

Enriching PLM's Landscape with Multi-Physics Simulation Processes and Data

Realize the value of simulation and MDAO in the enterprise digital thread

Key Takeaways

Use of simulations across the product lifecycle has been growing over the years. However, simulation artifacts have largely remained siloed in separate systems in design, testing, and validation workflows. Even proper organization of the data is lacking in most organizations.

With growing adoption of simulation from simulation-driven design to digital twins of products and manufacturing processes, there is a need to create traceability of data and process information used while performing the simulations as well as for the results of the simulations. This is not straightforward as processes, data, and systems have independent owners within organizations.

Having a configurable PLM connector which interfaces with simulation process and data on one side and PLM solutions on the other side is the only plausible solution to facilitate lifecycle traceability. Configurability of the connector is an important feature to manage the frequent BOM version changes which lead to the need to simulate with modified parts or material properties, as well as accommodating the customizations seen across the PLM/PDM landscape.

The solution architecture for simulation process and data to be integrated with PLM solutions is still evolving and early trends indicate that not all aspects of simulation process and data will be appropriate to be stored and maintained in the PLM solution due to file sizes and complexity of the models and results. A separate simulation process and data management system (SPDM) with usage-based integrations with PLM solutions may be a reasonable solution which can maintain the balance between data authorship and traceability.

ESTECO VOLTA and its PLM connector are an excellent choice for early adopters who are considering a SPDM system and developing a connection between PLM and simulation data. ESTECO VOLTA's strong connection with ESTECO modeFRONTIER provides users with a strong multidisciplinary design analysis optimization backbone to rely on.

Introduction

In today's complex and rapidly evolving engineering landscape, the ability to simulate real world application use cases and accurately predict product performance is invaluable. While Product Lifecycle Management (PLM) solutions are well established across the industry and take care of design,

manufacturing, and supply chain information, simulation data has been largely left out of the scope of PLM and still resides mostly unorganized on local workstations, back-up drives, and occasionally on cloud servers. The contextual information of the simulation data is almost always lost (the metadata W's—Who, What, When, Where, Why), reducing its re-usability over the lifecycle and costing organizations precious time and money. One of the challenges in managing the simulation data as well as associated empirical data is its complex nature and close association with workflows and processes. It needs to have a dedicated data architecture that is unique to performing verification and validation (V&V) activities as highlighted by many industries and working groups.¹

SPDM technology—a cutting-edge solution is designed to streamline and optimize the intricate processes involved in simulation-driven product development.

SPDM serves as a centralized environment that manages, organizes, and integrates simulation and test data, analysis models, reports, materials data, and orchestrates best practices workflows leveraging multi-vendor design and analysis tools. By doing so, it addresses the challenges of data fragmentation, redundancy, and inaccessibility that often plague traditional engineering projects. With the increasing complexity of products and the sheer volume of performance simulation models and data generated during the product design and development process, there's a pressing need for a system that can efficiently handle and make sense of this ever-increasing volume of information.

Integrating Simulation Best Practice Processes and Intellectual Property into the Enterprise Digital Thread

Organizations across industries are increasingly recognizing the need to streamline and optimize their product development workflows to improve efficiency, foster collaboration, and enhance decision-making. The integration of simulation processes, test/V&V processes, and associated data into the enterprise digital thread has become essential to most engineering organizations for staying competitive.

By connecting simulation to the digital thread, organizations can create a unified environment where design, analysis, and decision-making processes are seamlessly integrated into the broader product development lifecycle. Another industry requirement is the ability to automate design optimization earlier in the product development lifecycle. With growing product complexity and the demand for shorter development cycles, traditional trial-and-error approaches to design are no longer sufficient. Automated workflows for simulation and design optimization allow engineers to explore a broader design space, identify optimal solutions faster, and make data-driven decisions, all while minimizing manual intervention. This level of automation not only saves time but also ensures that engineering teams are free to focus on higher-level problem-solving and innovation.

Ultimately, the ability to integrate simulation into the enterprise digital thread represents a significant step toward achieving digital traceability of IP; enabling better design decisions; and enhancing engineering efficiency. Companies that can leverage this integration will be better positioned to handle the complexities of modern product development, collaborate effectively across teams and departments, and make informed, real-time decisions that drive innovation and business success. By addressing these needs, organizations can unlock the full potential of simulation-driven product development and maintain a competitive edge in an increasingly digital world.

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ESTECO VOLTA External Data Source for PLM Connection

The modern product development process is highly complex and, in many cases, agile, needing a process and data management solution that is focused on enabling and managing simulation workflows for rapidly evolving designs. While addressing the need for this interactive “work-in-process” capability, it is also imperative that key product information and its metadata are archived in the PLM solution at various key stages of product development. As shown in Figure 1 and 2, the ESTECO VOLTA Digital Engineering Platform and its External Data Source connector allows this balance to be maintained. The simulation data resides in the SPDM system while ensuring full traceability to and from the PLM platform.



Figure 1—VOLTA Digital Engineering Platform Capabilities
(Courtesy ESTECO)

The External Data Source connector for ESTECO VOLTA is language-independent and consists of two parts: one built into the product and another external part that can be developed by various parties, including customers. It integrates with external data sources like Google Drive, OneDrive, and GitHub, allowing users to pull data into simulation workflows while maintaining user access controls. The connector also facilitates the integration of simulation models and data from PLM systems into simulation workflows, enabling users to run simulations and manage results within the VOLTA platform.

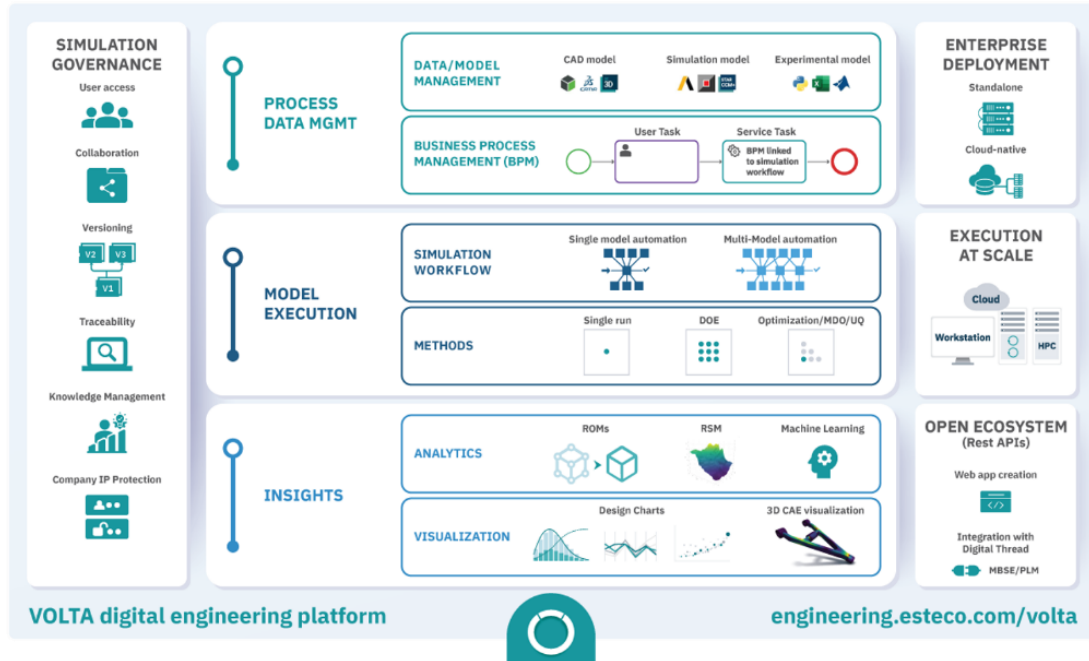


Figure 2—VOLTA Digital Engineering Platform
(Courtesy ESTECO)

A Case Study

The complexity of designing aerospace systems demands support for diverse models, datasets, practices, and regulatory requirements. Consequently, companies are increasingly recognizing the need to integrate Multidisciplinary Design Analysis and Optimization (MDAO) and SPDM capabilities with external systems like PLM. Case study of an aerospace company wanting to design a new drone for certain mission level performance requirements is presented.

- **Background and challenges:** The complexity of aerospace systems requires diverse models and regulatory compliance, making integration of MDAO and SPDM with PLM solutions essential to avoid model duplication and ensure consistency.
- **Multidisciplinary design analysis optimization:** MDAO integrates various simulation models into automated workflows, enabling rapid evaluation of design candidates and optimal configurations, while ensuring traceability and collaboration across teams.
- **Hyper-automation via business process management:** Hyper-automation for the entire workflow is accomplished with VOLTA and its modeFRONTIER process automation and design optimization technology. Project managers define processes with SPDM; CAE analysts handle simulations in aerodynamics, propulsion, and mission using CAD models from the PLM; simulation experts automate multidisciplinary workflows; and technical domain experts approve design decisions.
- **External Data Source (PLM) Connector:** The External Data Source Connector (see Figure 3) streamlines data exchange, enhances traceability, improves collaboration, reduces redundancy, and increases efficiency by avoiding data duplication between VOLTA and external repositories.

The external data source repositories connector for VOLTA enables users to connect to other data sources besides the VOLTA Data Manager, improving project management and collaboration with PLM users. For PLM platform users, it avoids data duplication and ensures traceability across systems, with future support

for pushing data from VOLTA to PLM. Engineering teams benefit from data flow across different platforms, avoiding duplication and ensuring traceability. This enhances VOLTA's connectivity with the enterprise.

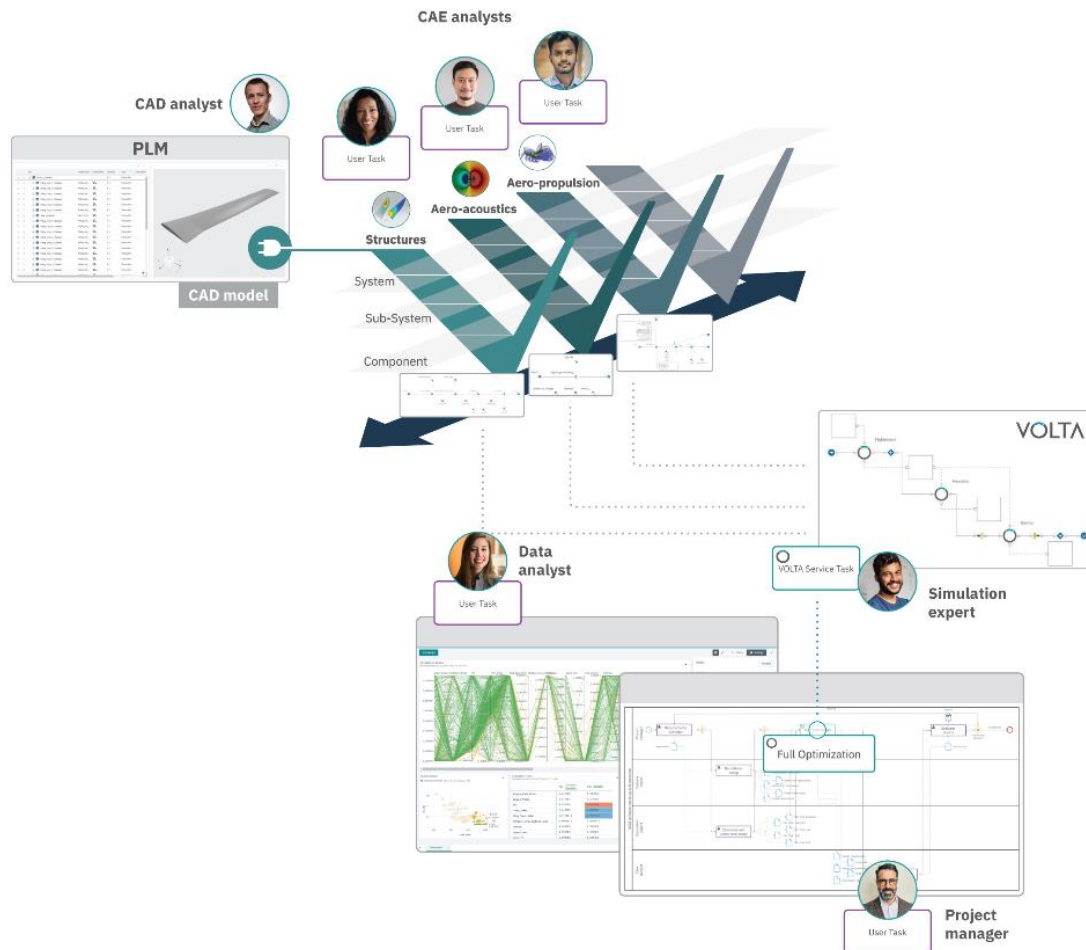


Figure 3—VOLTA Landscape Encompassing External Data Source Connection
(Courtesy ESTECO)

Concluding Remarks

In summary, the integration of simulation processes and data with PLM solutions is a critical step forward in enhancing the value of the enterprise digital thread. The use of ESTECO VOLTA along with modeFRONTIER and its External Data Source connector offers a promising solution for early adopters seeking to manage the complex data and workflows associated with simulation-driven product development. With its strong MDAO capabilities and the External Data Source connector, ESTECO VOLTA is well-positioned to meet the needs of companies looking to streamline their performance simulation activities and enable PLM integration to connect digital threads for a wide range of simulation and V&V processes.

In CIMdata's opinion, ESTECO's VOLTA environment for SPDM with its modeFRONTIER technology for MDAO provides a powerful suite of solutions to enable simulation-driven product development and "connect the dots" with other enterprise level PLM-driven processes for digital thread and digital twins.

We suggest that industrial companies include ESTECO VOLTA and its modeFRONTIER technology in the evaluation and implementation of commercial solution for SPDM and MDAO.

About CIMdata

CIMdata, an independent worldwide firm, provides strategic management consulting to maximize an enterprise's ability to design, deliver, and support innovative products and services by identifying and implementing appropriate digital initiatives. For forty years, CIMdata has provided industrial organizations and providers of technologies and services with world-class knowledge, expertise, and best-practice methods on a broad set of product lifecycle management (PLM) solutions and the digital transformation they enable. CIMdata also offers research, subscription services, publications, and education through certificate programs and international conferences. To learn more, visit www.CIMdata.com or email info@CIMdata.com.