Simulation Lifecycle Management

Opens a New Window on the Future of Product Design and Manufacturing

Figure 1: The SLM Concept

Paul Lalor, product manager for Dassault Systemes SIMULIA brand, discusses the importance and impact of SLM for the analysis community.

It's a given in most quarters of the product development community that aggressive use of simulation throughout the design process can lead to higher quality, more innovative products brought to market more quickly and efficiently than those designed using only conventional prototyping and physical testing. Several analyst groups have made this observation over the last few years; the Aberdeen Group's October 2006 report "Simulation-Driven Design Benchmark Report" found that leading companies use simulation earlier, more often and more effectively than the laggards in their respective industry.

Yet even companies that apply simulation effectively, usually fail to capture, manage and re-use the data and unique insight their simulations provide to consistently improve design, production, and quality. Key simulation parameters and results can be lost or worse, confused with similar data, which leads to flawed decisions that cost time and money. Without well-defined simulation processes, product developers cannot expect efficiency and consistency across programs or from one stage of product development to the next.

"Accurate and consistent simulation has to be at the heart of any design and manufacturing development process," states Frank Popielas, Manager, Advanced Engineering, Dana Sealing Products Division. "In order for simulation to provide more than a partial picture, we need system simulation capabilities as well as the ability to carry over simulation results from one stage to the next. A good example of this is the influence that manufacturing processes have on the functional behavior of the final product."

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A further absence of technically-capable communication frameworks limits engineers’ ability to share information and collaborate on solutions. As simulation continues to prove fundamental to effective product design and manufacturing, a new technology space is emerging to meet companies’ simulation management needs: simulation lifecycle management (SLM). SLM can be considered as a component of product lifecycle management (PLM), but simulation data, processes and their lifecycle are so unique and central to PLM’s success that it merits its own category. The most visionary PLM concepts encompass simulation environments where a product’s every performance attribute can be virtually tested under lifelike conditions before companies commit to final design, build and production. Realistic simulation is not a widget in this vision of PLM. It is its own domain, albeit part of the larger PLM landscape, and to be successful companies must treat it as such. The benefits for companies that embrace SLM are considerable: shorter development cycles, higher product quality, less waste, and a culture of innovation.

“Simulation lifecycle management will allow for many, previously excluded, downstream elements of projects to be engaged with the upstream elements as early as the concept creation stage,” states Tom Lange, director, corporate research and development modeling and simulation at consumer products giant Procter & Gamble. “The early integration of experts, designers, and managers, with requirements is the key. It will improve the productivity of the entire technical community to innovate – innovating how we innovate.”

The SLM concept explained

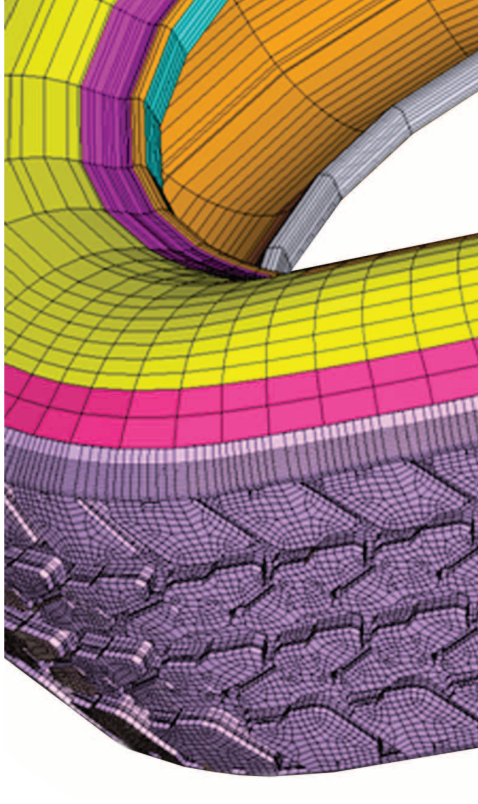
Simulation’s basic purpose is to support and enrich decisions about product design or process development whilst reducing or eliminating build and break cycles. Simulation Lifecycle Management is best defined as management of the intellectual property associated with simulation tools, data, and processes as related to product or process development. An SLM system must encompass four essential functional areas to be effective:

- collaboration,
- simulation data management,
- decision support, and
- integration and process automation.

Collaboration is SLM’s foundation. No process or product is created in isolation, in fact these days they are often created by teams and individuals in different facilities scattered over different time zones. These teams and individuals must be able to compare their results to work out differences before the late phases of product development, when the heavy money starts to hit the table. Cross-functional collaboration also promotes innovation and higher quality by giving everyone in the development process insight into the latest intellectual property and helps them keep abreast of others’ work that impacts their own.

For example, consider a tire manufacturer whose marketing department requests a design with a minimum treadwear grade of 400. The engineering department translates marketing’s requirement into engineering targets, such as maximum frictional energy dissipation rate, which must not exceed a certain value under a set of predefined load cases. Engineers simulate the tire’s performance in a virtual 3D environment and use the results to guide their decisions of how to balance marketing’s request with physical realities.

This is the first juncture of the process where simulation must evolve into simulation lifecycle management. The simulation data this process yields can help other members of the product development team make well-founded decisions. However, in most current environments, it would reside on the engineers’ hard drives or the department server, invisible except for a small circle of users. In an SLM environment, the data is managed in a central repository where it is associated with other data on this product design. Simulation also has a role in process planning. In this case, the company’s materials department simulates mixing and



curing techniques, inspecting and testing processes to maximize abrasion resistance and minimize cracks in vulcanized rubber compounds. The company must retain this simulation-driven process information and associate it with other information about the mixing, curing, and inspection processes, which will affect most, if not all of its tire designs.

Management of simulation data imposes the kind of discipline on simulation that has proven effective in other facets of product development, such as computer-aided design and bill of materials. Central data repositories provide a consistent, safe, and searchable environment for valuable data. A coherent data management structure gives engineers and designers quick access to existing intellectual property that can help them with their current work. It also supports the definition of best simulation practices through automated workflows that ensure data integrity and repeatable processes while eliminating wasteful labor.

Providing capabilities for decision support is about ensuring a product will meet its functional requirements; possess optimal cost, weight and durability; and be designed, manufactured and iterated in the least possible amount of time. To support these ends, SLM solutions must provide management tools for hitting design targets – in other words, making sure designs work as intended – and anticipating post-production performance. Those capabilities enable engineers to peer into the future, anticipate problems, and make the appropriate decisions early in the design process to ward off late-stage problems.

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Integration of a diverse set of simulation applications and subsequent process automation creates a unified simulation environment that facilitates toggling between various systems to complete a task. Essential, best in breed simulation capabilities from relevant outside resources must be integrated with simulation data and processes. Once all of the necessary resources exist in the same environment, simulation experts can link them together in automated workflows. Automating key processes adds accuracy and repeatability to simulation, which in turn improves quality and reduces time to market. It also allows the simulation community to expand to design engineers freeing up the time of simulation experts to develop the next generation of robust simulation methods.

Getting started in SLM

SLM’s foundations - simulation technology and PLM - are already firmly established at leading companies in every industry. Implementing SLM , as part of an existing PLM environment or as a stand-alone system, is a multi-faceted process, not a one-time event. An effective SLM system must be easily tied into related information systems for fluid data exchange. History has shown that heavily customized solutions are too expensive and time consuming to expand and adapt as the SLM system grows.

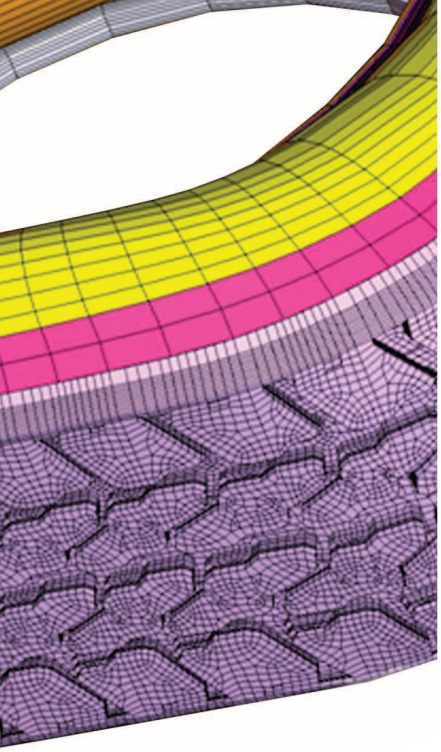

Figure 2: Engineering teams are able to use SLM to manage the data, processes, and IP related to a number of simulations during the tire design process, including static inflation, static footprint, rolling resistance, cornering force and moment, modal analysis, hydroplaning, and more.

The best SLM solution providers will combine expertise in simulation technology, process and product development, and PLM. Equally important, they will appreciate simulation's evolving role in product development and have a vision for making it a common, natural and value-producing process.

Shorter product lifecycles, higher material costs and the expanding body of international environmental regulations are just a few of the factors ensuring simulation will continue to play an increasingly critical role in product design and manufacturing. In fact, the research firm CIMdata predicts that its role will expand beyond specific validation phases and permeate every element of product development. According to their December 2006 white paper "Enterprise Simulation Management":

"Simulation capabilities will eventually become available much more broadly throughout a company, from purchasing, to sales, to many others as they are enabled to utilize them to make more informed and confident decisions. The business will benefit and be able to respond faster to customer requests while also improving design variation predictability, leading to more accurate quotations and higher profitability."

As simulation grows more important in product development, it must exist in an SLM framework that promotes collaboration, re-use of intellectual property, and adherence to best practices. Companies that embrace SLM now will position themselves as leaders in the future. Their ability to create virtual worlds that closely mirror the physical world will enable them to optimize performance, reduce material use, detect and correct errors at a level almost inconceivable with today's physical prototyping.

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Figure 3: SLM solutions from SIMULIA leverage visualization and collaboration technology from Dassault Sytstemes' 3D Live to enable product development teams to access simulation results and collaborate on product design decisions.

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NAFEMS publications and benchmarks are widely regarded within the engineering analysis community as the most authoritative source of information available. The areas covered by NAFEMS are expanding year by year with the growth in membership, and people increasingly view NAFEMS as a one-stop shop for all aspects of information on engineering analysis.

For engineering analysts, NAFEMS offers an excellent platform for continuous professional development.

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