COMMENTARY

The Transformative Impact of SPDM:

Stitching simulation data into the enterprise digital thread

Key Takeaways

Efficiency and productivity: Simulation Process and Data Management (SPDM) solutions streamline and automate repetitive tasks, allowing engineers to focus on high-value activities. This leads to faster simulation cycles and reduced time-to-market.

Data consistency and Integrity: By centralizing data storage and management, SPDM ensures that all simulation data is consistent, traceable, and free from discrepancies. This reduces errors and ensures that decisions are made based on accurate and reliable data.

Collaboration and accessibility: SPDM solutions provide a collaborative platform where teams can easily share and access simulation data and processes. This fosters teamwork and ensures that all stakeholders are on the same page.

CAIQ SIMWORX, with its roots in CONTACT software (a PLM company with its elements platform) and CAIQ (CAE services, CAE process consulting and simulation management) is extremely well positioned to help customers on their SPDM journey as part of their enterprise digital transformation/digital thread initiatives.

Introduction

In today's complex and rapidly evolving engineering landscape, the ability to rapidly simulate real world application use cases and accurately predict product performance is invaluable. SPDM technology—a cutting-edge solution is designed to streamline and optimize the intricate processes involved in simulation-driven product development.[1]

SPDM serves as a centralized platform that manages, organizes, and integrates simulation and test data, analysis models, reports, materials data, and orchestrates best practices workflows leveraging multi-vendor 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 simulation models and data generated during the product design and

[1] Research for this paper was partially supported by CONTACT Software

development process, there's a pressing need for a system that can efficiently handle and make sense of this ever-increasing volume of information.

While Product Lifecycle Management (PLM) tools 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 tools and still resides largely 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, Why), reducing its re-usability over the lifecycle and costing organizations precious time and money. One of the challenges in managing the simulation 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.

Supporting the Expanding Role of Simulation

The role of simulation across the product development cycle is expanding. While most of the usage is still concentrated on V&V methods, there is increasing usage in system architecture, system development, conceptual design, detailed design, manufacturing, operations, maintenance, and support parts of the product lifecycle through the implementation of physics-based digital twins. SPDM solutions are not just data and process archival solutions, but they provide an ecosystem that can be used to trace the entire evolution of the product through the lens of meeting product performance requirements. This allows users to understand and resolve any performance issues across the entire product lifecycle. Development of SPDM tools needs deep expertise in software data architecture as well as close connection with how simulation is used in the industry.

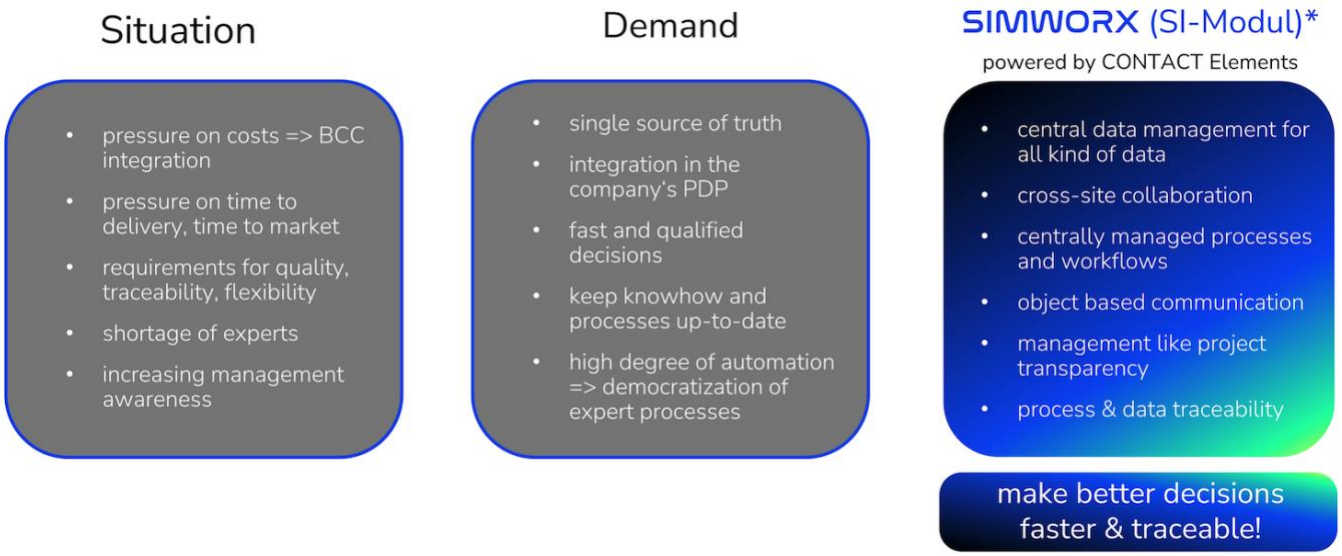

Figure 1—Simulation Process and Data Management
(Courtesy CAIQ)

SPDM Use Cases and CAIQ SIMWORX

SPDM plays a crucial role in modern engineering and product development. Here are various use cases where SPDM is particularly beneficial:

- Digital thread integration: It ensures that all simulation data related to a product's lifecycle is connected and updated promptly across company functions, from design to disposal.

- Data and process reusability: It enables engineering teams to reuse simulation data and best practices, which is cost-effective and promotes consistency across projects.
- Interdisciplinary collaboration: By managing simulation and related real world empirical data, SPDM facilitates collaboration across different disciplines, allowing for a more integrated approach to product development.
- Compliance and traceability: It provides traceability from requirements to results, ensuring that products meet necessary standards and regulations.
- Predictive analysis: SPDM is used to predict future events and validate models, especially in complex systems where direct experimentation is not feasible.
- Optimization: It helps in finding optimal design solutions by automatically running numerous simulation iterations, which is essential in all industries, especially in automotive, aerospace/defense, medical devices, and high-tech electronics, taking advantage of Machine Learning by creating a reliable data basis for this new way of engineering.
- Digital twin creation: SPDM is an essential enabler in creating and managing digital twins, which are virtual physics-based models of physical products. These models must evolve during the product's lifecycle, reflecting changes and updates to the "as designed" vs "as built" vs "as used" versions of the product twin.

CAIQ SIMWORX, with its roots in CONTACT software (a PLM company with its Elements platform) and CAIQ (CAE services, CAE process consulting and Simulation Management), has worked to create an integrated solution portfolio to meet these overall requirements. Its framework of project overview, task overview, automation, and custom apps provides a solution which can be used by experts as well as novice users equally efficiently. SIMWORX is presented as an SI Module in CONTACT Elements and has a strong connection with the rest of the Elements in the CONTACT Elements PLM platform. It is built by adding a data model for simulation and an automation module (a visual low-code environment) on top of process management and workflow management from CONTACT Elements This is a very useful feature for users as it provides an opportunity to integrate simulation process and data management even for design departments as "expertise as a service." Integration with other systems such as PLM and Enterprise Resource Planning (ERP), is achievable ensuring seamless data flow and collaboration. This creates significant potential for simulation data to make an impact on business decisions and performance.

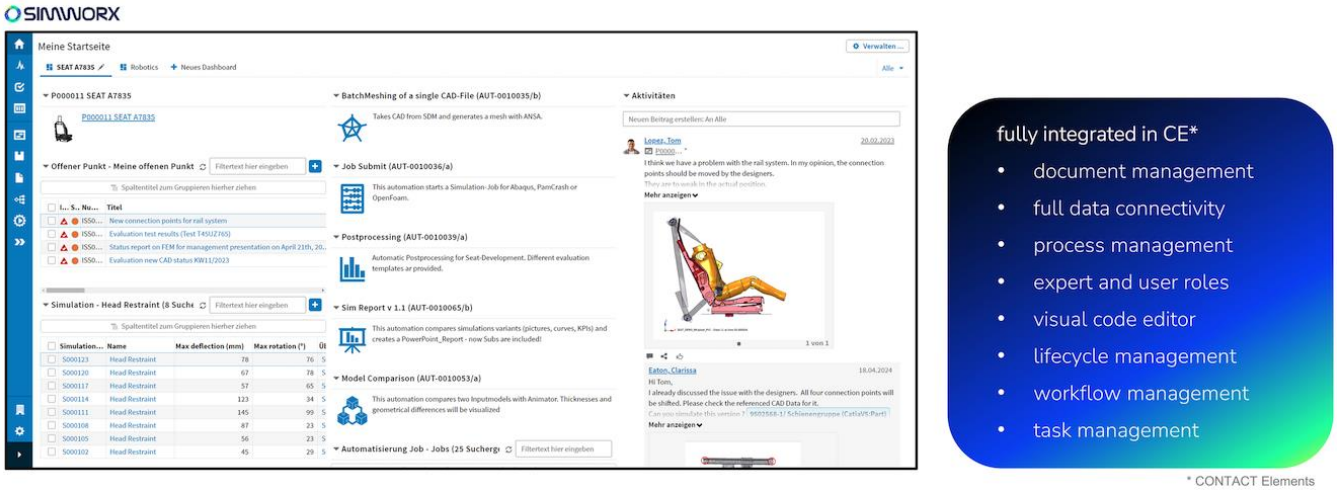

Figure 2—CAIQ SIMWORK: SPDM Solution based on CONTACT Elements
(Courtesy CAIQ)

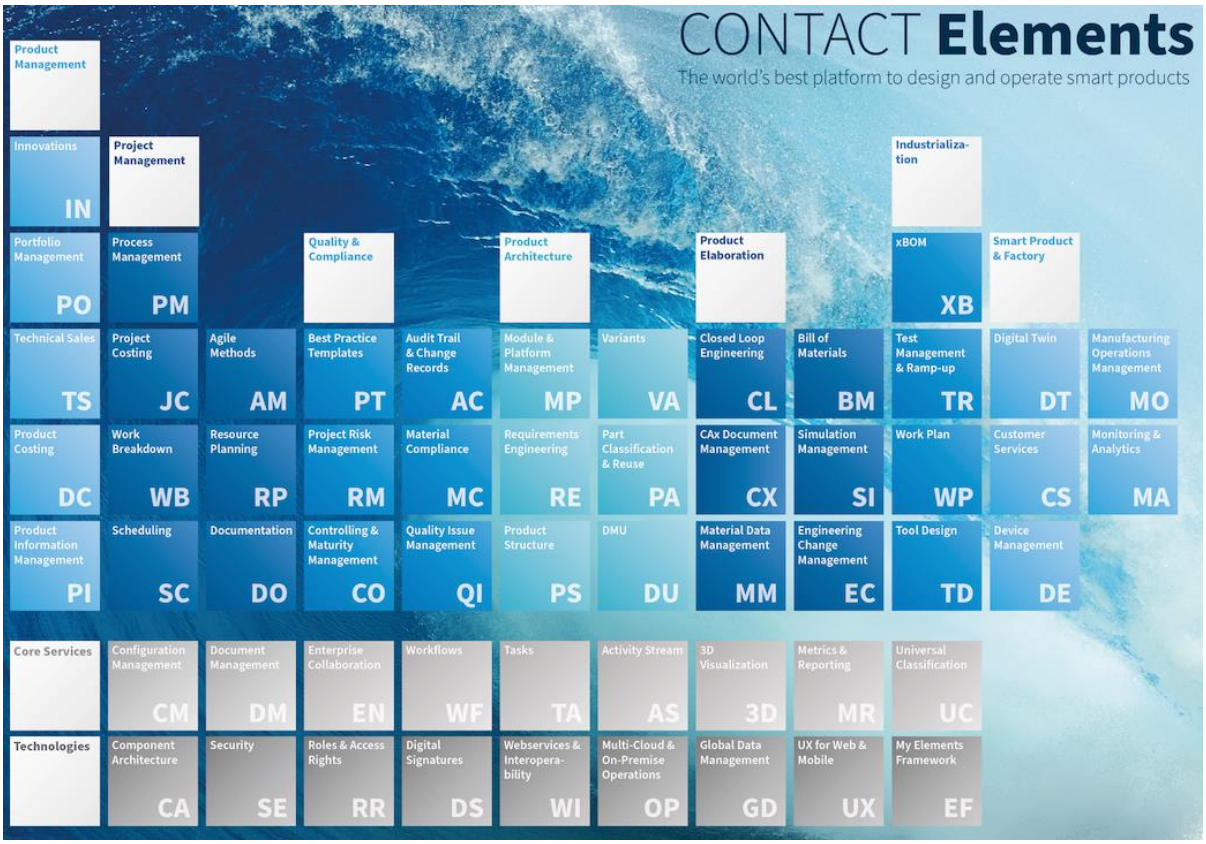

Figure 3—CONTACT Elements PLM Platform
(Courtesy CAIQ)

Concluding Remarks

In conclusion, SPDM has the potential to help transform the engineering landscape by driving the efficiency and productivity of product development teams as well as manufacturing and in service operations via the use of physics-based digital twins. It provides a reliable foundation for decision-making by ensuring data consistency and results integrity as well as a data traceability pedigree that supports quality goals and certification/regulatory requirements. The collaborative nature of an open, standards based SPDM platform enhances teamwork and accessibility, allowing seamless sharing and management of the intellectual property captured within simulation and empirical models, data, and reports that lead to better and faster product design and manufacturing decisions. Since the first commercial SPDM solutions were launched in the late 1990s, the adoption of SPDM within all industries has lagged significantly behind what was expected and forecast by almost everyone, including CIMdata. We finally see the rate of SPDM adoption increasing significantly over the next 2-3 years due to new technology and business drivers such as:

- Complexity of cyber-physical products requires more cross-discipline engineering collaboration.
- Competitive pressures for reduced cost, faster time to market, and product differentiation.
- Sustainability and Green initiatives.
- AI/Machine Learning combined with rapidly expanding computing options (Cloud, HPC, GPUs).

Tools such as CAIQ SIMWORX, with their roots in both the PLM and simulation domains, are pivotal to successful SPDM adoption but equally important is the process change required to implement such technology. The CAIQ SIMWORX platform is a comprehensive solution that covers everything from project to process, data, and workflow management. The software is based on the experience of former

engineering experts, making sure it fits the needs of real-world simulation challenges. CAIQ is proactive in its approach and seeing opportunities of emerging data technologies are planning on using them for improved simulation capabilities. The platform has promise to help companies in maximizing output from their engineering talent, improving processes, and fostering innovation.

Software solution suppliers such as CONTACT Software also provide implementation expertise in guiding organizations on their digital transformation/digital thread journey, unlocking new opportunities in product development efficiencies and innovation.

If your company has a digital transformation/digital thread initiative that does not include the adoption of SPDM technology, your odds of success are greatly diminished. We encourage you to seek out guidance in building a digital thread framework and implementation roadmap that builds in SPDM.

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.