest decisions. For more information on Siemens PLM Software products and services, visit www.siemens.com/plm.