

FROM BOTTLES TO BYTES: KRONES' DIGITAL TWIN REVOLUTION OF LIQUID HANDLING PROCESS SIMULATION



Learn how Krones, the global process manufacturing line provider for bottling, canning, and packaging, revolutionized its fluid simulations together with Ansys (part of Synopsys), CADFEM, Microsoft, NVIDIA, and SoftServe



Executive Summary

The implementation of digital twins in manufacturing has become a vital component of Industry 4.0. It enables real-time simulation, resource optimization, and predictive analysis to enhance efficiency and reduce operational risks.

To harness these benefits, Krones, the global process manufacturing line provider for bottling, canning, and packaging, developed in just two months a physically accurate digital twin application with AI to simulate beverage production processes.

Leveraging expertise and technologies from Ansys (part of Synopsys), CADFEM, Microsoft, NVIDIA, and SoftServe, Krones achieved accurate fluid dynamic simulations in under 30 minutes per cycle — driving resource and process optimization. That has accelerated its digitalization strategy and set a new standard for rapid technology adoption in manufacturing.

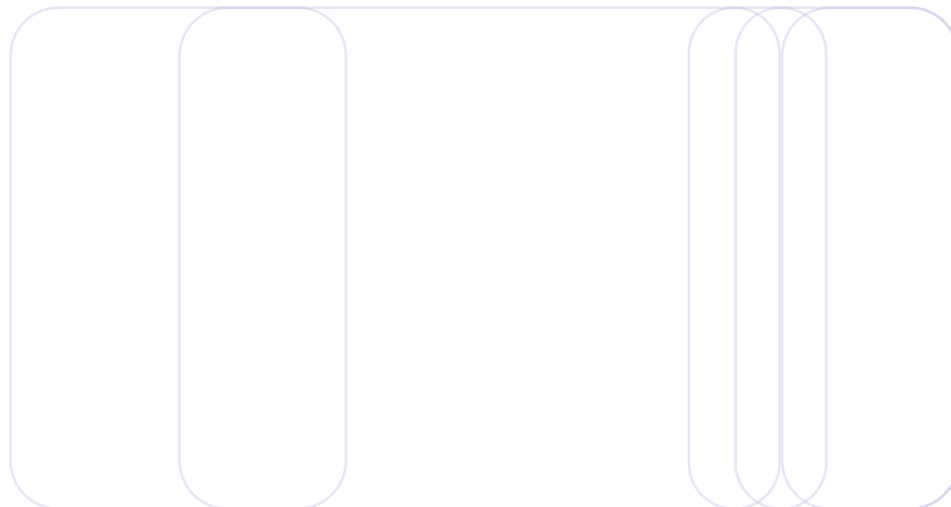


Project in Brief

Challenge: Krones' fluid simulations took 3-4 hours, hindering process optimization.

Solution: Partner ecosystem with Ansys (part of Synopsys), CADFEM, Microsoft, NVIDIA, and SoftServe collaborated to develop an AI-powered digital twin in two months.

Impact: Reduced simulation time to 30 minutes, enabled resource optimization, and boosted Industry 4.0 leadership.



Why Krones Needed Enhancements to Their Simulations

Krones, renowned for developing and providing complete production solutions for food and beverage manufacturers, encountered a limiting obstacle: time-consuming fluid simulation methods developed decades ago. Liquid dynamics in manufacturing are inherently fast-paced and unpredictable, requiring precise management at every stage. Velocity, machine and bottle design, and flow dynamics create significant challenges for controlling and simulating uncapped bottles, as every variable — including pressure, flow, and turbulence — must be meticulously controlled and predicted.

The inability to optimize these factors can lead to excessive waste, inefficiencies, and operational problems during subsequent phases, making advanced simulation technologies essential for maintaining efficiency and minimizing losses. But evaluating liquid dynamics in bottling and filling lines demanded two to four hours per simulation, restricting both innovation and the speed of operational upgrades.

Overcoming this pressure point became more urgent as market expectations shifted toward digital, data-driven manufacturing. Realizing the immediate need to transition from legacy workflows to comprehensive digital processes, Krones set clear priorities: cut simulation times, empower real-time decision making, and double down on the company's commitment to advanced industry practices.

The 2-Month Transformation: Digital Twins for Fluid Dynamics Simulation

With these priorities, Krones kicked off a multi-partner effort for a rapid engagement — focused not on abstract planning, but on tangible results. In just two months, Krones developed an application that enables modeling, visualization, and optimization of complex fluid behavior, encompassing both fluid dynamic simulation and filling machine simulation.

The result: **a digital twin equipped with AI**. The digital twin digitally maps the physical world down to the smallest detail. The use of AI and cloud computing enables insights for liquid processing optimization, so Krones' manufacturing customers can produce their products more efficiently, sustainably, and productively.

“Our solution integrates AI-based high-end fluid simulation into the digital twin of the filling machine, opening up completely new possibilities for forecasting, optimisation, and visualisation.”

— Thomas Albrecht, Head of Simulation at Krones

Crucially, this was much more than proof of concept. It equipped Krones to demonstrate — both internally and externally — how digital twins could drive operational excellence and progress. The immersive simulations, accessible through a single, intuitive interface, gave Krones a compelling technological edge to drive digital manufacturing innovation.

Results

The collaborative project succeeded through disciplined and synchronized teamwork, and each of the partners brought targeted expertise to the accelerated timeline:

Ansys (part of Synopsys): Delivers high-fidelity simulations of fluid behavior (Fluent), ensuring accurate and detailed digital representations and cloud HPC through Ansys Access on the Microsoft Azure platform.

CADFEM: Brings deep expertise in applying complex simulations.

Microsoft Azure: Powers the entire system with a scalable, secure, and always-connected cloud platform, supporting robust performance and reliability.

NVIDIA: Provides open libraries, visualization frameworks, and accelerated computing to enable real-time digital twins.

SoftServe: Designs system architecture and integrates data, logic, and AI as the “brain” of the digital twin.

Key elements of collaboration included frequent engineering workshops, joint development sessions, and a shared commitment to keeping the project tightly aligned with Krones’ business objectives. SoftServe served as the orchestrator, integrating all technology components and ensuring project delivery stayed on pace.

“

With our AI-enhanced digital twins, not only have we demonstrated that digitalization and AI are not just a vision. We are already delivering concrete efficiency gains and sustainable benefits today. Together with our partners, we are setting new standards in the beverage industry.

”

— Christoph Klenk, CEO of Krones AG

Moreover, Krones’ commitment to transparency and a close vendor partnership was instrumental. By actively guiding direction and rapidly incorporating feedback, Krones ensured the application met real operational needs — not just technical desires.



The Technology Engine: What Powered Krones' Digital Twin

The application was built on a future-ready foundation:

Microsoft Azure supplied a reliable, scalable cloud infrastructure, leveraging Azure Kubernetes Service (AKS) for rapid deployment and robust performance.

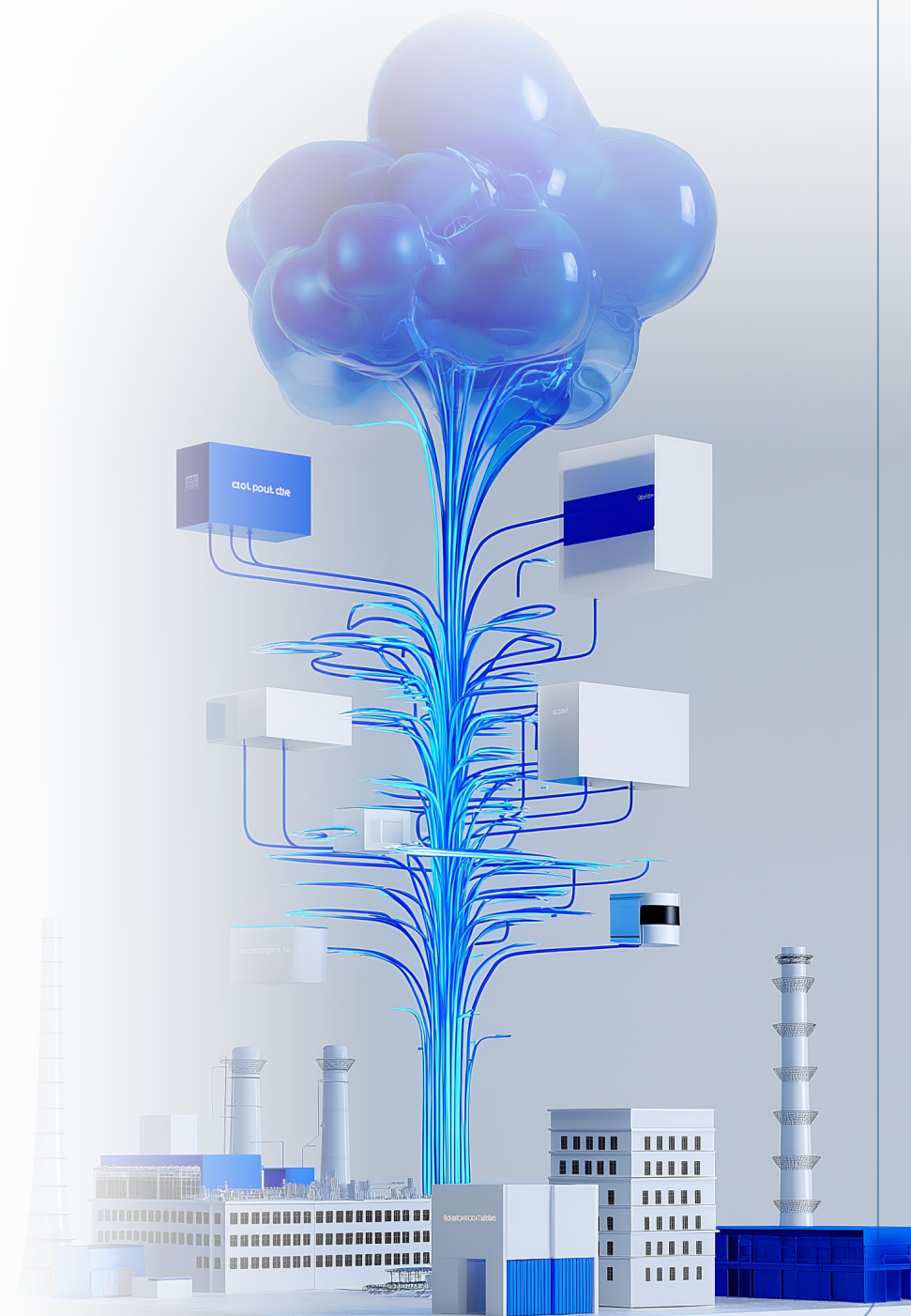
NVIDIA's accelerated computing, libraries, and frameworks including NVIDIA Isaac Sim™, Kit-CAE, and NVIDIA Omniverse™ Kit App Streaming enable real-time, physically accurate simulations, where behaviors can be both predicted and optimized virtually.

Ansys Fluent delivered world-class computational fluid dynamics, providing the backbone for credible, high-fidelity liquid simulations.

Ansys Access on Microsoft Azure provided on-demand HPC capacity in the cloud to accelerate simulations and streamline workflows.

Custom React.js web interface gives users full control and detailed insights — all in one location.

This stack provided exactly what Krones needed: reliability, speed, scalability, and a demonstration platform to drive a strategy in line with Industry 4.0.



What Krones Gained: Immediate Impact From Digital Twin Demonstration

Digital twins with AI digitally map the physical world down to the last drop and enhance decisions to optimize processes. Together with its partners, Krones is redefining how machines behave and can be simulated. The use of AI and cloud computing for liquid processing optimization allows Krones' customers to manufacture their products more efficiently, sustainably, and productively.



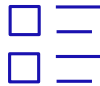
Drastic Reduction in Simulation Time

Simulation cycles shrank from 3-4 hours to just 30 minutes. This efficiency made iteration and improvement possible on completely new terms, enabling more responsive and data-driven engineering.



Intuitive and Accessible Demonstrations

Within the two-month timeframe, Krones had a finished, polished application. Animated videos actively showcase results for an enterprise audience beyond engineers and technicians.



Empowered Decision-Making

A unified dashboard provided by the web app centralized all simulation controls and data, streamlining workflows and enabling direct scenario comparisons — turning complex analysis into actionable intelligence.



Real, Measurable Cost and Resource Savings

The newfound control over fluid dynamics meant less water waste, reduced material costs, and a smarter, more sustainable production environment.



A Platform for Scalability

Krones now stands ready to expand digital twin technology across additional production assets, leveraging this project as a foundation for digital excellence throughout its operations.

These advantages are especially beneficial for Krones' beverage industry customers. The dynamics are highly complex, from filling speed and bottle design to flow behavior. By monitoring, predicting, and optimizing pressure, flow, and turbulence in real time, customers can avoid wasting resources or experiencing disruptions in later production steps.

Lessons Learned: Ecosystem Collaboration as a Catalyst for Krones' Progress

Krones' AI-enabled digital twin didn't just provide a showcase for digital twin functionality — it created a real, repeatable pathway for ongoing digital transformation. Physically accurate digital twins with AI enhancements are already enabling rapid optimization and faster innovation cycles. The result shows the value of moving fast, choosing the right collaborators, and focusing on demonstrable outcomes.

This project underscores a simple but critical insight — when manufacturers like Krones unite with the right technology and ecosystem partners, timelines shrink, risks fall, and business value accelerates. If your business is considering the next step in digitalization or is ready to unlock the potential of digital twins, SoftServe stands ready as your innovation partner in a robust innovation ecosystem.

Why SoftServe

SoftServe is a premier IT consulting and digital services provider. We expand the horizon of new technologies to solve today's complex business challenges and achieve meaningful outcomes for our clients. Clients confidently rely on SoftServe to architect and execute mature and innovative capabilities, such as digital engineering, data and analytics, cloud, and AI/ML.

Our global reputation is gained from more than 30 years of experience delivering superior digital solutions at exceptional speed by top-tier engineering talent to enterprise industries, including high tech, financial services, healthcare, life sciences, retail, energy, and manufacturing. Visit our [website](#), [blog](#), [LinkedIn](#), [Facebook](#), and [X \(Twitter\)](#) pages for more information, or follow this [link](#) to arrange a personal meeting with one of our experts.

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