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Engineering IoT Industry R&D
EIIR TREND

SIMULATION PROCESS AND DATA MANAGEMENT WILL DRIVE VIRTUALIZATION OF ENGINEERING INDUSTRY

With virtualization increasing in every industry and especially during pandemic, spotlight is on simulation for engineering industry. Simulation has many advantages and it has potential to increase its usage further but there are few challenges as well. Simulation Process Data Management (SPDM) should help in overcoming the challenges and increase simulation's value proposition and growth opportunities.

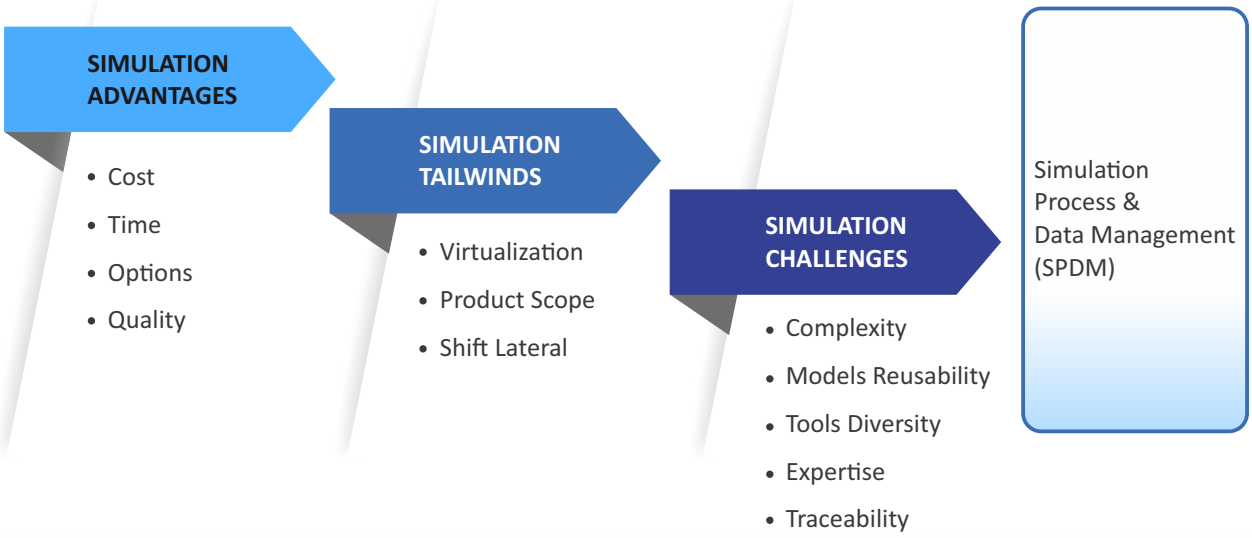

Figure 1: Simulation Advantages, Tailwinds, Challenges & SPDM

Engineering Simulation has many advantages and has potential to grow more pervasive

Engineering Simulation is a critical function in the product development process and especially for manufacturers of discrete products. It provides a means to virtually validate if the product will function the way it is envisaged under real operating conditions. This is done by modelling operating conditions (known as boundary conditions) virtually in simulation tools and studying the behavior of product being designed under those operating conditions. The conditions are provided based on design engineer's inputs and the simulation analyst's rendition of the operating condition.

Eventually the simulation models are modified based on inputs from prototype testing, pilot testing and inputs from products in operation in the field to make the models more realistic and closer to ground realities. Simulation provides a way to upfront validation and design optimization even before first physical prototype of the product is built. It is extremely important to have Simulation tightly integrated in the overall Digital Thread (Refer Figure 2) for enabling a seamless product development process.

Simulation is extremely valuable since it addresses some of the core problems in overall product development process and there is an emerging bigger need now because of following reasons.

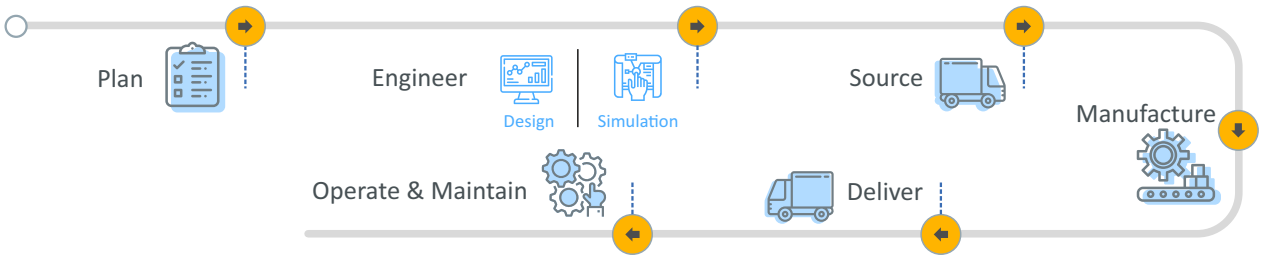

Figure 2: Simulation in the Overall Digital Thread

Reduction in cost of product development: Physical testing is always costly. Virtual representation and testing through simulation without building anything physically can help reduce cost drastically.

Reduction in time-to-market of products: Even if some enterprises can afford the cost, there is time required to get things done physically – sourcing parts/materials, manufacturing and prototype testing. Simulation can reduce turnaround time significantly. In an age when time to market is a major competitive advantage, simulation is extremely useful.

Increase design options and facilitate innovation: Simulation enables consideration of many design options before narrowing down on the chosen one. As evaluation of more design options is not constrained by cost and time of physical testing, instantly designers can get feedback on different design options and thus try more innovative designs.

Minimize risks while increasing quality: Any engineering product is complex integration of many parts, components, assembly, sub-systems and systems. There are conflicting design considerations and incompatible design of even a small component can create risk for entire product. Simulation can help in minimizing risks by testing design virtually.

Added tailwind to this is that Simulation is becoming more pervasive and there are multiple growth triggers:

Increase in virtualization: Post pandemic there is increase in virtualization, collaboration and remote working across industries. In engineering design and analysis virtualization will accelerate use of simulation.

Product scope: Historically simulation is confined to highly engineered products. With time, simulation applicability is seen to be increasing from highly engineered to all products including simple products.

Shift lateral: Simulation will move from design phase only to ideation, manufacturing, and operations phases. This implies higher volume of data, bigger challenges of configuration management and reusability, and more participants in the entire ecosystem.

There are challenges in proliferation of simulation inhibiting its growth

Traditionally usage of Simulation and its proliferation has been limited even though its importance is well understood and there are good reasons for that and detailed below and solutions to overcoming the same in subsequent section.

Process & Data Complexity: Simulation process is complex and typically requiring multiple iterations and huge volumes of data gets generated (often in Terabytes) and hence comes with inherent challenges in managing the configuration of this.

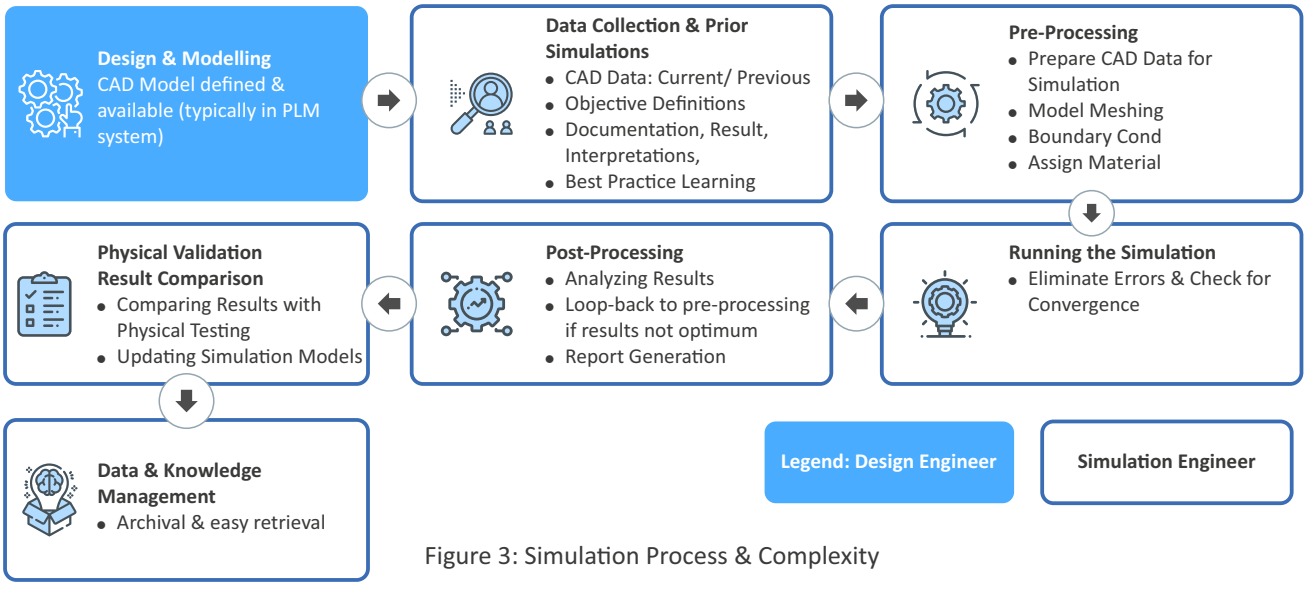

Figure 3: Simulation Process & Complexity

Reusability: Simulation is a very specialized activity and carried out by subject matter experts from design or R&D departments. Simulation models and corresponding output have traditionally resided in local servers and hard drives. Access has been as a result limited to the author or a few members in the simulation team locally and thus there have been inherent challenges in sharing and reusing the knowledge in larger gamut of the enterprise.

Diversity of Simulation Tools: The nature of analysis required on virtual representation of products often require multiple simulation tools and often from various vendors. This adds to the complexity since there is need for managing various file types and often the output from one tool needs to be made the input of another tool to conduct an analysis involving a chain.

Multi-Disciplinary Expertise: In many situations and often the more complex ones, it is required to conduct Multiphysics analysis involving multiple domains as structural, heat transfer, fluid flow, etc. These analyses require specialists from respective domains to collaborate and output from one analysis feeding into as input for the next one. The specialists maybe geographically distributed and hence challenge in collaboration.

Cost of experts: Inefficiencies in current day process often lead to sub-optimal distribution of resources across geographies and hence an impediment to optimizing cost of simulation resources which are often high due to the specialization involved.

Traceability: There are many situations especially when regulatory audits are carried out, or when there is a field failure, there is need to trace back to simulation result and compare with real-life data. The current approach of offline management of corresponding data is a major bottleneck during such situations.

The above challenges are an impediment to widespread adoption of simulation both by experts and non-experts. The latter category being those who need to refer to the simulation model and result but typically does not need to get into the details of the complexity of it.

Simulation Process & Data Management (SPDM) can address simulation proliferation challenges and make it pervasive

SPDM is a knowledge management application for simulation to effectively manage simulation data configurations, secure and streamline process, facilitate access to globally distributed teams and collaboration, provide traceability and enable decision making for product optimization.

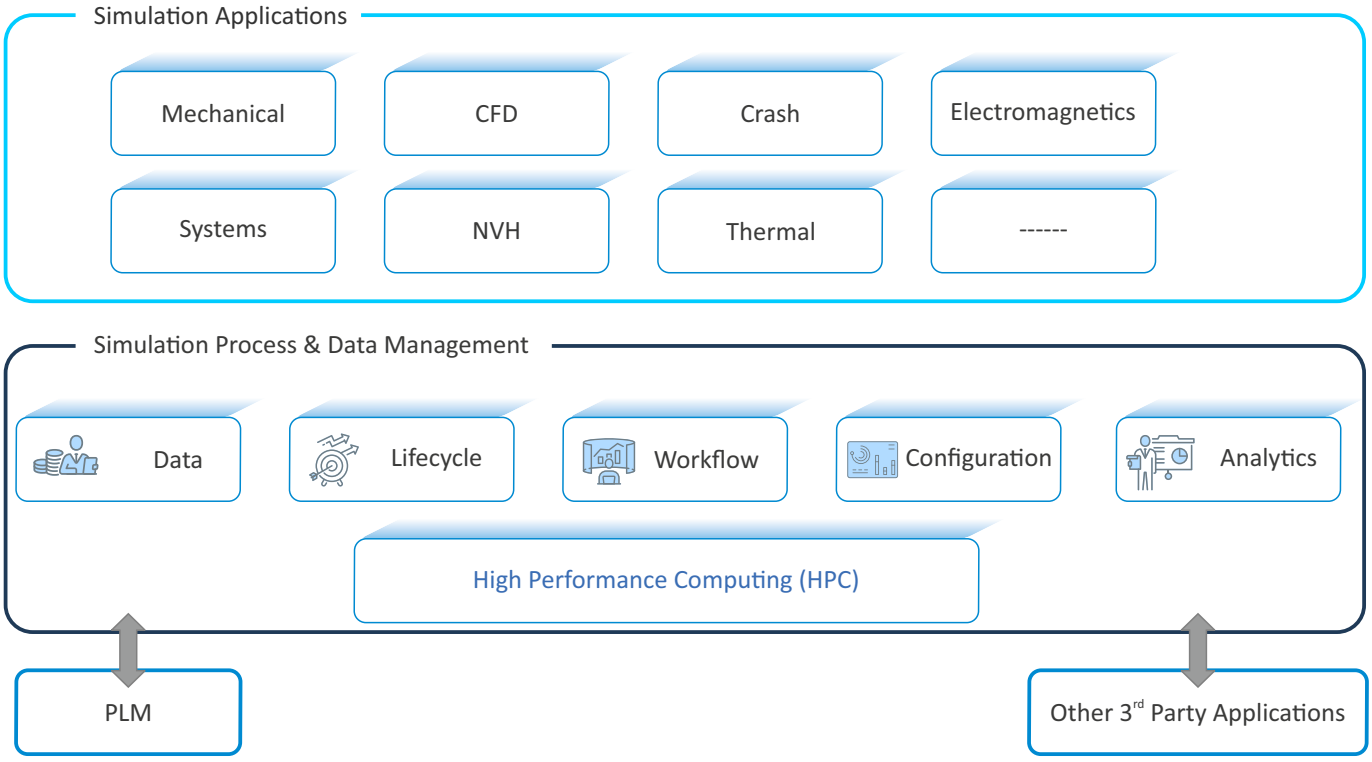

Figure 4: SPDM & its interplay with Simulation and other Applications

With traditional challenges of managing simulation data coupled with market drivers that are providing a tailwind to its proliferation, it becomes very important to effectively manage simulation data. Leading simulation vendors are addressing this space and providing solutions coupled with their platforms. Since simulation for products often need to be carried out with tools from multiple vendors, so cross-platform portability of such solutions become very significant. Leading tools come with capability to:

- Manage large volumes of simulation data
- Configuration management and traceability
- Search mechanisms
- Workflow processes
- Integration points to simulation tools
- Open architecture to integrate with PLM and other applications
- Templates for generating simulation reports
- Emerging functionalities around providing smart inputs before conducting simulation on prior similar work

The below figure delineates the working of SPDM in conjunction with other platforms as PLM, CAE & CAD within the overall Digital Thread. This can be part of the Engineering Release process, Change Management Process or acting standalone.

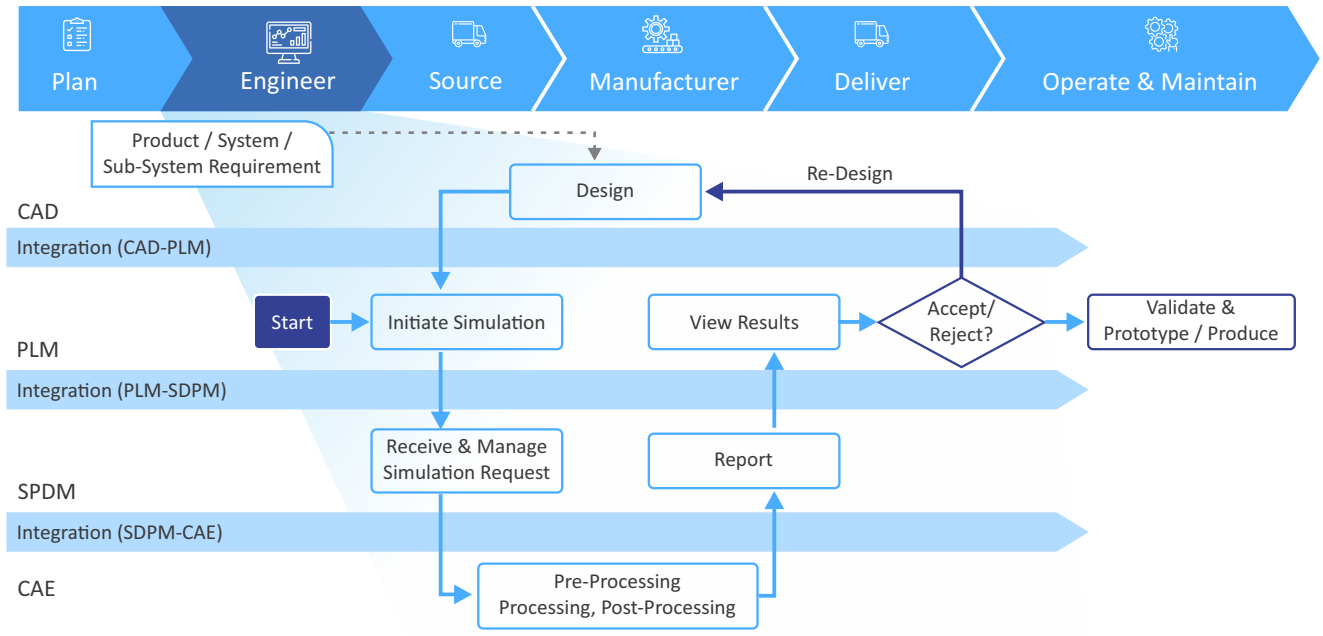

Figure 5: SPDM integrated to the Digital Thread

This SPDM solution addresses quite well all the challenges that are highlighted in earlier section.

- It provides a platform for strong configuration management and search mechanism; the simulation data gets well managed and easy to find
- A seamless integration to the Digital Thread ensures that a robust product development and change management process is enabled
- This also enables a far greater access to enterprise level users who need to access and use simulation results and models facilitating proliferation and democratization of data
- An architecture that is open and enables easy integration of simulation authoring tools from diverse vendors adds to the pervasiveness as end-to-end analysis of products can be done seamlessly

As these solutions further mature and starts providing the capability to integrate to and compare with the results of physical validation and verification, that would provide far-reaching implications in terms of refining the models, optimizing design and reduce time to product development.

There is significant interest being seen from customers to such solutions and many have initiated or on the threshold of proof-of-concepts to get a better view of how these solution fits into the overall landscape and provide value. Amongst various others, a manufacturer in Hi-Tech industry is in process of working with this solution to help them realize improvements in time-to-market, improved quality and lowered cost of development of their state-of-the art products.

Bottom Line: SPDM can help enterprises scale their simulation activities. Enterprises should look for SPDM capability in their simulation partners

SPDM can help enterprises to scale their simulation activities enabling virtualization of engineering activities. The specific value areas include:

- Improve time-to-market of products enabled by – faster search; effective collaboration; simulate more and earlier in lifecycle
- Better quality of products enabled by – reduction of rework; improved synchronization of design with simulation teams
- Optimized cost of product through – reduction of physical test; effectively communicate design intent; automate process and best practices

SPDM implementation will require knowledge of simulation, SPDM tools and experience with other engineering applications. Enterprises should look for simulation partners which have expertise in SPDM implementation for getting this quick and right. Virtualization of engineering industry is bound to grow and enterprise which doesn't scale simulation will be left behind!

Authors

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