HD-PLM Vision

SIEMENS

White Paper

Make smarter decisions that result in better products with high definition PLM

Contents

Executive summary

This white paper describes high definition PLM (HD-PLM), Siemens PLM Software's vision for helping companies make smarter decisions that lead to better products.

Working from the knowledge that companies in all industries are faced with increased complexity in both products and processes, Siemens PLM Software's HD-PLM vision is built on three core concepts: intelligently integrated information, a future-proof architecture, and a high-definition user experience.

The technology foundation of each core concept is explained. More importantly, the paper outlines the benefits each aspect of HD-PLM brings to companies as well as to individual users.

Introduction

Companies across all industries are focused on trying to build right product, and build it the right way. This objective has grown complicated by the increased complexity of the products themselves as well as their development processes. The sheer volume of information being driven into and around the product is now so great that some companies have opted to remove content rather than attempt to manage the complexity. Product development has become complicated by environmental, safety, and government regulations; worldwide development practices; and diverse global market requirements. The critical question for today's companies is this: Will this complexity sink you, or can you turn it into a competitive advantage?

In all of the processes a company goes through to produce a product, thousands, if not tens or hundreds of thousands, of decisions must be made, from start all the way to the end of the product's lifecycle. The faster decisions are made, the faster the process goes. The more accurately decisions are made, the fewer the problems that occur downstream. Fast, accurate decision-making is no easy feat, given all of the information that must be considered, as well as the fact that information and knowledge are spread throughout a company, its supply base, its joint-venture partners, and of course, its customers.

It is no longer enough to capture, manage and integrate information. Information must be given intelligence. It must understand what it is, how and why it relates to other information, and how and

where it should be used so that people don't have to hunt for it. In this approach, information is pro-active, not reactive. It's there at exactly the right time, in the right context, and in the precise level of detail so that this decision – the one being considered right now – can be made as quickly and accurately as possible.

This is the objective of high definition product life-cycle management (HD-PLM).

As HD-TV brings significantly improved clarity to the viewing experience, HD-PLM brings much greater clarity to the product development experience. It goes beyond managing CAD files, requirements, and documents. It does more than support collaboration around information in a managed environment. It offers more than defining and validating in 3D. It's all of these capacities, integrated and performed in an intelligent way. The vision of HD-PLM is that all information is delivered to the user in the context of his or her current task, intuitively, without having to search. HD-PLM requires an architecture that doesn't need re-invention but instead adapts and grows with every IT innovation and change in the business environment.

Siemens PLM Software is delivering on the HD-PLM vision by focusing on three core concepts:

1. Intelligently integrated information
2. Future-proof architecture
3. High definition user experience

Intelligently integrated information

Over the years, methodologies and practices have evolved for organizing and understanding the information that drives decision making. To create an environment for fast and accurate decisions, PLM must support the following:

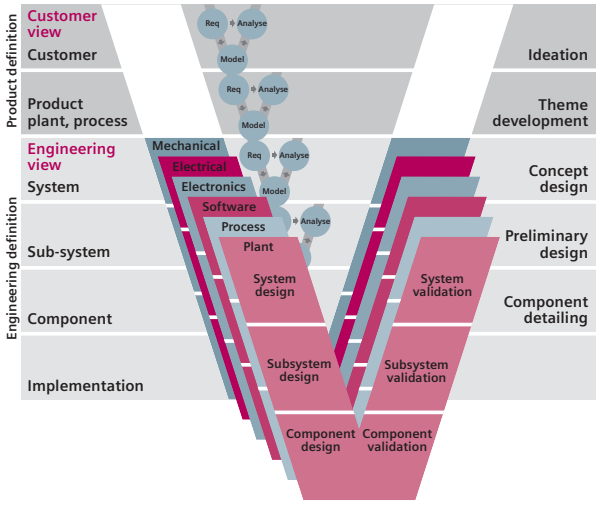
- Systems-level engineering to provide a consistent process framework across mechanical, electrical, software and electronic domains
- Integration of all BOMs and BOPs to provide a comprehensive definition of the product and processes
- Integration of product development with production to provide closed-loop feedback from production to product development and manufacturing engineering

Systems engineering

Systems thinking has been around for years. It is practiced extensively in aerospace where a deep understanding of decision making is critical. Knowing what decision are made, when, and for what reason is critical to understanding the true and complete impact of those decisions. Other manufacturers employ some aspects of systems thinking, but it is not practiced as thoroughly as in aerospace.

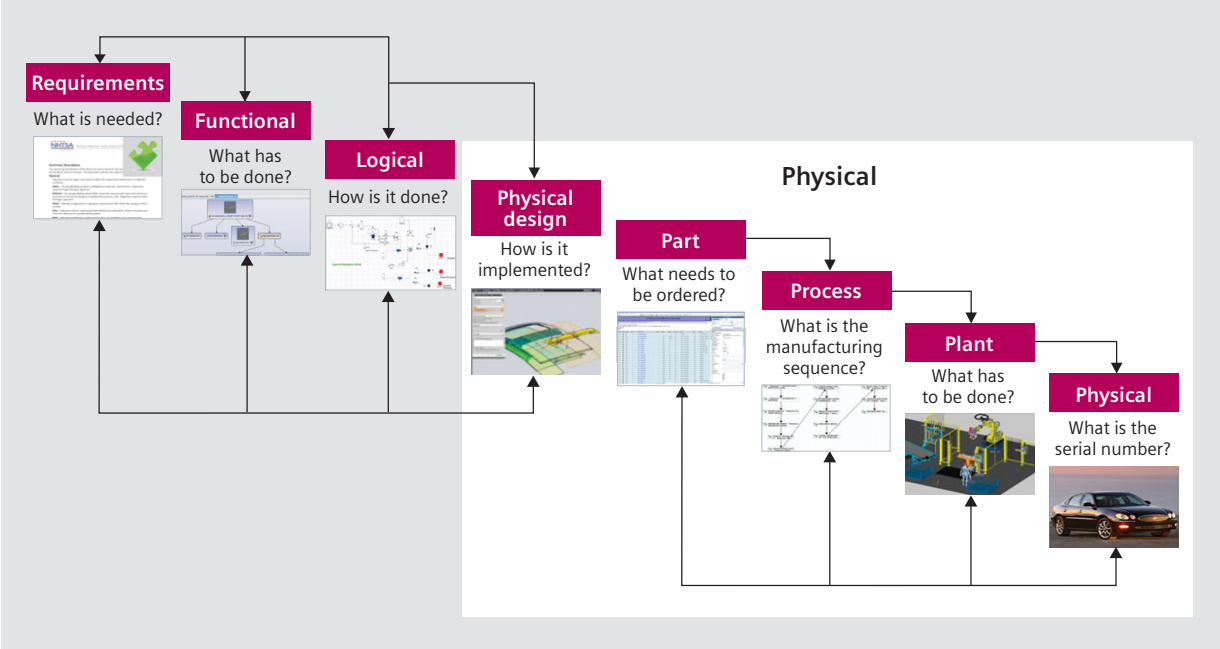
With systems engineering, companies can capture, manage and organize information and knowledge, beginning with the voice of the customer and continuing through to service, support, and end of life. By modeling requirements and allocating them through functional and logical decompositions to physical implementation, you achieve a significant level of traceability throughout the product. You also gain a thorough understanding of the dependencies within the model. Another significant benefit is that systems modeling helps drive alignment between engineering domains (mechanical, electrical, software, electronics). When coupled with configuration and change management, systems engineering can serve as a consistent process framework that drives efficiency and accuracy during development and validation processes.

Synchronized, cross-domain product development is realized through a systems engineering process that leverages a comprehensive understanding of functional behavior and enables knowledge capture and re-use on the systems level. This same systems engineering process can also be applied to production, where there are four additional instantiations of the physical representation. These include: part, process, plant and the actual physical object that is produced. Incorporating production into the systems model provides a comprehensive systems view including product, process and plant.



Requirements, which are initially domain independent, now become analyzed and conveyed in functions organized in a hierarchical approach from the complete product level on down. As functions are decomposed, they are networked in a way that depicts the interactions between them. We call this a functional network. Interactions between functions (such as information exchange) are important because they encompass the interface definition that is refined as the decomposition continues. Interface definitions form an integral part of the definition of each logical element and, ultimately, each physical component of the product. These interfaces, in conjunction with the exchanged information (inputs and outputs), the functional definitions, and related performance data are required to validate the behavior of each function.

This approach provides a much better understanding of the behavior of the system, including its variability, and helps deal with its complexity. Systems engineering defines the overall best-suited system (architecture) solution. It enables re-use, knowledge capture and early validation, and drives the development process consistently across all development domains. Enabling this approach through HD-PLM allows it to be easily integrated with more formal process such as change and configuration management, providing a complete and consistent process framework across all development domains.



Integrated product definition

It is common to have multiple views of a product housed in many different, disconnected systems. Each system contains unique information that describes the product or process to the audience it serves. Because these various systems are not linked, when change occurs, there is no way to evaluate its effect on other parts of the organization. Aligning all views – engineering, business, manufacturing, service, purchasing, finance and support – allows rapid impact assessment across the entire product definition.

Today's design world is dominated by solids and constraints while the business perspective is dominated by parts, features, quantity and cost. There is limited connectivity between the virtual design and business worlds where actual configuration and change happen. This prevents early virtual validation (on geometry data as well as electric and electronic simulations and other CAE-based validations). It also makes it impossible to validate saleable product configurations. As a result, it is critical to unite the different product BOMs and BOPs, and even more importantly, to align the semantics of these different views (usage versus product structure, for example).

These alignments serve as an effective decision bridge between the business (product planning/sales orders) and virtual (engineering across multiple domains) aspects of the BOM and manufacturing builds. 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 integrated environment supports critical business functions by ensuring that all views of the product definition are always accurate. Allowing development domains to leverage this integrated product definition solves one of the biggest problems of the development process: the constant synchronization of the product definition between development domains.

The integrated product definition, combined with the consistent process framework that sytems engineering provides, delivers a number of benefits. For example, aligning the business BOM with the bill ofdesign and manufacturing processes provides the ability to virtually validate the product by applying the configuration rules in the business BOM across all engineering domains. Now entire mechatronic systems can be virtually validated in the exact configuration in which they'll be sold. Also, the process for building those saleable different configurations can be validated in the exact ways the different plants will build them. For the first time, companies will be able to virtually validate exactly what they'll produce at a specific plant. This will dramatically reduce the amount of physical validation required while also improving first time quality.

Product/production integration

The third element of HD-PLM's intelligently integrated information architecture brings plant and production information into planning and product development. This allows a much higher rate of production success – in terms of items such as cost, quality, and throughput – because what actually happens at the plant level is fed back into product development and manufacturing planning. The virtual actions of defining product and processes become much more predictive of what will happen in manufacturing. This eliminates the need for adjustments, prove-outs[CP2] and other time and labor-intensive remedies that were previously required when virtual planning wasn't able to address real-world plant conditions.

By connecting the physical devices in the plant and the software used to plan and manage plant operations within the PLM backbone, much more knowledge of what actually happens in manufacturing can be captured and driven into the early planning stages of product and process development.

This permits critical capacities such as virtual commissioning, where PLC programs can be validated in a virtual environment (the physical PLC drives a virtual model of the production environment). Once all the issues are resolved, the PLC can be connected to the physical equipment and production can begin immediately, eliminating the need for prove out of all the physical equipment and PLCs before starting production.

Closing the feedback loop between product and production allows for continuous improvement of products, processes and plants by ensuring that changes and variations made during production are captured and fed back into development. This makes the virtual world much more predictive of what will actually happen in production.

The biggest benefit of integrated product and production is the ability to look at production as a system for producing the product. As such, the systems engineering concepts discussed above apply to production just as they do to products. The entire product, process and production lifecycle can be thoroughly planned and analyzed in a systems engineering context. Only HD-PLM can deliver this intelligently integrated view of product, process and production.

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 product development and production, improving productivity, time-to-market, first-time quality and ultimately helping you build the right product, and build it in the right way.

Closing the feedback loop between product and production

Future-proof architecture

To provide an effective decision-support environment, the HD-PLM architecture must never become obsolete. It must be upgradeable and expandable to permit the introduction of new technologies and innovations. It must easily integrate with other systems because not everything is stored directly in the PLM system. It must change and morph to adapt to the changes in your business. To accomplish this, we used the following core principles to guide us in architecting HD-PLM.

Flexible Deployment

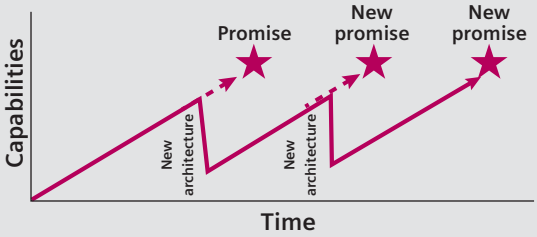
Manufacturers today have global footprints that include both product development and manufacturing. Operating models are needed that can take advantage of a global footprint. While mergers and acquisitions won't go away, we see an increasing amount of joint ventures to address a specific demand. Because the climate for partnerships and joint ventures is dynamic, your competitor today could be your partner tomorrow.

In terms of PLM, this sets up the need for a highly flexible approach to deployment that will allow manufacturers to quickly adapt to business changes while still ensuring security and performance. By flexible deployment, we mean the ability to extend the solution deep within your organization and broadly throughout the many geographic regions. In other words the solution is scalable. Approaches to achieving scalability have varied as desktop and network technology has improved.

HD-PLM has made the evolution from purely centralized client-server processing, to distributed peer-to-peer data sharing, to the current model: a centralized data center with as much data distribution as the business demands. Because our model can support multiple approaches, manufacturers and their suppliers can choose the right model for their needs, whether that is centralized data (to drive down cost of IT) or distributed data (to transcend organizational boundaries, or to provide local autonomy independent of the network, such as for "black" projects).

HD-PLM, with its service-oriented architecture (SOA) and FMS file delivery, has come full circle, enabling the centralized data center to seamlessly support global collaboration efficiently and inexpensively. You distribute only as much data as your business demands.

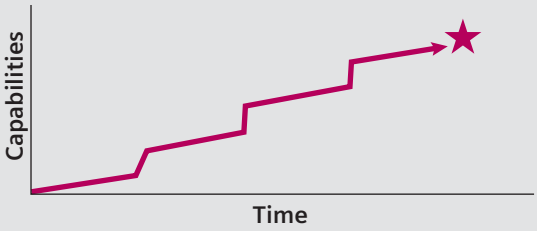
Discontinuous approach



Advantages:
- Provide immediate change
- Focus more on new without having to worry about migration

Disadvantages:
- Huge re-investments to deploy
- Large disruptions to business

Continuous approach



Advantages:
- Much lower cost to customer over time
- Smaller disruptions to customers' business

Disadvantages:
- Vendor must plan innovation in advance
- Resources required by vendor to ensure forward migrations

Openness

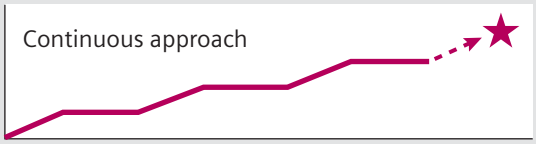
We believe that open systems lead to more innovation, value, and freedom of choice for consumers. They also provide a vibrant, profitable, and competitive ecosystem for our partners and system integrators. Many PLM companies make this same claim since they know that declaring themselves to be open is both good for their brand and completely without risk.

There are two components to our definition of open: open technology and open information. Open technology means that we release, publish and actively support other companies' use of our technology (such as JT™, Parasolid®) to help grow the PLM market. Open technology also means open standards, meaning we adhere to accepted standards and, if none exist, work to create standards that improve the entire PLM ecosystem. Open information means that a customer, having implemented our tools to manage all aspects of their product and process development, has invested in something that is extremely valuable. We are transparent about what that information is, how it is organized and how they can access it, import to it, or export from it. We give them full and ultimate control over their information.

At Siemens PLM Software, we embody a consistent commitment to openness, and accept the responsibility to lead by example and encourage other companies and industries to adopt the same commitment.

Maximum business flexibility

Lower, more predictable costs



Future-proof PLM architecture

Open
- Rich API set – SOA, NX Open
- Toolkits/published formats – PLM, XML, SDK, JT, Parasolid

Scalable
- Four-tier architecture
- Transparent adjustment to needs based on demand

Flexible
- Layered platform services
- Codeless customization
- Data model extensibility

Preferred device support

People who need to interact with PLM aren't just sitting at their workstations anymore. New devices such as smart phones, tablet computers and other handheld platforms are becoming the main productivity tool for many. Today, with HD-PLM, field engineers can now visualize a part, mark it up and log issues into the PLM system from a number of different handheld devices. An issue can proceed through a review process while the field engineer is still on site, creating the real possibility for instant analysis and feedback with the customer. Sales personnel could configure a product while the customer views it on a handheld device, even to the point of visualizing configuration changes as he or she makes them.

In summary:

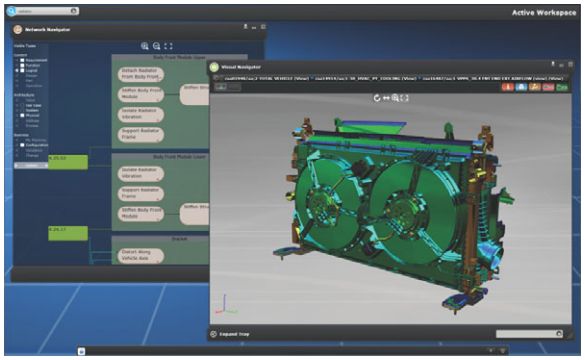
- We future-proof the Infrastructure with a centralized datacenter allowing data distribution based on business needs
- We future-proof operations with an open architecture and flexible delivery
- We future-proof the workforce by giving them the ability to access data in their preferred environment, language and device, enabling re-use and knowledge capture on all levels

HD user experience

Ease of use is an important differentiator when selecting tools and appliances of any kind, from microwave ovens to cell phones to computer software. The design and placement of the interface elements – buttons, handles, dials and so on – can greatly influence how well a tool enables its user to perform the desired task. A well-designed interface will result in increased productivity and user satisfaction.

The topics described above (regarding the architecture and functionality of HD-PLM) are complex. The challenge is to provide a user experience that is not. To accomplish this, the HD-PLM interface leverages the same intelligence used to deliver precisely tailored information to each user, eliminating many of the administrative tasks required to find, enter and maintain information. To create an HD user experience, we focused on four key concepts:

1. Put the user in right context for his work
2. Help the user accomplish his tasks
3. Present the information intuitively
4. Help the user validate decision rationale

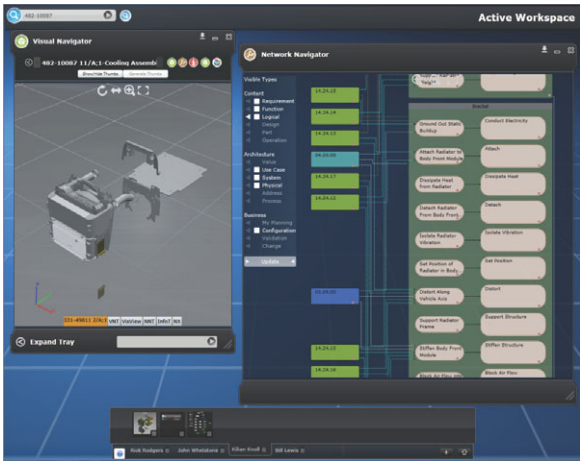


Context and situational sensitivity

HD-PLM knows who you are. It knows what role you play and what you worked on last time you were in the system. It knows who you collaborate with. All of this information, and more, can place the user in the right context every time he or she enters the system, reducing the amount of work he or she must do to get the necessary information on the screen to do work.

Help users accomplish their task

Web 3.0 introduces the concept of robots or agents to help people navigate their way around tasks and functions. HD-PLM will adopt this same concept. Agents in HD-PLM can help the user with a variety of functions. Agents can be active[CP3] or proactive depending on the type of task you want them to perform. For example, if you are working on an issue, an agent could enter all of the information required to log the issue in the system, simply through its context and situational sensitivity (see above). Once the information is complete, the agent could then ask you for approval to submit the issue to a specified process. This is just one of many ways agents can help the user create, find and manage information through HD-PLM.



Present information intuitively

Different users interact with information differently. For some users, 3D is how they want to view information. Others prefer a spreadsheet view. Still others prefer graphs or charts. What "intuitive" means is dependent on the user and the task he's trying to perform. To present information intuitively, it must be in the right format, the right context, and at the right level of granularity. Presenting too much information requires significant work to find what you want or need. The system should be able to present just the right amount for the task at hand, while giving the user the option to get more detail if required.

Validate against decision rationale

Understanding why you made a certain decision is critically important for a variety of reasons, including traceability, issue resolution and definition of best practices. The ability to capture the rationale you used to make any decision – at any point in the product development process – is key to tracing the root cause of problems. It also allows you to reapply the same rationale to arrive at the same decision, thus forming the basis for a best practice. HD-PLM enables this by providing tools for capturing the thought processes through which decisions are made.

Conclusion

The original question, “Will complexity sink you, or can you turn it into a competitive advantage?” offers two very real possibilities. HD-PLM is designed to allow you achieve the latter, thriving in the current environment by turning complexity’s challenges into opportunities for customer satisfaction. By providing intelligent information that is there at exactly the right time, in the correct context, and at the precise level of detail that each person needs, HD-PLM can help manufacturers in all industries achieve a new level of productivity and quality.

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.

www.siemens.com/plm

X5 26286 11/11 C

Siemens Industry Software

Headquarters
Granite Park One
5800 Granite Parkway
Suite 600
Plano, TX 75024
USA
+1 972 987 3000
Fax +1 972 987 3398

Americas
Granite Park One
5800 Granite Parkway
Suite 600
Plano, TX 75024
USA
+1 800 498 5351
Fax +1 972 987 3398

Europe
3 Knoll Road
Camberley
Surrey GU15 3SY
United Kingdom
+44 (0) 1276 702000
Fax +44 (0) 1276 702130

Asia-Pacific
Suites 6804-8, 68/F
Central Plaza
18 Harbour Road
WanChai
Hong Kong
+852 2230 3333
Fax +852 2230 3210