

Strategy for Sustainable Innovation in Consumer Packaged Goods

Realistic Simulation, Design Optimization, and Simulation Lifecycle Management

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Consumer Packaged Goods (CPG) is a multi-trillion dollar industry which includes food, beverages, tobacco, cleaning products, and hygiene and beauty products. Companies in this industry are faced with daunting challenges of developing new and innovative products—and then producing them in large volumes, with regional appeal—quickly and at the lowest possible cost.

Today's packaged products must meet many conflicting performance objectives. They need to be unique, lightweight, stackable, and easy-to-open, yet strong enough to resist damage during production and distribution. Often, they must be recyclable, resealable, and reusable, but they must always be affordable for the average consumer. To meet these pressures, the CPG industry is increasing its use of Finite Element Analysis (FEA), Multiphysics, Design Optimization, and Simulation Lifecycle Management solutions from SIMULIA. These solutions are heavily entrenched in the aerospace, automotive, and energy industries where there are many mature, proven, and repeatable simulation processes.

While simulation use is not as prevalent in the CPG industry, there are several companies that are leading the way—and today there are many complex simulations being performed as an integral part of the CPG development process. Abaqus FEA is well-suited to analyzing a wide range of CPG applications due to its capabilities such as advanced material models, general contact, implicit and

explicit solvers, flexible multibody dynamics, multiphysics simulation (such as fluid-structure interaction) and its ability to leverage high-performance multi-core hardware. Our software is being used by leading manufacturers such as Glass Service Improve for developing glass bottles, Dupont for researching adhesives, Tetra Pak for the analysis of paperboard cartons, and Silgan Containers for the analysis of metal cans (*INSIGHTS*, p. 11).

Container Lifecycle Analysis

Abaqus FEA enables designers and engineers to evaluate the complete lifecycle of a product and package: from concept, to selecting the right materials, to manufacturing and processing, through to the use cases experienced by the consumer. During the development of a plastic bottle, for example, the blow-molding process can be simulated with Abaqus to ensure manufacturability. The simulation results provide the wall thickness distribution, enabling designers to optimize the bottle design for weight, material usage, and strength. The final shape and wall thickness

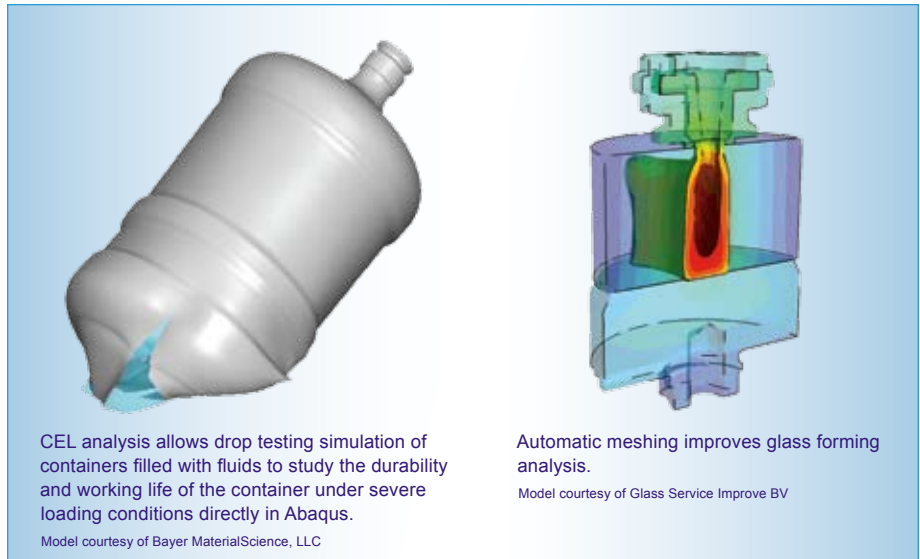
distributions are critical to achieving accurate simulation results in subsequent virtual tests, such as:

- Top loading simulations performed to evaluate whether containers can withstand the loads during stacking.
- Heating and cooling analysis to predict how bottles soften or swell during processing.
- Conveying simulation to ensure container stability on conveyor systems.
- Pressurization analysis to help determine if bottles will buckle due to changes in internal pressures during storage and transportation.
- Grip stiffness simulations to confirm that a bottle will have sufficient strength and appropriate deflection under various squeeze loads.
- Finish design simulation of bottle caps to ensure an effective seal is created.
- Opening analyses performed to determine the forces required to open various seals that are often made of films or plastic tabs.
- Drop simulations to help determine whether bottles filled with fluid will break.

Many of these load cases require accurate representation of the actual product inside the container which is often a fluid, such as ketchup, detergent, or water. To gain a higher level of accuracy and realism, we have incorporated the Coupled Eulerian-Lagrangian (CEL) method directly in Abaqus, enabling engineers to include the effect of a fluid interacting with structures. We have also provided the ability to couple third-party CFD products to Abaqus to allow our customers to use the best combination of solutions required to evaluate a product's realistic performance.

Design Exploration and Optimization

Isight is used by consumer goods companies to connect a variety of applications, automate the execution of multiple simulations, and perform multidisciplinary design exploration and optimization. In the case of bottle manufacturing, the software is used to determine the optimal parison thickness profile for blow-molded plastic bottles. Isight is helping our customers reduce material costs while ensuring that their bottles still satisfy the minimum strength tests. Isight is a key enabler for selecting the best design parameters to meet engineering targets, improve efficiencies, and reduce design cycles.



CEL analysis allows drop testing simulation of containers filled with fluids to study the durability and working life of the container under severe loading conditions directly in Abaqus.
Model courtesy of Bayer MaterialScience, LLC

Automatic meshing improves glass forming analysis.
Model courtesy of Glass Service Improve BV

Many of the simulation process flows described for the virtual testing of a new bottle design—and for the other package types—are robust, mature, and repeatable. This makes it possible to capture the methods, deploy them to non-experts via a template-based interface, automate their execution, and share the results for collaborative decision-making.

The Need for SLM

The new Simulation Lifecycle Management (SLM) solution from SIMULIA enables individuals, workgroups, and large enterprises to manage simulation processes, applications, data, and results. Procter & Gamble recently announced their decision to use SIMULIA SLM to make the benefits of realistic simulation available to a broader range of users than previously possible (*INSIGHTS*, p. 4).

SIMULIA SLM provides unique online collaboration capabilities that allow distributed engineering teams to share simulation methods, models, and results in order to make better-informed design decisions. These capabilities offer significant benefits to the CPG industry, where traceability of simulation results and their impact on design decisions are critical for accelerating product development and achieving regulatory compliance.

Customer-Focused Strategy

As our technology capabilities and product portfolio grow, it is critical that our solutions meet the needs of the CPG industry. We are closely engaged with our customers to understand their processes and simulation requirements in order to deliver specific functionality that answers

their needs. Customers in this industry can expect to see focused developments in the areas of advanced material modeling and multiphysics simulation, as well as improvements in ease of use for their challenging analyses. We are also working with industry-leading CPG companies to further define the role of Isight and SLM for their particular simulation process flows. SIMULIA is delivering robust simulation solutions that are enabling designers and engineers to meet the demands of lower cost, more efficient, and more sustainable product development.



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David is responsible for developing and promoting our strategy for simulation within the CPG industry. He has worked at SIMULIA since 1995 (initially at our UK office and then at our Providence, RI, headquarters) in various capacities within our customer service and marketing teams. He has visited our CPG customers around the world to understand their simulation workflows and requirements. Information gathered during these visits will help SIMULIA provide enhancements for advanced technology, usability, and productivity so that simulation can become an integral part of CPG design practices.

Download CPG-related customer papers at: www.simulia.com/cust_ref