SOLIDWORKS

INNOVATION THROUGH SIMULATION

Efficiently and Cost-Effectively Develop Innovative Consumer Products that Exceed Consumer Expectations via Simulation-Driven Product Development

Consumers in the 21st century have become much more discerning and informed about the products that they want to buy. With so many more places to shop online and the ability to utilize social media to post reviews and share information, consumers today can either make or break a product simply by making their satisfaction or dissatisfaction with a purchase known through social media. The need to satisfy increasingly higher consumer expectations puts pressure on manufacturers of consumer products to deliver higher quality, more innovative products faster and more cost-effectively, contributing to the specialization and segmentation of the broader Consumer product market into four distinct market segments: furniture & home goods, sport & leisure goods, fashion & luxury goods, and specialist retailers. This segmentation creates challenges for brands and manufacturers—challenges that can be overcome through the greater insights, efficiencies and collaboration resulting from simulation-driven product development, through which consumer goods manufacturers can achieve the time savings, cost reductions, improved quality, customization and increased innovation that exceed growing consumer expectations and create a competitive advantage. This paper examines the challenges and opportunities of an increasingly segmented consumer products market, and how integrated SOLIDWORKS® Simulation and cloud-based **3D**EXPERIENCE® SIMULATION solutions can help Consumer products, brands, and manufacturers adapt, innovate and succeed.

THE IMPACT OF GROWING CONSUMER EXPECTATIONS ON PRODUCT DEVELOPMENT AND MANUFACTURING

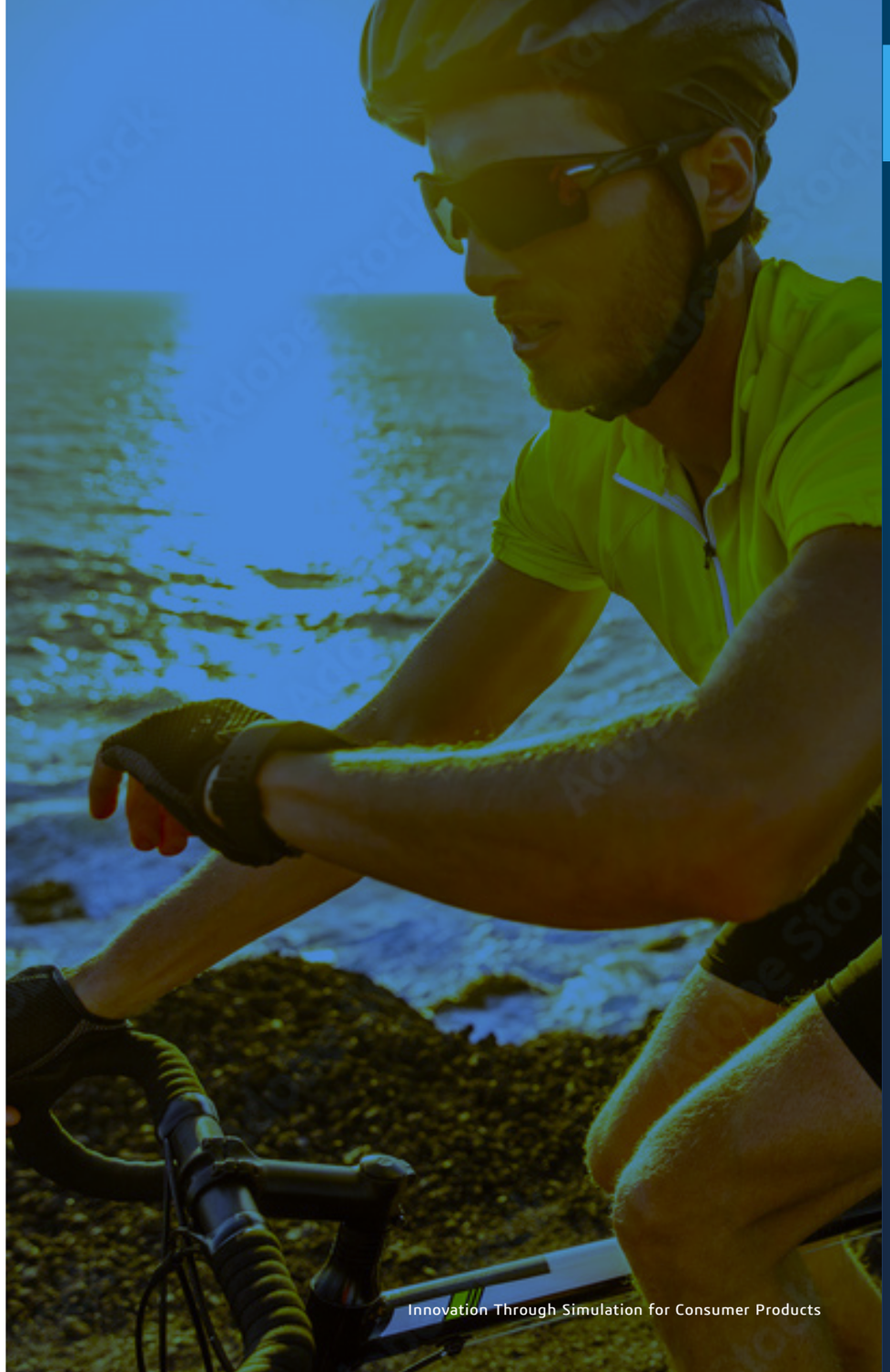
Today's manufacturers of consumer products face a range of product development and production challenges associated with the combination of more informed, demanding consumers and an evolving, segmenting market. Consumers have become much more difficult to satisfy and much more willing to share their opinions regarding their product experiences over social media than in years past. This trend stems from the greater access consumers have to product information—both online and via social media—as well as from a steadily increasing number of shopping and purchasing options. Today's consumers want something new or different—products that make them feel like they were made for them or with a clear purpose. Innovating products that create a buzz and brand status in the marketplace—and differentiate brands—has always been a challenge for manufacturers of furniture, home appliances, sports and leisure goods, and even with fashion products. With the additional challenges posed by the changing consumer, as well as market segmentation and specialization, manufacturers need to develop innovative products faster, better and at less cost than competitors to remain successful.

The evolution of the Consumer product market is in response to several factors, including product convergence with Internet of Things (IoT)/data-driven technologies; a growing mandate for sustainability; the emergence of new, disruptive business models; margin pressures; supply chain volatility; and the demands of today's consumers. The market segmentation increases demands on manufacturers and their brands to deliver innovation, mass customization, improved quality, shorter development cycles, new experiences based on technology, faster times to market, sustainable supply chains, and cost reductions to make products more affordable.

To meet these requirements, consumer goods manufacturers are moving from supply chains optimized for high volume to value chains optimized for flexibility. T his transformation of the digital enterprise can be facilitated through the use of simulation-driven product development. For example, with watches there are many small components and designers need to test and simulate them to ensure that they're not going to touch each other. For bikes, engineers need to simulate the aerodynamic characteristics of the design. For safety helmets, product developers need to test the shell's resistance to the shock of a collision.

Developers can capitalize on the growing demands of today's more discerning consumers; strengthen consumer-centric innovation; implement sustainability-first thinking; manage quality; and improve the agility, flexibility and efficiency of product development, supply chain and production processes by incorporating simulation technology, also known as finite element analysis (FEA), into their product development processes. Because simulation tools can minimize costly, time-consuming physical prototyping, manufacturers in the Consumer product market can leverage simulation technology to accelerate time to market while simultaneously increasing innovation and improving quality.

In addition to saving time and money, leveraging integrated simulation tools —like SOLIDWORKS Simulation and cloud-based **3D**EXPERIENCE SIMULATION solutions—frequently provides designers, engineers and product developers with the insights needed to create the innovative approaches that lead to informed decision-making and breakthrough products. Simulation can also support more consistent levels of quality, a more agile response to emerging customer needs, and solutions for optimizing manufacturing processes, resulting in more cost-effective production through increased cycle times. Moreover, cloud-based simulation solutions provide additional flexibility and greater simulation computing power at lower cost.



ADVANTAGES OF SIMULATION-DRIVEN DEVELOPMENT WHEN COMPARED TO PROTOTYPE-DRIVEN DEVELOPMENT

SIMULATION-DRIVEN DEVELOPMENT

- Minimizes repetitive rounds of physical prototyping.
- Saves time and money.
- Validates design performance.
- Mitigates risk on design manufacturability.
- Identifies potential field failure or warranty issues.
- Reveals innovative approaches.
- Improves quality.
- Optimizes design performance.
- Validates production processes.
- Shortens time to market.

PROTOTYPE-DRIVEN DEVELOPMENT

- Relies on repetitive rounds of costly physical prototyping.
- Takes longer, costs more for design validation.
- May or may not validate design performance.
- May or may not mitigate design for manufacturability risk.
- May or may not reveal potential field failure or warranty issues.
- May or may not reveal innovative approaches.
- May or may not improve quality.
- Does not provide a design optimization option.
- Can require additional production process prototyping.
- Extends time to market.

REVOLUTIONIZING HYDRATION PRODUCT DEVELOPMENT AT CAMELBAK

Ever since founder Michael Eidson filled an IV bag with water, stuck it in a tube sock and strapped it on his back to compete in the Hotter'n Hell Hundred bike race in Texas in 1988, CamelBak Products, LLC has innovated unique ways to stay hydrated. Today, CamelBak is the leading hydration brand, expanding its initial offering of reservoir backpacks with product lines for the bottled, filtration and military markets.

Developing new products and innovative features demands the greater design power of 3D, according to Principal Engineer Jeff Davies. "Expanding product lines required 3D design tools, including organic surfacing, rapid prototyping, and FEA [finite element analysis] simulation capabilities," Davies explains.

"With SOLIDWORKS, we can roll out product innovations in a timely manner," Davies says. "SOLIDWORKS saves us time and money because we can iterate quickly on a design, helping us to shorten time-to-market, meet firm deadlines, and ensure product durability and performance."

Because CamelBak offers a lifetime "GOT YOUR BAK" guarantee on all products, the company strives to design products to last a lifetime. That doesn't mean CamelBak skimps on innovation. In addition to conducting extensive testing of its design concepts, CamelBak relies on SOLIDWORKS Simulation Professional FEA capabilities to push the envelope of what's possible, such as the patented auto-seal trigger on the Forge insulated travel mug.

"The Forge travel mug presented an interesting design challenge because we were introducing an industry innovation while attempting to shorten time-to-market," Davies notes. "With SOLIDWORKS Simulation Professional, I was able to quickly study stress concentrations and deflection of the leaf spring which operates the trigger mechanism. This enabled me to whittle 30 different designs to three or four for prototyping, and then reduce the number of prototyping cycles required to identify the optimal design."

By choosing SOLIDWORKS design and simulation solutions, CamelBak grew its product offering to include bottled, filtered and military hydration products; innovated the first BPA-free plastic water bottle; supported its lifetime "GOT YOUR BAK" product guarantee; and created prototypes 10 to 20 times faster.

READ THE WHOLE STORY

To read the full CamelBak story, click here.

CAMELBAK®

INTEGRATED SIMULATION AND CLOUD COMPUTING TECHNOLOGIES "MUST-HAVES" FOR CONSUMER GOODS MANUFACTURERS

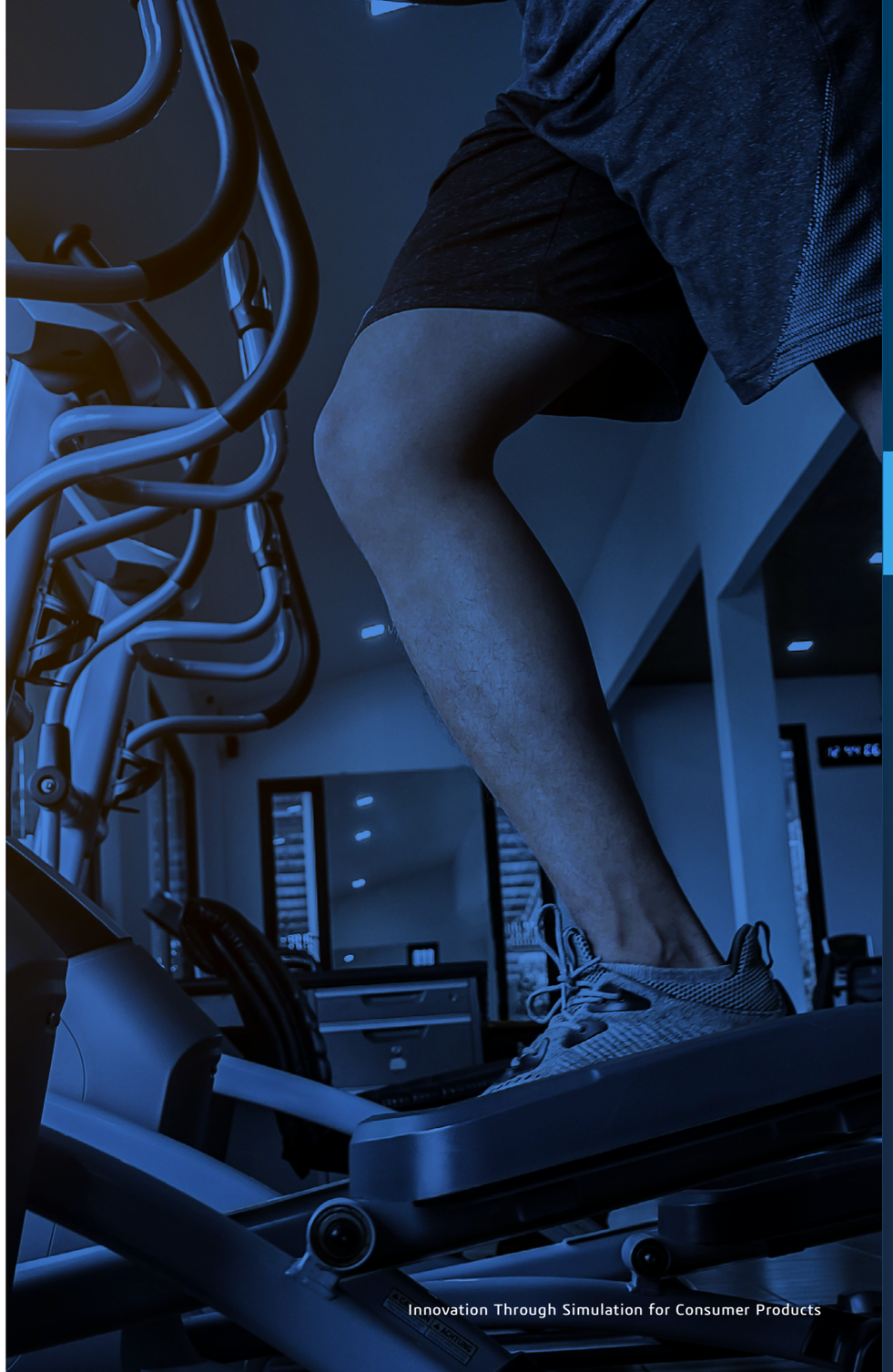
Facing mounting pressures to develop more specialized, more innovative and higher-quality products more quickly and cost-effectively than ever, Consumer product manufacturers are steadily turning to integrated simulation tools—like SOLIDWORKS Simulation and cloud-based **3D**EXPERIENCE SIMULATION solutions—to gain and maintain a competitive edge. Simply put, product developers need more information about design behavior and performance—information that's readily available with integrated simulation tools—early in the development process in order to deliver better, more innovative and more complex products more quickly and affordably. Because manufacturers need to develop more specialized products in less time, integrated simulation and cloud-computing technologies are becoming "must-haves" for efficiently and accurately understanding design behavior and validating design performance while avoiding the time delays associated with numerous rounds of physical prototyping.

Increases Flexibility and Easily Provides Access to Innovation

Cloud computing is becoming increasingly valuable for developing products for these markets. Many companies in these industries are small and have limited IT infrastructure and computing resources, but can now access the cloud to support simulation computing without needing to invest in costly hardware. With cloud-computing simulation capabilities, consumer products manufacturers can avoid the time and cost of repetitive physical prototyping by accessing the cloud to do most of the testing virtually, saving time and money and only needing to do a final physical test.

Improves and Accelerates Collaboration

In addition to avoiding the expense of computing hardware, cloud-based simulation tools can improve collaboration and produce the insights that lead to innovative products. For example, cloud-based **3D**EXPERIENCE SIMULATION Review delivers detailed information to engineers and design teams, enabling them to make value-based trade-off decisions between product design alternatives. Simulation Review will help all stakeholders involved in the design process leverage their organization's library of deployed simulation processes, ultimately making more informed decisions to design better products.



Saves Time

While simulation tools cannot replace a final physical test to validate a product, they can dramatically reduce the number of prototypes and rounds of physical prototyping required, often bringing the number of physical tests required down to one and saving substantial amounts of time. As products become more innovative, specialized and complex, the need to understand design behavior and performance becomes more challenging. Because developing more complex products has historically required more design iterations and rounds of physical prototyping to fully understand design behavior and validate product performance and safety, product developers can use simulation tools and virtual prototyping—as well as cloud-based simulation reviews—to complete many design iterations in less time. Instead of spending time and money to build and test a physical prototype after every iteration, they can simply run a virtual simulation, share the results over the cloud with key contributors and synthesize the results and inputs into the next iteration. With the substantial time savings associated with simulation-driven product development—from initial design through production—Consumer product manufacturers can accelerate any related government/regulatory approvals and speed product time to market. Using simulation instead of prototyping to validate tooling saves additional time.

Saves Money

Physical prototyping is costly, and the more rounds of prototyping that are required to develop a product, the greater the cost. By replacing many possible rounds of physical prototyping, integrated simulation capabilities can help manufacturers of Consumer products save money. Moreover, these cost reductions go beyond the obvious savings of reduced physical prototyping. When design performance is simulated repeatedly, designers and engineers gain a better understanding of design behavior than is possible solely through physical prototyping, resulting in fewer engineering change orders (ECOs) and reduced costs related to returns, warranty claims and field failures. With injection-molding simulation capabilities, manufacturers can also eliminate the cost of prototype tooling. Integrated simulation supports both rapid and cost-effective product development, resulting in faster times to market.

Improves Quality, Increases Innovation

For consumer goods to be successful in today's rapidly segmenting market, not only must they be innovative, specialized and provide more features or better performance than existing approaches, they must also be reliable, require less maintenance and last longer before needing to be replaced. In today's consumer market, the quality, performance and life span of a product are as important as the specialized functions that they provide

With simulation capabilities, brands and manufacturers can deliver both consistent quality and increased innovation. A consistent level of product quality is the outcome of the numerous design performance simulations and refinements made during design iterations with simulation tools. Because a product is repeatedly tested in software and then validated through a physical test, it will generally be of higher quality and include more improvements than those developed through the build-and-break-and-redesign paradigm. Innovation typically begins with an idea. However, refining that initial idea into a usable product or innovative feature is best achieved using integrated simulation tools. With the ability to perform design-and-simulation iterations quickly, designers and engineers can use analysis results to refine innovative designs or even discover completely new approaches.

EXPANDING PHYSICAL FITNESS EQUIPMENT PRODUCT LINE VIA SIMULATION

Although Brudden Equipment Ltd. is known throughout Latin America as the manufacturer of the Brudden® brand of agricultural machinery, the company also produces recreational kayaks, as well as the market-leading Movement® brand of physical fitness equipment.

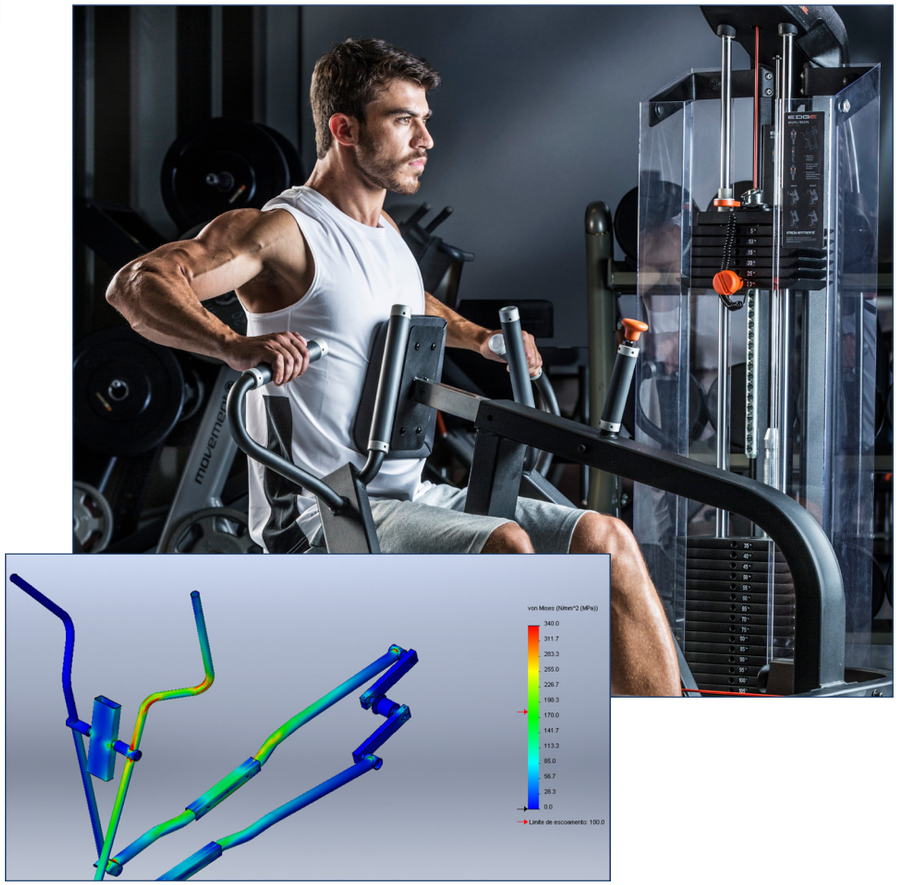
"The company leveraged its expertise in agricultural products and its relationship with the Biomechanics Laboratory at the University of Sao Paulo to become the first Brazilian company to enter the fitness market," recalls Engineering Manager Victor E. F. Xavier. "Since then, we have achieved the largest market share in the Latin and South American fitness equipment market."

Brudden moved to SOLIDWORKS design and simulation tools because the company "... wanted to streamline and accelerate development—with faster solutions for handling sheet metal, complex geometries requiring surfacing, and integrated design analysis—to support our product line expansion and need for greater throughput," Xavier explains.

Since implementing SOLIDWORKS solutions, Brudden has achieved its product development goals, reducing time-to-market from 24 to 19 months to 18 to 13 months (a 25 to 30 percent reduction), and quadrupling annual new-product output from five new products each year to 19.

In addition to helping Brudden compress design cycles and shorten time-to-market, SOLIDWORKS solutions enable the company to reduce prototyping requirements, and associated costs, while simultaneously improving product quality and performance with SOLIDWORKS Simulation tools. "Before we implemented SOLIDWORKS, most finite element analysis [FEA] was outsourced to a consultant, primarily for validation at the end of development." Xavier notes.

"Using SOLIDWORKS Simulation Premium and the analysis capabilities of SOLIDWORKS Premium, we now run analyses more frequently and as part of initial design. Instead of needing four or five physical prototypes during development, we now require only two or three," Xavier continues. "We not only have enjoyed a 40 percent reduction in prototyping costs as a result, we also have improved product quality, expanded our knowledge of design performance, and increased our confidence in our products."



By embracing a simulation-driven approach to product development, Brudden shortened product time-to-market for its Movement brand by 25 to 30 percent, cut prototyping costs by 40 percent and quadrupled annual new-product development throughput.

READ THE WHOLE STORY

To read the full Brudden Movement story, click here.

Brudden EQUIPAMENTOS

IS STRUCTURAL SIMULATION ENOUGH, OR DO WE NEED MORE?

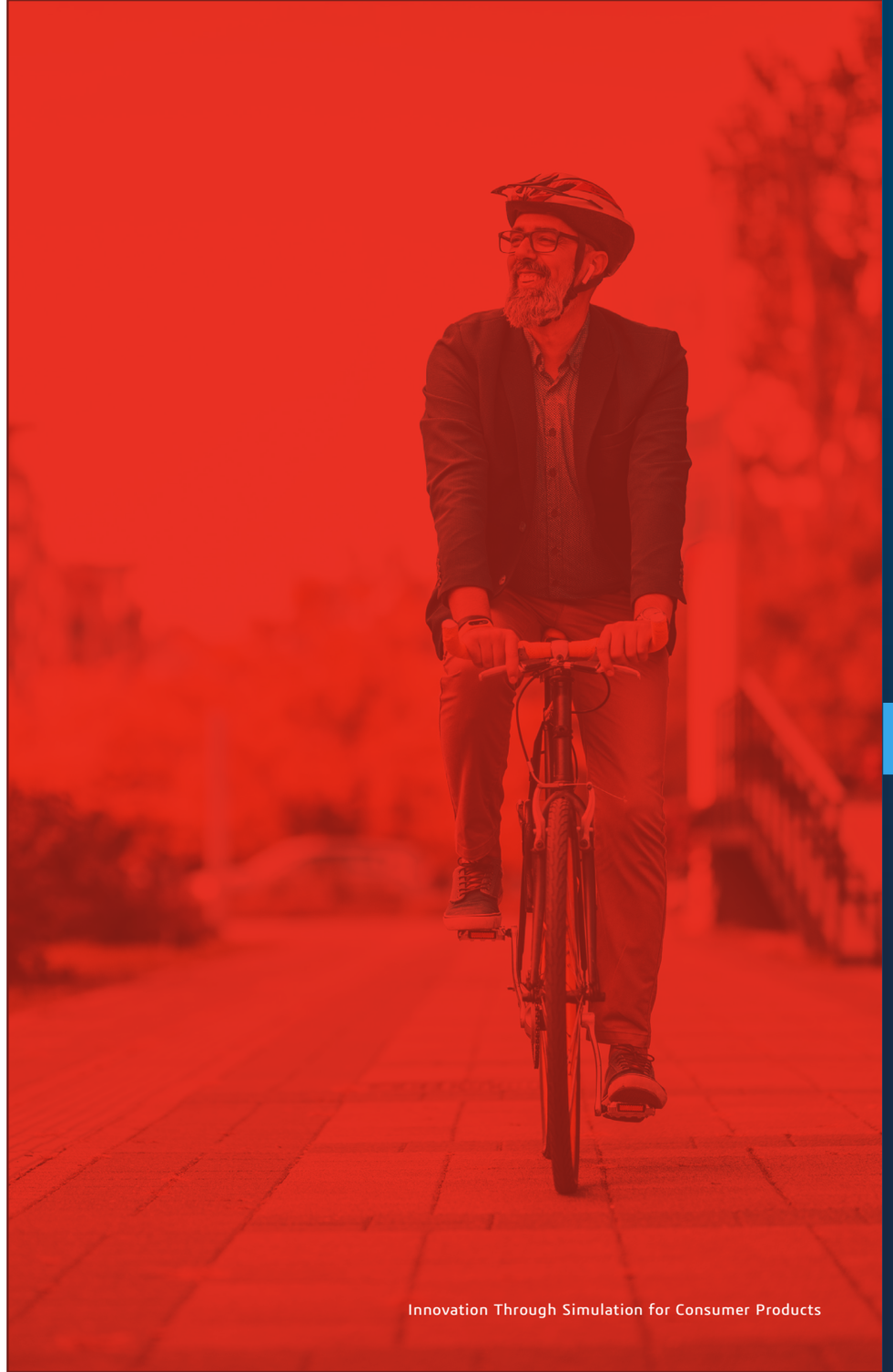
Most designers and engineers associate simulation and analysis with structural analysis, also called finite element analysis (FEA). Structural analysis tools are the most widely used type of simulation for understanding the stress, deflection/deformation, vibration, fatigue and buckling responses of a part or assembly design under load. These tools can help product developers answer important questions like: Will it break? Will it bend? Will it deform? Is it stiff enough? When will it wear out? Answers to these questions can help facilitate development, but there are many other types of integrated simulation tools that can help these manufacturers accelerate time-to-market while improving quality and boosting innovation.

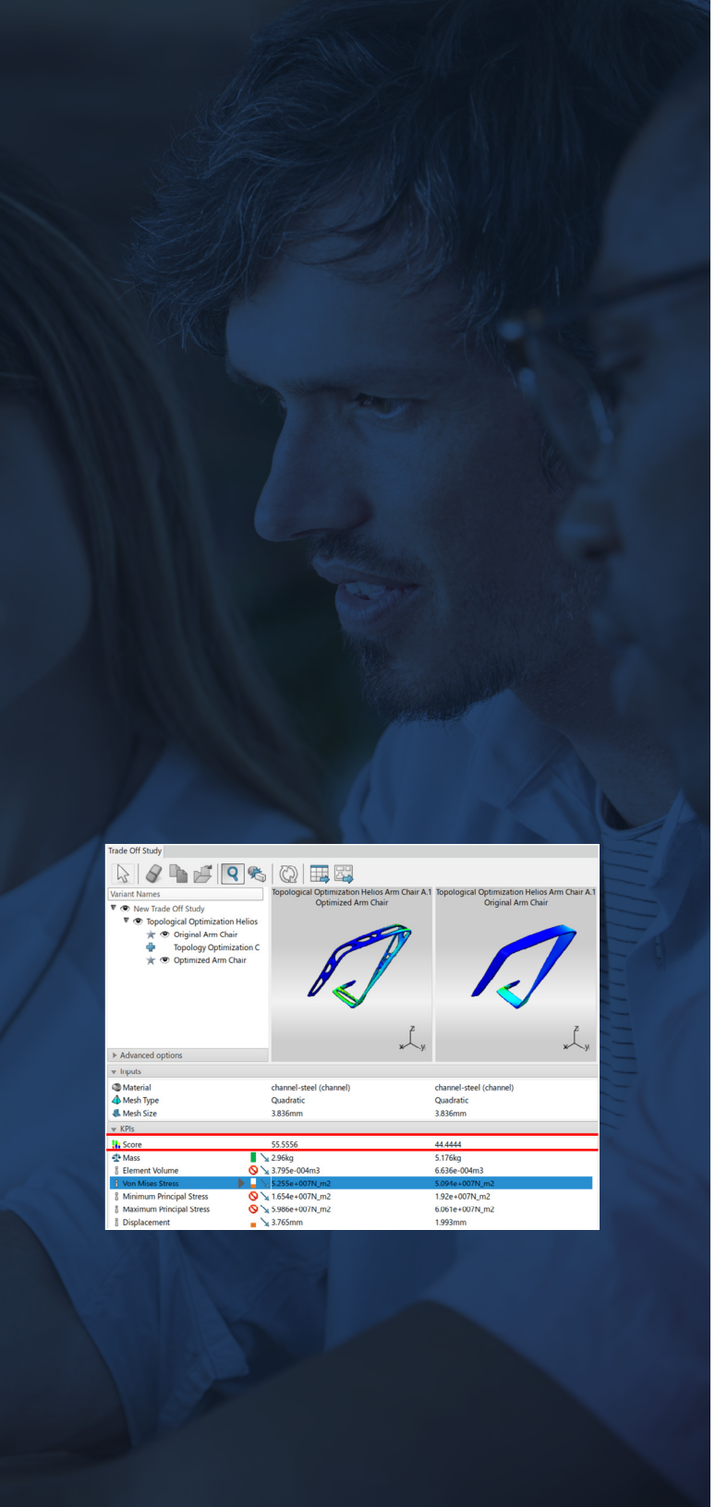
Structural Analysis

To identify areas of high stress that could result in component or assembly failure, product developers need at minimum the ability to conduct linear static stress analyses. By simulating a design's structural response to the loads and boundary conditions of its operating environment, designers and engineers can pinpoint areas of high stress and use simulation tools to rework the design to bring stresses within allowable levels, verify the appropriate factor of safety, or reduce weight/material usage, while maintaining performance.

In addition to linear static stress simulation capabilities, SOLIDWORKS Simulation and cloud-based **3D**EXPERIENCE SIMULATION solutions provide integrated simulation tools for understanding the natural frequencies of a component design. This is another valuable simulation capability for designers because such studies show whether a design will deflect, or be displaced, too much or too little. On some designs, controlled deflection is a design requirement so the part cannot be too stiff. On other designs, the goal may be to not have the component deflect much at all, making stiffness an important objective. In either case, the ability to quickly simulate deflection/displacement becomes a valuable tool.

SOLIDWORKS Simulation and cloud-based **3D**EXPERIENCE SIMULATION solutions also have solutions for predicting how long a particular product will last based on usage. Extending a product's lifespan—or ensuring that the product will continue to perform past its warranty period—requires an understanding of when a part or parts will wear out. With integrated SOLIDWORKS Simulation and cloud-based **3D**EXPERIENCE SIMULATION fatigue analysis tools, designers and engineers can project the number of cycles, or use over time, before a specific component will wear out and fail. With this valuable information in hand, they can make design modifications to either maintain or extend the life of a part.





Motion and Kinematics Analysis

Although not all mechanical assemblies move, many assemblies, such as mechanisms, move a great deal. Using SOLIDWORKS Simulation and cloud-based **3D**EXPERIENCE SIMULATION kinematics and motion simulation tools, designers can actually see how their assemblies will move, as well as generate important dynamic loading information for the design, which improves the accuracy of both assembly and individual component structural simulations. By simulating assembly movement, designers and engineers can gain a better appreciation for the dynamics of the entire assembly and quickly pinpoint areas that need improvement.

Nonlinear Analysis

Although linear analysis tools can help solve many types of structural problems, other types of simulations—especially with complex designs—require nonlinear analysis tools to obtain an accurate solution. Nonlinear structural analysis problems, which are distinguished from linear problems because the response is not proportional to the loads and boundary conditions, generally fall within three categories: nonlinear materials, nonlinear geometries and nonlinear interactions between parts or contact nonlinearities. Some nonlinear problems can even involve all three types, as well as nonlinear loads/boundary conditions and nonlinear dynamics/vibration. Other nonlinear problems involve highly nonlinear contact between parts or between the product and another object, such as drop tests. Nonlinear analysis tools are available in SOLIDWORKS Simulation Premium software and the cloud-based **3D**EXPERIENCE SIMULATION solution.

Topology Optimization

Another type of integrated structural simulation that is particularly useful in helping designers and engineers develop innovative products is topology optimization. A topology study explores design iterations of component geometry to satisfy a given optimization goal—such as minimizing mass, minimizing maximum displacement or balancing the weight-to-stiffness ratio—based on specific l oads a nd g eometric c onstraints, i ncluding t hose i mposed b y t he manufacturing process used. Topology optimization is a valuable tool for generating innovative and organic design concepts, establishing starting points for the design team or generating ideas for refining an existing design.

Thermal Analysis

In addition to simulating the impact of structural loads on a design, engineers need thermal simulation capabilities to understand how temperature and heat transfer effects influence structural performance. Such analyses provide the insights necessary for determining whether a heat sink or cooling system is indicated. Then, analysts can use the same thermal analysis tools to validate that the heat sink or cooling system transfers away enough heat to ensure optimal performance.

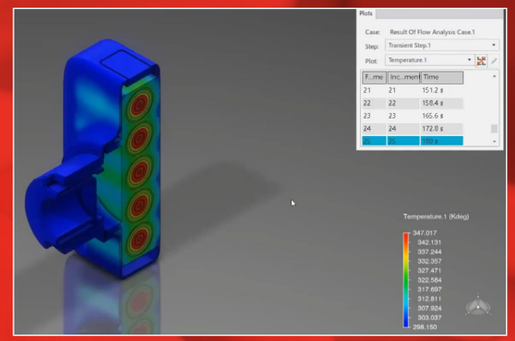
Understanding how heat transfer impacts design performance is important for an increasing number of products for safety and performance reasons. Many materials have temperature-dependent properties, and integrated SOLIDWORKS Simulation and cloud-based **3D**EXPERIENCE SIMULATION analysis tools can simulate different types of heat transfer—including conduction, convection or radiation—and calculate heat transfer within and between components in a design and its environment. These tools can simulate transient and steady-state effects. Thermal problems can be solved using either structural or fluid flow analysis. In a thermal structural analysis, the effect of moving air or liquid becomes a load or boundary condition. In a fluid flow analysis, the software calculates the thermal effects of moving fluids, whether they be a liquid or a gas.

Multi-Physics Analysis

While a large portion of simulation problems examine a particular type of physical phenomena—such as structural mechanics, structural dynamics, fluid dynamics and thermal analyses—there are many situations that require a combined multi-physics approach. Examples of multi-physics simulations include thermal stress or thermo-mechanical (thermal/structural), fluid structural interaction (flow/structural), fluid flow with heat transfer (flow/thermal) and fluid structural interaction with heat transfer (flow/thermal/structural).The combination of SOLIDWORKS Simulation, SOLIDWORKS Flow Simulation and cloud-based **3D**EXPERIENCE SIMULATION solutions provides a powerful, integrated suite of tools for analyzing many possible combinations of physical phenomena, enabling designers and engineers to gain a definitive understanding of how various physical phenomena affect the way a design will function and perform.

Fluid Flow Analysis

Product developers in the Consumer product market can use fluid flow analysis, also known as computational fluid dynamics (CFD) analysis, to better understand how the behavior and dynamics of fluids—either liquids or gases—affect design performance. Although initially used primarily as an alternative to expensive wind-tunnel testing for improving the aerodynamics of aircraft and automobiles, SOLIDWORKS Flow Simulation and cloud-based **3D**EXPERIENCE SIMULATION Fluid Dynamics Engineer CFD analysis technology are now increasingly used to evaluate other flow-related issues, such as validating sufficient cooling of electronics; maximizing the performance of heating, ventilation, and air-conditioning (HVAC) systems; optimizing the flow of molten plastics within molds; and refining other flow-based manufacturing and piping processes.



Electronics Cooling Analysis

With the SOLIDWORKS Flow Simulation Electronics Cooling Module, designers and engineers are able to more easily optimize airflow and cooling in electronic designs. This powerful tool enables product developers to improve airflow and cooling by moving components and/or creating air baffles and ducts; validate overall thermal performance by studying heat-up/cool-down cycles and maximum temperature under load; and pick the best heat sink by assessing the impact of airflow cooling over the printed circuit board (PCB). Understanding and isolating the thermal characteristics of the PCB allows for evaluation of component placement and the use of heat pipes, thermal pads and interface materials, as well as selection and placement of the ideal fan arrangement, which can have a dramatic impact on the overall thermal performance of a design.

Electromagnetic Analysis

Using cloud-based **3D**EXPERIENCE SIMULATION Electromagnetics Engineer computational electromagnetic analysis capabilities, Consumer product developers can simulate product scenarios involving steady-state electrical conduction, piezoelectric phenomena and low-frequency eddy currents. Simulating steady-state electrical conduction is important for understanding whether an electric field creates an electric current and the characteristics of that current depending on the transmission material used. Understanding the effects of piezoelectricity is critical for products utilizing sensors, electric motors or igniters (e.g., gas grills). Simulating low-frequency eddy currents is valuable for instances when eddy currents are utilized to achieve electromagnetic damping.

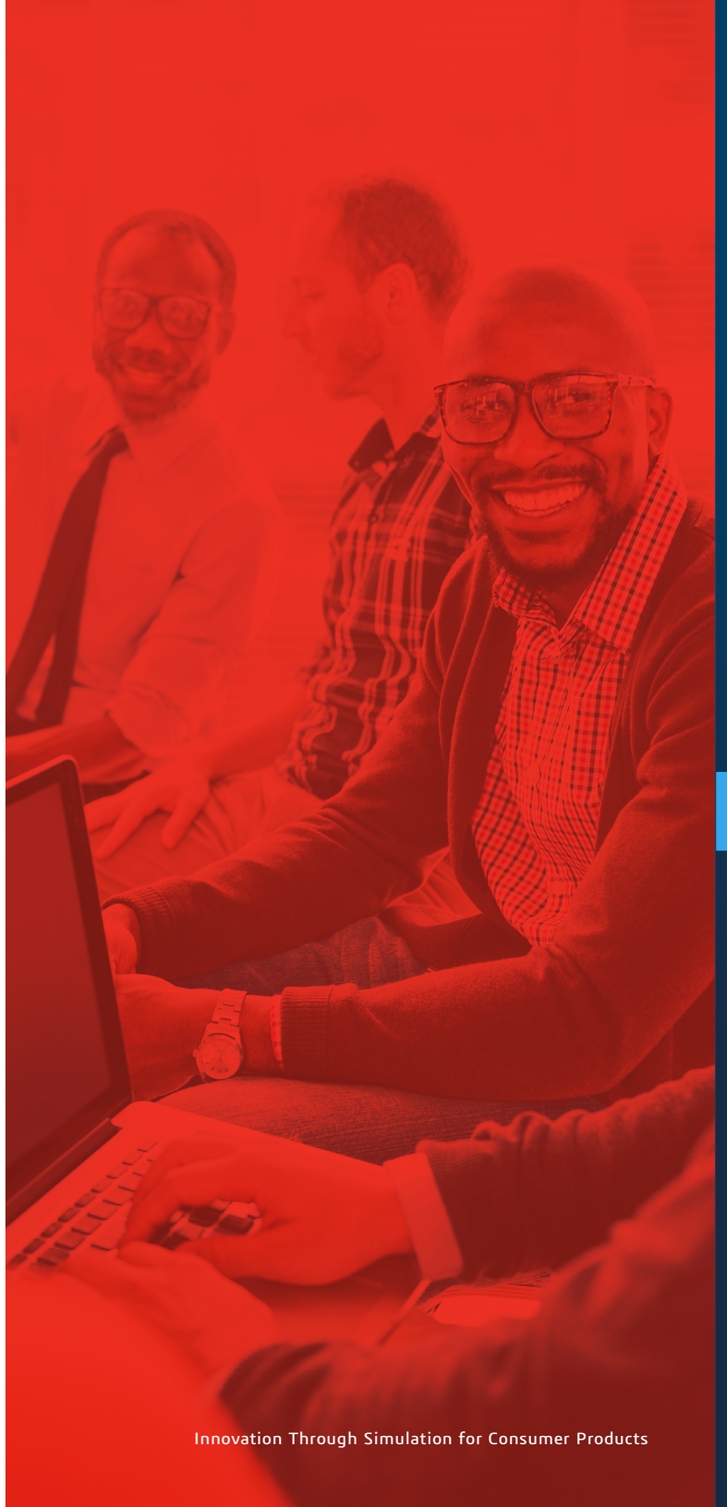
Plastics Injection-Molding Analysis

SOLIDWORKS Plastics and cloud-based **3D**EXPERIENCE SIMULATION Plastic Injection Engineer injection-molding analysis software allows product developers to simulate the injection-molding production process for plastic parts to optimize tooling development. This solution enables product designers and engineers to evaluate the manufacturability of injection-molded parts during the early stages of design. By simulating the mold-injection process, product developers will understand how the mold will fill, whether there are any air traps or voids, and where parting/weld lines will be. With these tools, product developers can consistently deliver designs that don't require manufacturing modifications, reducing the need to prototype tooling.

Cloud Computing: Running and Reviewing Simulations in the Cloud

With integrated SOLIDWORKS Simulation and cloud-based **3D**EXPERIENCE SIMULATION analysis tools, Consumer product developers can take advantage of the ability to tap additional computing resources and collaboration tools in the cloud, freeing up local computing capabilities to continue working while analyses run. Leveraging capabilities in the cloud provides access to simulation power only when it's needed, and the platform's collaborative tools allow review and input from key contributors worldwide. Instead of having a simulation solution sit on the shelf or on a machine until the problem arises for which it was purchased, engineers can more affordably tap cloud-based simulation capabilities only when they are needed, improving simulation capabilities and conserving local computing resources while reducing costs at the same time.

3DEXPERIENCE SIMULATION Simulation Collaborator facilitates collaborative decision making across an organization through 3DDashboard access to review, compare and make trade-offs between design alternatives. Engineers can share simulation data with stakeholders enabling them to visualize and compare different design choices on their 3DDashboard. Though shared communities, everyone on the project is kept up to date during the design process. As new information becomes available, decision makers can evaluate alternatives and perform trade-offs between competing objectives and constraints. Selection of the best design is accelerated by comparing multi-disciplinary performance metrics across several alternatives and ranking designs based on requirements. Cross-functional teams can work concurrently to provide their perspective on divergent goals and understand the implications and consequences of trade-offs, thereby reacting to changes to gain alignment and agreement through real-time informed discussions.



INNOVATING ELLIPTICAL BIKES THROUGH SIMULATION-DRIVEN PRODUCT DEVELOPMENT

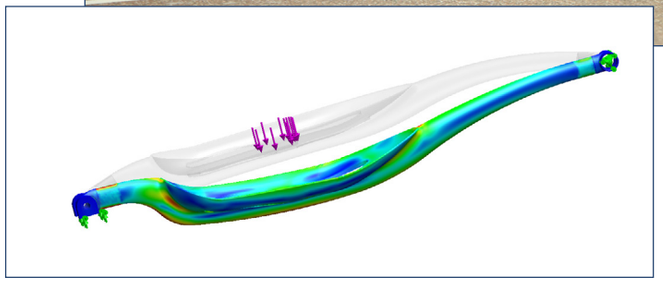
What began as an effort to help former Ironman triathlete Bryan Pate find an outdoor, low-impact workout following knee and hip injuries has led to ElliptiGO Inc., a rapidly growing manufacturer of the world's first elliptical bicycles.

Pate's preference for the elliptical trainer, which emulates the running motion without the constant impact of hitting the ground, combined with his frustration over being restricted to a gym, prompted him to seek out an elliptical trainer on wheels that he could use outside. When he couldn't find one, he contacted Brent Teal—also an Ironman triathlete, as well as a mechanical engineer—to discuss his idea for an elliptical bike.

In July 2005, the pair sat down at a coffee shop in Solana Beach, California; sketched out a concept drawing for an elliptical bike on a newspaper; and started working on making this concept a reality. Nearly 16 years later, the company has secured 23 issued U.S. and international patents, has delivered more than 30,000 elliptical bikes worldwide and counts many professional athletes as customers.

To develop this innovative product, Teal says that he needed access to advanced 3D design and simulation technology. "There was so much trial and error involved in engineering an elliptical bike that we needed a powerful design and simulation environment for iterating and gaining insight into our design, then efficiently and cost-effectively expanding our product line," Teal explains.

ElliptiGO extensively leveraged integrated SOLIDWORKS dynamic motion and finite element analysis (FEA) tools to extend its product offering while improving performance and keeping manufacturing costs down. "With SOLIDWORKS Premium software, we run linear static stress and fatigue studies to identify stress concentrations, which helps us shave weight and material, and reduce manufacturing and testing costs," Teal says. "We also utilize a lot of multi-body parts. The robustness of the FEA in SOLIDWORKS Premium is leaps and bounds ahead of other packages that I've seen because we can analyze these parts as assemblies. These tools save a lot of time—during both iterations on the design and testing."



Through SOLIDWORKS simulation-driven design, ElliptiGO shortened time-to-market, improved product performance and quality, reduced manufacturing costs and expanded the line of its revolutionary, first-of-its-kind product.

READ THE WHOLE STORY

To read the full ElliptiGO story, click here.

CREATE INNOVATIVE PRODUCTS MORE QUICKLY AND COST-EFFECTIVELY WITH SOLIDWORKS SIMULATION AND 3DEXPERIENCE SIMULATION SOLUTIONS

Manufacturers of Consumer products can more quickly respond to changing market demands by using fully integrated simulation tools—like those that operate inside the SOLIDWORKS product development system or on the cloud through **3D**EXPERIENCE SIMULATION solutions. With these design and integrated simulation capabilities, Consumer product manufacturers can realize the agility and flexibility required to develop more innovative, high-quality products more quickly and affordably than the competition. To find out more about each solution, click on the hyperlinks at the right.

Structural Analysis

SOLIDWORKS Structural Analysis on the Desktop

- Linear Static Analysis
- Assembly Analysis
- Motion/Kinematics Analysis
- Fatigue Studies
- Thermal Analysis
- Frequency Studies
- Buckling Studies
- Pressure Vessel Studies
- Topology Studies
- Linear Dynamic Studies
- Nonlinear Analysis

3DEXPERIENCE **SIMULATION Structural Analysis on the Cloud**

- Linear Static Analysis
- Assembly Analysis
- Motion/Kinematics Analysis
- Fatigue Studies
- Thermal Analysis
- Frequency Studies
- Buckling Studies
- Pressure Vessel Studies
- Topology Studies
- Linear Dynamic Studies
- Nonlinear Analysis

Thermal Analysis

SOLIDWORKS Thermal Analysis on the Desktop

3DEXPERIENCE **SIMULATION Thermal Analysis on the Cloud**

Fluid Flow Analysis

SOLIDWORKS Flow Simulation on the Desktop

3DEXPERIENCE **SIMULATION Fluid Flow Analysis on the Cloud**

Electromagnetics Analysis

3DEXPERIENCE **SIMULATION Electromagnetics Analysis on the Cloud**

Plastics Injection-Molding Analysis

SOLIDWORKS Plastics Injection-Molding Analysis on the Desktop

3DEXPERIENCE **SIMULATION Plastics Injection-Molding Analysis on the Cloud**

DEVELOPING A BETTER LAWN TRACTOR USING SIMULATION-DRIVEN PRODUCT DEVELOPMENT

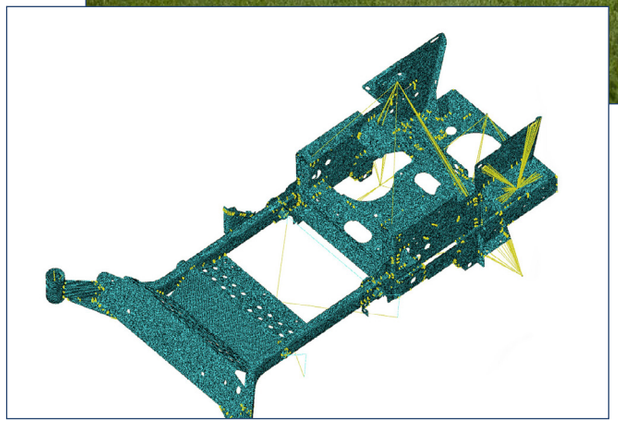
A major American manufacturer of industrial and personal lawn-care equipment, Ariens Company owns the century-old Gravely® brand that produces a state-of-the-art zero-turn commercial lawn mower.

With the latest upgrade in the Gravely zero-turn due, Ariens engineers were tasked with a list of important challenges. "We needed to make the mower stronger, less expensive to manufacture, and more fuel efficient," says Mathew Weglarz, lead engineer and structural analyst at the Ariens Company. "Our goal was to design a structure as simply as possible, while maintaining the mower's ability to perform the task at hand."

Weglarz, a long-time user of SIMULIA's Abaqus software, proposed the idea to incorporate the SIMULIA portfolio into Ariens' design process. With the help of Weglarz and Ariens' structural analyst and engineer, Aleysha Kobiske, the engineering team at Ariens used a number of SIMULIA tools to drive innovation in the design of their newest Gravely mower.

The team began by examining the current model and finding areas that could be improved upon—such as geometry, material thickness or maintenance access. All parts of the mower were simulated—everything from the main chassis, frame tubes, and cross and under-bracing brackets, to engine support mounts and seat platforms. The frame, which comprised 22 different pieces of steel that were welded together, was where a majority of the design changes were made. "A strong structural design is key for noise and vibration control, durability, and overall manufacturing costs," Weglarz says.

With SIMULIA simulation tools, the design team was able to locate and accurately model strain gauges in all areas of the lawn mower, enabling weld elimination, part-count reduction, fatigue life improvement and other design enhancements. "Now, one piece of steel could perform multiple tasks without the need for three or four brackets to be welded to it," Weglarz says. "These design changes increased the overall strength of the frame structure considerably."



At the end of the redesign process, the new frame had 50 percent fewer parts (11 total) and cost less to manufacture than its predecessor. Testing time and costs were also reduced. When the new mower went through final field tests, Ariens engineers' confidence in their simulations was supported by the product's improved performance.

READ THE WHOLE STORY

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ARIENS

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