Siemens PLM Software's Simcenter: Predictive Engineering Enables Systems-Driven Product Development

CIMdata Commentary

Key takeaways:

- *A major transformation is underway in engineering processes for complex cyber-physical products (mechanical, electronics, embedded software, and controls)*

- *Global market leaders in multiple industries are rapidly expanding their strategic use of virtual prototyping and simulation into the cyber-physical systems realm*

- *Siemens PLM Software continues to execute within the overall Siemens corporate strategy for enabling Systems-Driven Product Development*

- *The new Simcenter™ solution is Siemens PLM Software's next major step in evolving cross domain and multi-physics performance modeling, simulation and testing tools as a foundational capability within their Smart Innovation Portfolio of industry solutions*

Virtual prototyping via both conceptual systems level (0D/1D) simulation and detailed 3D design analysis has moved well beyond just being a design checking tool or an alternative to minimize physical testing and validation cycles. Today's simulation and analysis technologies enable engineers to quickly and cost-effectively investigate "what-if" scenarios, explore innovative new design alternatives, and gain deeper insights into how a product can deliver its intended customer value throughout its lifecycle, including re-cycling, re-purposing, and other re-x's. Significant global product development trends are making multi-domain, systems-level virtual prototyping and performance simulation capabilities an indispensable element in enabling the transformation to simulation-driven systems development, especially for complex cyber-physical systems. These trends include:

- Smart systems being driven by the Internet of Things and Industrie 4.0

- Mass customization with software features being a key differentiator

- Design-for-purpose materials and new manufacturing methods (e.g., additive)

- Design-for-energy efficiency and scarce materials conservation and re-use

- Products delivered as services; an on-going innovation and utility business model

Systems-level virtual prototyping and in-service performance emulation (i.e., the "digital twin") will be a foundational element in developing Model-Based Systems Engineering (MBSE) processes for enabling product innovation, quality, and profitability throughout the lifecycle.

Unfortunately, today's virtual performance engineering environments are often limited in domain scope and are typically loosely connected or even totally disconnected from the enterprise workflow processes and IT infrastructure necessary to realize maximum bottom-line business impact. Virtual performance simulation and test verification "silos of information" that are disconnected from each other as well as from the enterprise product development platform (i.e., the development focused elements of an enterprise's product innovation

platform) are not adequate to meet industry's business challenges going forward. The need for open and standards-based product innovation platforms (i.e., business process and data platforms) that connect system requirements, product data, engineering best practice processes, and enterprise knowledge across functional domains will be critical. Tomorrow's systems modeling, simulation, and testing processes and the associated performance engineering software capabilities must be at the core of enterprise product engineering platforms to enable innovative product ideation, rapid prediction and validation of system performance versus requirements, and high confidence decision-making in a dynamic and collaborative global product development environment.

Siemens PLM Software's Simcenter Portfolio

Siemens PLM Software is addressing the global product development trends, described above, in the context of their overall strategy for Systems-Driven Product Development.[1]

Similar to other major CAE software solution providers who have grown via an aggressive acquisition strategy, Siemens PLM Software faces the significant business and technology challenges of continuing to provide best of breed simulation, analysis, and testing solutions to current users while also integrating across those capabilities to enable user-friendly, collaborative, and flexible workflows for simulation, design, and test engineers; yet still data-managed, process centric, and with flexible delivery models.

Siemens PLM Software is focusing on the next generation of integrated, analytics-driven performance engineering solutions that will enable companies to address the business and engineering challenges described above. The new Simcenter portfolio of performance modeling, simulation, and test capabilities, augmented by several major recent computer-aided engineering (CAE) acquisitions, is the initial step forward in providing a comprehensive solution for multi-physics and multi-domain behavior modeling and simulation of complex products and systems. This is integrated with an enterprise product development platform (Teamcenter®) for simulation and test data management and overall performance engineering process management.

Within the Simcenter portfolio, Simcenter 3D brings together an extensive set of CAD-neutral modeling with structural, thermal, and flow simulation capabilities from the NX CAE suite including NX Nastran with the LMS 3D Simulation solutions (LMS Virtual.Lab and LMS Samtech) into a single, multi-discipline environment for the CAE analyst.

Simcenter 3D includes:

- Structural analysis and thermal and thermal/flow geometric modeling capabilities including multi-CAD support for importing and editing geometry from many different types of external geometry sources

- Structural and thermal meshing capabilities that enable the rapid creation of extremely large-scale models including automated batch meshing mode

- Synchronous Technology: flexible direct modeling capabilities that enable CAE analysts to rapidly abstract and de-feature, heal, and modify existing CAD models to be suitable for CAE mesh generation, as well as the ability to rapidly create concept design geometry, enabling dramatic CAE modeling time reductions

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[1] For more detailed background on Siemens' vision and the associated Smart Innovation portfolio of solutions strategy see: http://www.plm.automation.siemens.com/en_us/about_us/facts_philosophy/smart-innovation-portfolio/index.shtml

- System modeling capabilities such as Assembly FEM that enable analysts to easily create models of complex systems consisting of multiple component level finite element models created by different CAE analysts in the organization or even by CAE analysts in supplier companies and third-party consulting organizations

- Integrated multi-discipline solutions based on industry-proven solvers such as NX Nastran and LMS Samcef for a wide range of linear and nonlinear physics

- Industry vertical solutions for laminate composite structures, space systems thermal analysis, and electronic systems cooling (ESC)

- Industry-proven solutions for acoustics, durability, and multi-body dynamics from the LMS Virtual Lab portfolio of solutions

- Out-of-the-box integration with Teamcenter for 3D model and data management, as well as SDPM

CIMdata anticipates that over the next several releases, the Simcenter portfolio will enable functional capability synergies and harmonize user workflows between various solutions in the portfolio including Simcenter 3D, LMS Imagine.Lab, LMS Test.Lab suites, as well as the recently acquired STAR-CCM+ and HEEDS applications acquired with CD-adapco:

- Use of hybrid test and simulation models for high-frequency NVH applications such as vibro-acoustics that cannot be practically solved with only FEA simulation techniques

- Proven techniques for test-based correlation, calibration, and updating of CAE models to create higher fidelity, accurate simulations (closing the loop with test)

- Digital signal processing capabilities to analyze and create real world inputs for use in virtual simulations (e.g., duty cycles, component loads, and boundary conditions)

- 0D/1D systems simulations with hardware and software in the loop (HiL/SiL)

- Co-simulation between 0D/1D system dynamics models and detailed 3D component or sub-system models, leveraging industry standards such as Modelica and FMI/FMU

- Process integrated and compute efficient robust design and optimization (HEEDS)

- Large scale, general purpose CFD modeling and simulation capability (CD-adapco)

Simcenter has been designed by Siemens to provide the breadth and depth of capabilities needed by manufacturing organizations and their global supply chains to deliver timely simulation-driven product decisions. The Simcenter portfolio is based on an open platform strategy. For example, Simcenter 3D solutions are interoperable with all major mechanical CAD solutions and support a host of industry data exchange standards as well as a number of third-party simulation solutions (e.g., MSC Nastran, ANSYS, and ABAQUS). As a result, even in companies where there is no use of NX CAD or the Teamcenter PLM platform, CAE analysts requiring a CAD-agnostic, advanced multi-physics modeling and simulation environment can effectively utilize the applications available within the Simcenter portfolio.

CIMdata believes that this Simcenter portfolio strategy, in conjunction with the organization's recent major investments in LMS and CD-adapco, is compelling evidence that Siemens PLM Software is committed to creating a world-class performance engineering environment that unifies the best-in-class capabilities of the overall Siemens PLM Software Smart Innovation Portfolio. In addition, the increased focus on effective engineering decision-making via multidisciplinary design exploration, and data analytics (i.e., predictive analytics) is expected to be a key element of Siemens PLM Software's Simcenter value proposition in achieving the "digital twin" vision.

In the near term, CIMdata expects Siemens PLM Software's strategy to enable better integration of disconnected data and process silos in the functional domains of virtual simulation, mechanical design optimization, and physical test verification by unifying the definition, capture, and re-use of performance engineering knowledge across the global enterprise. In the longer term, CIMdata looks for Siemens PLM Software's Systems-Driven Product Development strategy to extend the impact of modeling and simulation into other domains by leveraging other recent acquisitions, such as manufacturing systems design, factory design and automation, and embedded software design and Application Lifecycle Management (supported by Polarion).

CIMdata will continue reporting on Siemens PLM Software's progress in executing their overall Smart Innovation Portfolio solution strategy for Systems-Driven Product Development and the role that an expanding Simcenter simulation and test portfolio for systems-level performance engineering will play in enabling innovative product ideation, realization, and utilization.

About CIMdata

CIMdata, an independent worldwide firm, provides strategic management consulting to maximize an enterprise's ability to design and deliver innovative products and services through the application of Product Lifecycle Management (PLM). CIMdata provides world-class knowledge, expertise, and best-practice methods on PLM. CIMdata also offers research, subscription services, publications, and education through international conferences. To learn more about CIMdata services, visit our website at http://www.CIMdata.com or contact CIMdata at: 3909 Research Park Drive, Ann Arbor, MI 48108, USA. Tel: +1 734.668.9922. Fax: +1 734.668.1957; or at Oogststraat 20, 6004 CV Weert, The Netherlands. Tel: +31 (0) 495.533.666.