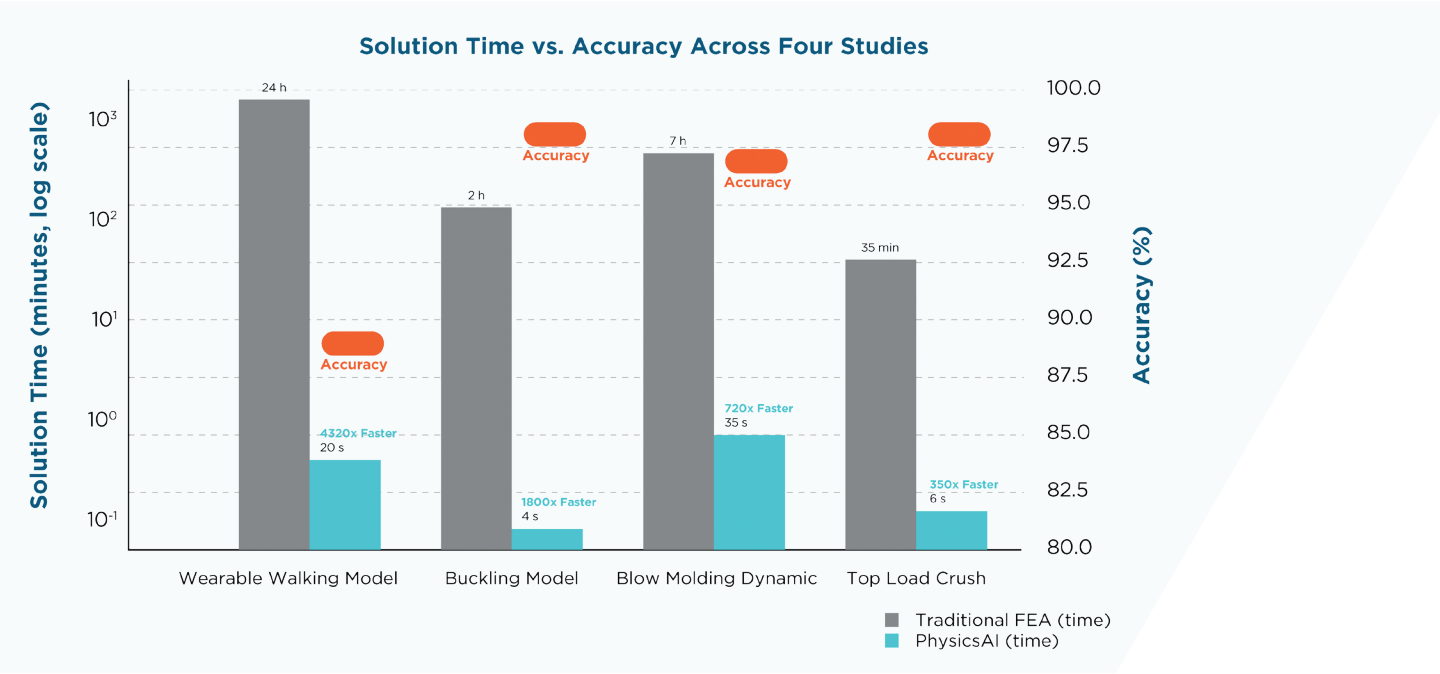
CASE STUDY



AI-BASED LIGHTWEIGHTING SAVES MILLIONS OF DOLLARS

ALTAIR® PHYSICSAI™ DRIVES SPEED, SAVINGS, AND SUSTAINABILITY FOR CONSUMER-PACKAGED GOODS

About the Customer

Since 1988, **Kinetic Vision,** a U.S.-based design and development consulting firm, has partnered with Fortune 500 companies to create transformative products, processes, and digital-first solutions. These partnerships span multiple vertical markets, including consumer packaged goods (CPG), medical technology, automotive, aerospace, supply chain, and more. The Kinetic Vision team includes industry experts on the use of digital twins for the development and optimization of products, systems, processes, and operations. These multidisciplinary experts combine the latest digital tools, like AI, with extensive prototyping, testing, and metrology capabilities.

Their Challenge

Kinetic Vision's CPG customers face constant pressure to reduce packaging costs and improve sustainability metrics without compromising on performance. According to the United Nations University: Institute for Water, Environment and Health, the world produced 600 billion plastic bottles in 2021. Environmentally speaking, this makes bottles an obvious target for material minimization. Savings of 20% to 30% are typical for lightweighting efforts. This would be the equivalent of taking billions of plastic bottles out of landfills annually. However, traditional finite element analysis (FEA) studies are time and resource-intensive, often requiring weeks or months to arrive at optimum designs. This limits the ability of packaging engineers to explore alternative geometries at-scale, leaving billions of dollars (according to Future Market Insights' Blow Molded Plastic Market 2024 report) in potential material savings untapped.

> Lightweighting isn't just about cutting costs — it's about multiplying impact. Every gram removed saves resin, reduces waste, and scales to millions of units on store shelves. PhysicsAI makes it possible to deliver these results faster than ever before.
>
> Shane Mooney, director of development, Kinetic Vision

Try Altair® PhysicsAI™ Today: **Download Now**

Our Solution

Kinetic Vision adopted Altair® PhysicsAI™, a breakthrough AI-driven simulation approach that combines the power of deep learning and historical CAE data to deliver fast physics predictions. By training PhysicsAI with historical simulation data, Kinetic Vision was able to replace lengthy FEA runs with near-instant predictions — cutting solution times from hours, or days, to seconds.

To validate solution accuracy, Kinetic Vision compared PhysicsAI results to conventional simulation methods for four nonlinear scenarios. Data concerning the simulation model scenarios and the training of their corresponding PhysicsAI models are summarized below:

1. Modeling the fit of a fabric on a walking human
   - Simulation: A dynamic, explicit model run using LS-DYNA.
     - Computations: 24 hours to solve using 64 high-performance CPUs.
   - PhysicsAI model trained on 22 simulation results.
     - Training time: 2.5 hours using a traditional CPU.
2. Assessing the second and third phase buckling of a component
   - Simulation: A dynamic, explicit model run using Abaqus.
     - Computations: 2 hours to solve using 64 high-performance CPUs.
   - PhysicsAI model trained on 180 simulation results.
     - Training time: 48 hours using a traditional CPU.
3. Optimizing the blow-molding process to make a bottle
   - Simulation: A dynamic, explicit model run using Abaqus.
     - Computations: 7 hours to solve using 64 high-performance CPUs.
   - PhysicsAI model trained on 47 simulation results.
     - Training time: 9 hours using a traditional CPU.
4. Evaluating the stresses and deformations from crushing a bottle with a top load.
   - Simulation: A dynamic, explicit model run using Abaqus.
     - Computations: 35 minutes to solve using 64 high-performance CPUs.
   - PhysicsAI model trained on 45 simulation results.
     - Training time: 7 hours using a traditional CPU.

The resulting computational times and accuracy of the PhysicsAI models, compared to traditional simulations, is displayed in the chart at the top of the previous page. The graph shows orders-of-magnitude improvements for computational speeds. AI results also show high accuracy when compared to FEA results. With this knowledge, product lightweighting for Kinetic Vision's main CPG customers has reduced from weeks to days, enabling the customer brands to save millions of dollars annually, while dramatically reducing plastic waste.

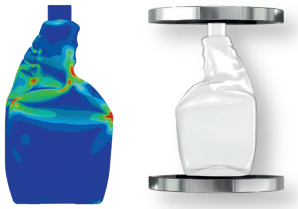
Results

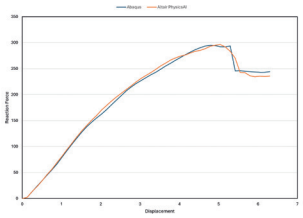
Kinetic Vision's product packaging lightweighting study revealed how:

- CPG organizations can save millions of dollars annually by minimizing material usage across multiple high-volume production lines.
- The equivalent of billions of bottles can be eliminated from landfills each year through lightweight, sustainable design.
- PhysicsAI models run on standard CPUs can run 350x to 4,000x faster than traditional FEA while maintaining accuracy in the range of 87.5% to 97.5%.
- AI produced results can match the engineering rigor of simulations while scaling innovation.

Plastic blow-molded products are everywhere, and most are conservatively designed from legacy prototype and test methodologies — even though validated simulation methods have existed for decades. The hundreds of simulations and associated weeks, or months, needed to optimize CPG designs are seen as unnecessary impediments to rapid market introduction and product sales.

PhysicsAI changes that. The result is that leading companies can save hundreds of millions of dollars annually, while removing the equivalent of billions of plastic bottles from landfills. For example, by unlocking rapid design iteration, PhysicsAI empowered Kinetic Vision and its CPG partners to deliver lighter, stronger, and more sustainable product packaging at unprecedented speed.





TOP: Kinetic Vision Innovation Center in Cincinnati, Ohio.
MIDDLE: Top-load simulations showing stress distribution (left) and crush test rendering (right) for a lightweighted bottle design.
BOTTOM: A corresponding PhysicsAI model produces results 350 times faster with only a 2% error

20-30%
MATERIAL SAVINGS

350x TO **4,000x**
SPEED IMPROVEMENT

RESULTS ACCURACY BETWEEN
87.5% AND **97.5%**

SIGNIFICANT COST AND ENVIRONMENTAL SAVINGS