

Systems-driven automotive product development

SIEMENS

White Paper

Success in the global automotive industry hinges on smarter decision-making throughout the development process

Siemens PLM Software believes the need to manage product complexity in the global automotive industry mandates a systems-driven process which combines systems engineering with an integrated definition of the product across all domains. This process will provide the right people with the right information at the right time, enabling smarter, more informed decisions that will ultimately yield better products.

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Executive summary

Recent automobile ads promote the fact that many of today's cars make thousands or even millions of operational decisions. Making such vehicles also requires many decisions at many levels during every stage of the development process. These decisions can mean the difference between a successful vehicle program and a money-losing proposition.

There's a lot riding on your decisions, so it makes good sense to be sure your product decisions are highly informed – based on a complete and unambiguous knowledge base that gives you the actionable information you need from initial concept through design, testing, manufacturing, distribution, and responsible disposal at the end of a vehicle's lifecycle.

You need to be sure you clearly understand the voice of the customer and respond with the types of vehicles they demand.

Good decisions must be made in the context of not only customer demands, but also take into account environmental concerns that impact vehicle performance and emissions, increasing vehicle complexity with greater and greater investments in electronic systems and safety systems. All this is complicated further by the increasingly global nature of the industry and its suppliers.

Building the right product and building the product right is a challenge that can be met, however, if your company is ready to take a systems-driven approach to all phases of product development.

Siemens can help you get there.

Smarter decision-making

“The changing nature of technologies and operations has a tremendous impact on the complexity of decision making¹,” says Joe Barkai, IDC’s Research Vice President, Product Lifecycle Strategies. “Decisions require a broader set of communities, both inside and outside the enterprise, to work collaboratively and cohesively. However, those communities have much less ability to collaborate efficiently and to make better decisions due to added complexity. Product-related decisions are multidisciplinary and must represent the needs and business drivers of multiple stakeholders, such as engineering, supply chain, manufacturing, compliance and numerous others.

“OEMs and suppliers must ensure that they have the necessary information to make the right decision with high levels of precision and certainty. What’s needed is a way to synthesize various views and different perspectives, inside and outside the enterprise as well as among supply chain and dealer channels, which, in turn, facilitates effective collaboration and improves the accuracy and timeliness of decision making.”

The progressive introduction of electrical, electronics and software as part of vehicle development has created a hunger for more efficient and effective integration of all relevant disciplines. In the past, much of this cross-domain knowledge was based on the individual insights and experience of engineers. But that’s just not possible any longer. Vehicles are too complex. And because of the complexity involved, it takes a long time to be absolutely sure you’ve covered everything and that you know what impact your decisions are having on other parts of the vehicle or in manufacturing.

Take the time to get it right and your resource costs are going to go way up and your time-to-market will keep getting longer.

Rush it and pay the warranty penalty.

Try to reduce complexity, and you are just eliminating the new features that your consumers want, or, for example, limiting the ability of your powertrain to meet new fuel efficiency standards.

You just can’t do it all manually anymore, especially when many of those you need to work with are dispersed globally.

At Siemens PLM Software we believe the future of the automobile industry is systems-driven. OEMs and suppliers must work closely together as partners in extended enterprises that are increasingly global in reach. This requires increasingly intimate, complex and multi-faceted partner relationships between OEMs and their supplier networks.

But despite these complications, you not only have to build the right product, you must also build the product right.

To build the right product, you must listen to the voice of the customer in terms of:

Timing – to meet aggressive time-to-market goals,

Functionality – to provide the features customers demand,

Performance – to delight your customers more than the competition,

Style – because design and visual appeal are vitally important, and

Price – you simply must be cost competitive.

To build the product right, you must meet your own internal requirements for:

Cost – to continuously reduce the development and production costs to enable higher margins,

Quality – because every market demands high quality and quickly culls out substandard products,

Reliability – to perform as expected for as long as expected,

Availability – at sufficient quantities to fulfill the right market demands, and

Sustainability – maintaining profitability while meeting consumer and regulatory requirements.

The only way to get there is to make better decisions, more deeply informed decisions, based on:

- A complete understanding of the voice of the customer and hearing that voice by turning key product concepts into requirements
- Effective analysis and validation of the overall vehicle, systems and component performance according to strategic objectives
- End-to-end integration; giving your people access to necessary information across all domains to create the best solution to meet your objectives, while capturing and reusing best practices and designs for vehicles, manufacturing processes and facilities

This can lead to several key benefits – from faster time-to-market and reduced cost to optimized efficiency and improved quality.

Siemens is uniquely qualified to help you reach your objectives. It is not a coincidence that the vast majority of the world's top automotive OEMs and suppliers use Siemens PLM solutions.

How do you get better at making the right decisions to make the right product in the right way?

Product lifecycle management for the automotive industry

Siemens PLM Software helps automakers and suppliers establish coherent, repeatable processes, as well as manage consistent and accurate information across a product lifecycle from concept ideation to vehicle end-of-life. This comprehensive digital environment enables you to create, develop, manufacture and manage innovation across globally distributed product development and manufacturing teams that include your supply chain and customers.

We believe that product lifecycle management (PLM) is the mission-critical system that every company needs to continuously facilitate product and process innovation. PLM provides immediate access to the knowledge that you need to make the right business decisions – decisions that enable your innovation investments to deliver more business benefits. There are four major requirements for driving successful innovation:

Effective globalization Today's automakers must be able to maximize their globalization advantages to support a "design anywhere, build anywhere, support anywhere" business strategy. Follow-the-sun processes should be in place to connect geographically dispersed and diverse partners, suppliers and customers into a global value chain and assure their continued alignment.

Fully optimized enterprise resources All lifecycle processes should be managed to maximize product development and manufacturing productivity, ensure peak performance and eliminate inefficiency. Project resources need to be rigorously optimized to appropriately balance marketplace demands for product quality, cost and scheduling.

Accelerated time-to-market Lean processes must be in place across every phase in the product lifecycle. Product and production teams need to eliminate non value-added tasks from their everyday processes. Collaboration and continuous feedback need to be facilitated to eliminate unnecessary rework. Downstream processes need to be started early and performed in parallel with upstream processes as much as possible to compress time-to-market.

Sustainable product content Requirements-driven processes must be implemented to deliver innovative content that the market wants at a price it is willing to pay – as well as to ensure product and process compliance with environmental, government, industry and international regulations. Sustainable content reduces business risk by helping you make certain that your products are "right to market" and that you avoid noncompliant conditions that prevent your products from being sold into new markets.

PLM's innovation role

Because PLM is able to maximize the business advantage of the rich product and process data that today's automakers author and manage, it is recognized as the best technology for meeting these four innovation requirements. In fact, best-in-class manufacturers are four times more likely to use PLM technology to drive their innovation initiatives than average companies. PLM provides a transformational business model that unites global partners, suppliers and customers in a continuous process of innovation. A PLM foundation enables breakthroughs to originate anywhere at any time by providing product teams with the means to elevate, evaluate and commercialize their best ideas.

Leading automakers use Siemens PLM Software to distribute their operations so that they can innovate at every stage of the product lifecycle across a global value chain. With PLM, companies are able to establish an innovation process that drives five of today's most highly prized business benefits, including:

- Accelerated product launch
- Profitable revenue growth
- Reduced manufacturing cost
- Extended lifecycle returns
- Re-usable best practices

Computers on wheels

Today's vehicles have been described as "computers on wheels," replete with onboard diagnostics, braking and steering controls, navigation aids, telematics and telephony communication systems, and an ever-growing array of infotainment options. Increasingly, software and electronics content must work in concert with mechanical components to deliver more vehicle innovations such as driver assistance systems. Successful innovation requires you to facilitate open collaboration both inside and outside your organizational boundaries, while instilling discipline across your vehicle development process.

At Siemens PLM Software, we're developing a collaborative decision support platform, HD-PLM, to bring together all of the cross domain knowledge into a single, logical location that is accessible to authorized users no matter where they are in the world or in the organization.

Armed with this knowledge, you'll be able to make better decisions, more collaborative decisions in concert with others, while understanding how the decisions you are making impact others throughout the organization, whether it is a design decision impacting manufacturing, a mechanical design decision impacting electronics, an electronics design decision impacting software, or the ripple effect of a decision cascading throughout the entire system.

HD-PLM brings high definition to the 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 in the right way.

To effectively support decision-making, the Siemens HD-PLM architecture will never become obsolete. It will remain upgradeable and expandable to permit the introduction of new technologies and innovations, 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 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 solutions are scalable, to serve the needs of users in any company, from a single person business to multi-thousand person enterprises. You'll have the flexibility to configure solutions to your business needs without building customized in house solutions.

The HD user experience is all about personalizing the interface to your role and task at hand; clarifying rich product information so you can understand the data more easily and make smarter decisions.

Systems-driven product development

In a typical automotive development environment, the process of engineering – of making decisions to mature each of the different disciplines – results in multiple streams that mature at different rates. Ultimately, these streams need to come together through the process of integration. Automakers must drive these different maturity curves together sooner – and in parallel – to shorten the overall product development timeline. Getting to maturity earlier results in fewer mistakes and less rework and ultimately, earlier to market. Siemens enables a systems-driven product development approach to help automotive OEMs make smarter decisions that result in better products. Key elements of this approach include:

- A consistent process framework based on systems engineering
- Configuration management
- Issue, change and schedule management
- Traceability throughout the entire lifecycle
- All built on an open foundation

By applying a consistent process framework based on systems engineering within our systems driven approach, you can capture, manage and organize information and knowledge, beginning with the voice of the customer, and continuing through to service, support and end-of-life. By modeling requirements and allocating them through functional and logical decompositions to physical implementation, you will achieve a significant level of traceability throughout the vehicle. Modeling the systems provides a thorough understanding of the dependencies within the model and helps to drive alignment and enable traceability between engineering domains (body, chassis, exterior, interior, powertrain, electrical/electronics and software integration). To better manage the complexity of the product, and to really understand and manage the myriad cross domain dependencies, it is important to apply this systems engineering methodology across all development domains. As a result, the overall development challenge gets broken down into subsystem challenges that are considerably more understandable and manageable. At the same time, systems engineering gives you the ability to define the best

solution overall. Ultimately, this approach results in a robust system of systems that helps to define and understand the relationships between the bits of product and process information as well as understanding how and why those relationships exist.

It is critical to the success of an automaker to unite the different product bills of material (BOMs) and bills of process (BOPs), and even more importantly, to align the semantics of these different views, such as usage versus product structure. Today's automotive OEMs often define their configuration logic centrally, including various packages and configurations. This logic then gets pushed out to the different systems and subsystems and their specific needs. It is important to keep configuration logic consistent, yet at the same time provide each discipline the freedom to work within the boundaries to do their jobs.

Talking about configuration management does not mean to only apply consistent variant configuration methodology, but equally important lifecycle configuration such as applying the correct effectivity and usage information. Once those alignments have been built, this information backbone makes it possible to drive integrated processes, such as configuration and change management from end-to-end. This environment supports critical business functions by ensuring all views of the product definition are always accurate. Allowing development domains to also leverage this integrated product definition solves the big problem in the development process: the constant synchronization of the product definition between development domains (e.g. mechanical, electrical, electronic, software).

When a change is required to the product or to the manufacturing process, how quickly can all of the stakeholders in the change be identified and the impact of the change assessed? What process controls the deliverables to all the team members to ensure a smooth implementation of the change?

Siemens PLM Software helps you consistently manage change across multiple domains development stages while respecting the schedule of the overall vehicle project. Schedule management drives the stage gate process, and gives you the ability to do those "what if"

analyses if problems arise such as a supplier who cannot meet a given timeframe, or introducing new technology/functionality that was not initially planned. It links all the different domains together and helps to review the “as planned” versus the “as is” status of the vehicle project.

The Siemens PLM Software solution is built on open standards to allow for integration between our applications as well as with legacy data and systems and other third party applications. This gives you the business flexibility to implement the business process you require, even as you take advantage of best-of-breed applications, and aggregate work from diverse authoring environments and authors. Throughout the entire process, everyone will be working with a single source of the truth.

End-to-end lifecycle integration

Siemens facilitates product design from planning and development through manufacturing and support by providing comprehensive solution suites for digital product development and lifecycle management as well as digital manufacturing. Siemens solutions include best-in-class, integrated functionality for CAD, CAM, CAE and product data management (PDM) for all of your product development initiatives.

Our solutions enable you to establish a single source of product, process and manufacturing information for your enterprise even though that information is often captured in disparate authoring systems. Entitled users across your entire value chain can access this common resource to quickly find the information they need within the context of their role in the vehicle lifecycle.

Siemens provides powerful end-to-end PLM applications that leverage the environment’s workflow and information management capabilities, thereby enabling your entire value chain to collaborate and share knowledge throughout the lifecycle.

Open for business

Automotive OEMs are faced with rapidly-changing requirements and must react to technology considerations (e.g. electric vehicles) as well as business considerations such as addressing new segments, markets, growth targets, development partnerships, mergers and acquisitions. Responding to these considerations requires a very fast responding, flexible organization and collaboration ecosystem, as well as maximum flexibility in seamlessly adapting best-in-class processes and tools in a minimum of time and with a minimum of effort.

At the same time it is absolutely critical to protect your existing investment in solutions for specific business processes, including commercial, legacy and proprietary systems. You must also share and re-use knowledge and intellectual capital across your business enterprise; innovate with common processes in extended communities created due to joint ventures, outsourcing, and mergers and acquisitions; and deploy technology on a shared architecture and common infrastructure.

This mandates an open environment on all levels – on the IT landscape level as well as on the business processes level where you won’t be restricted through non value-added constraints.

When we talk about “open”, we look at it from both the technology and our business model. Unlike other PLM vendors, Siemens addresses the flexibility business needs to take advantage of best-of-breed applications as well as data models based on open, published standards so that aggregating work from diverse authoring environments and multiple authors still ensures a single source of truth.

Scalable solutions

While globalization presents many challenges, it also provides you with opportunities to adapt operations such as purchasing, development, and manufacturing to help you achieve growth objectives in emerging markets. Globalization fosters extensive partner/supplier networks for designing, developing and manufacturing vehicle content. Diverse customer needs in each market drive automakers to respond with more vehicles and variants which necessitate flexible manufacturing capacity to meet local market needs.

Siemens has responded to these challenges by delivering scalable PLM solutions that can be used by a handful of engineers or by tens of thousands. You can easily integrate a single application or a complete, integrated suite with solutions that are flexible out of the box, and can also be configured to meet your unique requirements. Every automotive company has a unique approach to running its global product development and manufacturing operations. In fact, for many companies, this approach constitutes a key competitive advantage. A one-size-fits-all approach to PLM would force these companies to compromise their processes. That's why so many automotive OEMs have standardized on Siemens PLM Software's technology – because it enables their strategy the way they want it to work.

Customer-focused success

Siemens PLM Software delivers a comprehensive service offering to the automotive industry, providing excellent customer service through breadth and depth of automotive knowledge.

Our global scale and financial strength secures our customers' investments in our products. Our strategic investments in R&D for the automotive industry ensure our vision and our commitment to maintain the long history of Siemens innovation leadership in software solutions and industry know-how.

Our customers have experienced double-digit improvements in time-to-market, thanks to the ability to simulate product performance and validate product performance in software instead of in physical prototypes.

Your productivity is aided by intuitive, easy to use software that provides a gateway to intelligent information to enable better decisions. You will achieve greater efficiency at managing design and production complexity, enjoy improved flexibility to rapidly, and appropriately, respond to changes in product specifications and the introduction of innovative new technology.

Conclusion

Systems-driven product development, implemented based on Siemens PLM Software's products and solutions, can help automakers throughout the world build the right products and build the products right by optimizing their decision-making process in an environment of continuously increasing complexity.

Siemens systems-driven product development solutions provide you with:

Traceability of voice of the customer throughout the development process to align decisions with product strategic intent that delivers the product customers want

Reduced rework through continuous analysis and validation of the vehicle, system or component performance to objectives

End-to-end integration ensuring that everyone across all vehicle domains can get the right information when they need it to create a product that best meets customer requirements

The result of smarter decisions? Better products.

References

1. IDC Manufacturing Insights, Analyst Connection, final IDC white paper 1044 111910.pdf

About Siemens PLM Software

Siemens PLM Software, a business unit of the Siemens Industry Automation Division, is a leading global provider of product lifecycle management (PLM) software and services with 6.7 million licensed seats and more than 69,500 customers worldwide. Headquartered in Plano, Texas, Siemens PLM Software works collaboratively with companies to deliver open solutions that help them turn more ideas into successful products. For more information on Siemens PLM Software products and services, visit www.siemens.com/plm.

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