Breaking barriers to digital twin adoption: CP-Sens paves the way for SMEs

Small and medium-sized enterprises (SMEs) often struggle with high costs and extensive time requirements for testing and maintaining large or complex structures. Digital twin technology allows companies to gather real-time data and create virtual models that predict and optimise performance, saving time and costs.

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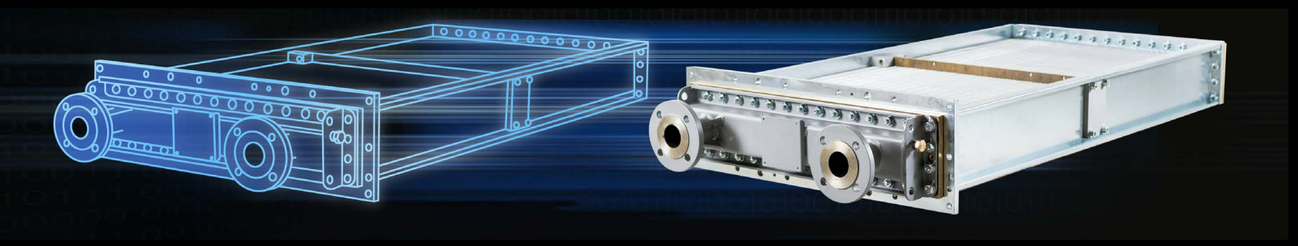


Despite their benefits, SMEs face significant barriers, such as high upfront costs and lack of technical expertise, making it difficult to leverage this technology.

CP-Sens is set to make this technology a practical reality for mechanical and structural engineering SMEs. This three-year long project, set to conclude in 2026 may only be in the initial stages, but it's already off to a flying start.

We spoke with the CP-Sens project team to learn more.

Digital twins explained

Digital twin technology creates virtual replicas of physical systems, enabling continuous monitoring and analysis through real-time sensor data.

Giuseppe Abbiati of Aarhus University illustrates the challenge: "Imagine a large structure like an engine cooler that needs to be tested. Traditionally, you'd have to ship it to various labs across Europe for different tests—vibration tests, thermal tests, etc. This process can take up to two years, is costly and involves significant downtime."

Claus Ibsen of Vestas Aircoil adds, "We cannot buy an engine ourselves and test our product in the lab because these engines are huge. The smallest one produces several megawatts. That's enough to power a small town."

"A digital twin integrates simulation models with data from physical assets, allowing us to predict future states and optimise performance," explains Giuseppe.

Projecting future performance is critical to enabling companies to shift from reactive to preventative maintenance. HBK's Research Engineer Dmitri explains: "Predictive maintenance is really important. It allows us to maintain systems more efficiently and avoid the high costs associated with unexpected failures."

The challenge: barriers to SME adoption

Despite the clear benefits, SMEs often encounter hurdles in implementing digital twins.

Perceived complexity

Many SMEs perceive digital twin technology as complex due to a lack of understanding and internal expertise. "The real challenge is understanding what digital twin technology can do and how to implement it. Without this understanding, the technology appears much more complex than it is," says Dmitri. Peter Furtner of Vienna Consulting Engineers adds, "Digital twins seem like a huge leap for companies used to traditional methods. But with the right support, the transition can be much smoother than they think."

High costs

The upfront costs for implementing digital twin technology can be prohibitive. "Immediate financial pressures make it challenging for these companies to prioritise long-term investments," notes Dmitri.

Market dynamics

"One of the main barriers to entry for SMEs is the high cost of digital twin solutions provided by large software companies," explains Giuseppe. "New companies with innovative digital twin solutions often get acquired by large corporations who then set high price points, making it difficult for SMEs to find affordable options."

The solution: CP-Sens makes digital twins a practical reality

"We aim to produce financially accessible and easy-to-integrate solutions," says Giuseppe.

CP-Sens uses a 'playground' approach, **creating an environment where companies can experiment with digital twin technology without costly mistakes.** "We encourage SMEs to explore and innovate, fostering a culture

of experimentation and learning," says Peter. CP-Sens is developing a one-stop shop for enterprises to test IT systems tailored to their needs without significant financial risk.

The project leverages the strengths of its partners to provide a comprehensive solution.

Aarhus University (AU)

Aarhus University brings extensive research expertise to the CP-Sens project. The university's team, led by experts in computer, civil and mechanical engineering, creates advanced simulation models and integrates them with real-time data from physical assets. Their research drives the development of user-friendly digital twin solutions, ensuring that the technology is practical and effective for real-world applications.

FORCE Technology

FORCE Technology validates the digital twin solutions, ensuring they meet industry needs and disseminating the project's findings through documentation, workshops and training. They engage with industry partners to align solutions with market demands and provide ongoing support to SMEs during implementation, facilitating a smooth transition and maximising the technology's benefits.

HBK (Hottinger Brüel & Kjær)

HBK provides cutting-edge sensors and expertise in data collection and analysis. Their sensors are crucial for gathering real-time data from physical assets, which are then used to create accurate digital twin models. HBK's expertise ensures the reliability and precision of the data, and its role is essential in bridging the gap between physical systems and their virtual counterparts.

Vestas Aircoil and Vienna Consulting Engineers

Vestas Aircoil and Vienna Consulting Engineers (VCE) are the project's industrial partners representing the needs of SMEs. They bring their real-world problems, challenges, and expertise to the table to enable the project partners to work collaboratively to ensure the digital twin technology can be practically applied to overcome real-world scenarios.

> "The most exciting part is understanding how to harness this technology to create value in society. We are constantly learning from our partners about their specific problems and how to solve them."
>
> **Giuseppe Abbiati, Aarhus University**

Advisory Board

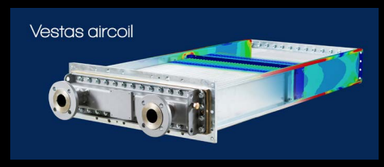
The project's Advisory Board provides crucial industry insights and feedback, helping to align the project's solutions with market needs. Comprising representatives from various sectors, the board ensures that the developed digital twin technologies are practical, relevant and beneficial for SMEs. Their guidance and expertise help ensure that the technology is accessible and effective for various applications.

Real-world application

Vestas Aircoil and VCE are each leveraging the technology to address specific challenges.

Vestas Aircoil

Vestas Aircoil manufactures heat exchangers and charge air coolers for marine, power plant, generator, compressor, gas, wind energy and offshore applications. Digital twins offer a transformative solution. "We've installed a cooler with multiple sensors to monitor real-world usage," says Claus. "By using digital twins, we can simulate scenarios and optimise designs virtually, reducing the need for physical prototypes and accelerating development."



Before adopting digital twin technology, Vestas Aircoil faced significant challenges in testing and development. "To produce a new cooler, we need to conduct several tests on customer prototype engines. The less physical testing required, the better it is for both parties," explains Claus. Considering the size of the structures they produce, one can immediately see the drawbacks involved in traditional testing methods. "With digital twins, we can now perform these tests virtually, saving time and money."

Digital twins are expected to enable Vestas Aircoil to improve their product's performance and reliability. "Real-time data from sensors allows us to make informed decisions and optimise our designs continuously," adds Claus. "This has led to faster innovation cycles and better-quality products."

Vienna Consulting Engineers (VCE)

VCE is a leading consulting engineering office based in Vienna, Austria. VCE applies digital twin technology to manage large infrastructure projects such as offshore wind farms. "Digital twins help us assess the current condition of structures and predict their remaining lifetimes," explains Peter. "We can provide real-time operational insights, optimising wind turbine performance and extending operational life."

Before implementing digital twins, VCE struggled with monitoring and maintaining large infrastructure projects.

> "This project is like building a rocket together and hoping to see it fly. The possibility of seeing this technology in action and making a real difference excites me the most."
>
> **Dmitri Tchernik, HBK**

"Assessing the condition of offshore wind turbines was challenging due to their size and remote locations," says Peter. "Digital twins allow us to monitor these structures in real-time, providing accurate data for maintenance and operation."

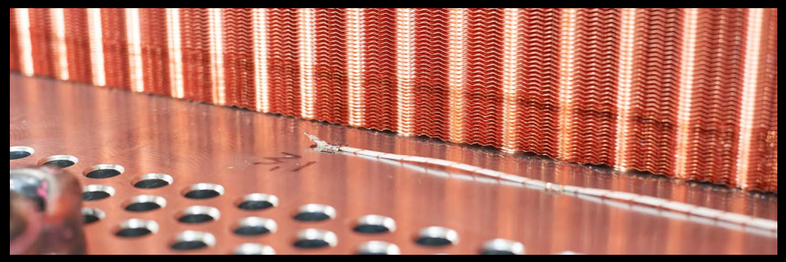
Peter highlights the broader implications: "The digital twin allows us to simulate the behaviour of the structure based on real-time data, enabling us to make informed decisions about maintenance and operation. This not only extends the lifespan of the structures but also improves safety and reduces costs."

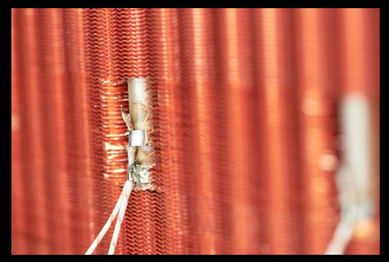
By collaborating with CP-Sens, both Vestas Aircoil and VCE are integrating digital twin technology into their operations, demonstrating the practical benefits and potential of this innovative approach.

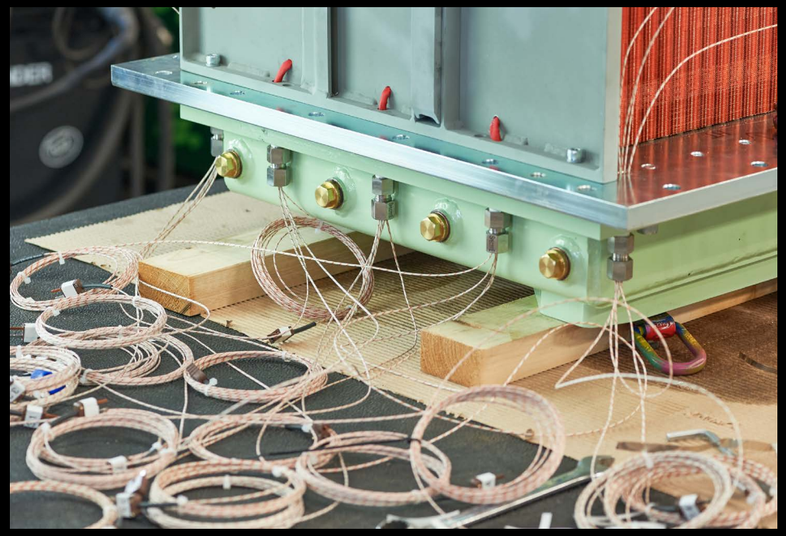
Digital twin as a service

In the CP-Sens project, collaboration across disciplines is vital to leveraging digital twin technology to optimise the performance and maintenance of complex systems. Central to this effort are sensors developed by HBK, which are crucial for collecting data to create accurate virtual models.

"Sensors are the backbone of our digital twin technology," explains Dmitri. "They collect real-time data from physical assets, which is then used to create a virtual model."







Aarhus University plays a pivotal role in creating these virtual models. “Our team at Aarhus University develops the simulation models that integrate with the data from sensors,” says Giuseppe. “This combination allows us to run simulations that predict and optimise performance.”

One of the groundbreaking aspects of CP-Sens is the development of ‘digital twin as a service.’ “This platform makes it easier for SMEs to adopt digital twin technology without needing extensive technical expertise,” says Giuseppe. “The service provides an integrated solution where all necessary tools and software are pre-configured and documented. Companies can access and use these tools through a cloud-based platform, reducing the barriers to entry significantly.” And it’s thanks to INTO-CPS that this is possible.

A lasting legacy: INTO-CPS

INTO-CPS is a non-profit association dedicated to maintaining and developing the digital twin technology infrastructure beyond the project’s duration. “Licensing all IP produced in this project to INTO-CPS ensures that the technology remains accessible to SMEs,” explains Giuseppe. “This model prevents the technology from being monopolised by large corporations and keeps it affordable for smaller companies.”

The association’s role is to maintain and improve the digital twin tools and services, ensuring they remain available for educational and non-commercial use. “Students and researchers can access these tools for free, and companies can try them out at no cost. When they decide to use these tools in a commercial setting, the licensing fees support the maintenance and development of the infrastructure,” adds Giuseppe.

This approach ensures the sustainability of the digital twin technology developed by CP-Sens, allowing SMEs to continue benefiting from these innovations well into the future.

Changes required for future readiness: long-term challenges to exploiting digital twins

While CP-Sens is set to break down the immediate barriers to SME use of digital twin technology, the project team warns that greater changes are required if we as a society want to enjoy the full benefits of this technology.

Long-term innovation to remain competitive

Dmitri emphasises the need for businesses to invest in long-term innovation to stay competitive. “Companies often focus on immediate problems, but if you don’t invest in future technologies now, in five to ten years, you could be out of the game,” he warns. “It’s crucial for companies to look beyond short-term gains and focus on long-term strategies to remain competitive in a rapidly evolving market.”

Digital skills essential for all engineers

Representing the project’s academic partner, Giuseppe is in a strong position to underscore the need for engineers to develop basic coding and digital literacy skills. “For our society to adopt these technologies, engineers must understand programming languages and digital tools,” he explains. “When I was a kid, we were given basic education in tools like Excel and Word at high school. Now, it’s essential for engineers to have an understanding of programming languages and digital tools to enable this transformation.”

Conclusion

By offering a cloud-based platform, user-friendly tools and expertise, the CP-Sens project is making digital twin technology accessible to SMEs. This initiative reduces costs, accelerates innovation and enhances efficiency by leveraging real-time data and simulations. SMEs can now optimise operations, predict and prevent failures and streamline development processes without needing extensive technical expertise.

We’ll be catching up with the CP-Sens team over the lifetime of the project.

Follow CP-Sens on LinkedIn for the latest updates on the project. Explore collaboration opportunities, or learn how digital twins can benefit your business by reaching out to the project team.

Vestas aircoil R&D lab
CENTER OF EXCELLENCE

> “We are developing here a solution which will be the future for the lifecycle management of big infrastructure, supporting sustainability by extending the lifespan of structures and optimising their performance.”
>
> **Peter Furtner, Vienna Consulting Engineers**

> “I haven’t seen any other companies in our industry offering a system like this. The potential to create something truly innovative and unique is incredibly exciting.”
>
> **Claus Ibsen, Vestas Aircoil**

CP·SENS
CREATING DIGITAL TWINS

PROJECT NAME

CP-SENS – Cyber-Physical Sensing for Machinery and Structures

PROJECT SUMMARY

CP-Sens is working to make digital twin technology accessible to small and medium-sized enterprises (SMEs) in the mechanical and structural engineering sectors. The project is creating a user-friendly platform that combines sensors, simulation models and real-time data to create virtual replicas of physical systems. This technology allows SMEs to monitor, analyse and optimise their products and processes, leading to cost savings, faster innovation and improved efficiency.

PROJECT PARTNERS

Aarhus University
Hottinger Brüel & Kjær (HBK)
Vestas Aircoil
Vienna Consulting Engineers (VCE)
FORCE Technology

PROJECT LEAD PROFILE

CP-Sens is led by researchers at Aarhus University, specifically in the: Department of Electrical and Computer Engineering; Department of Civil and Architectural Engineering; and Department of Mechanical and Production Engineering.

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