KUEHNE+NAGEL

Healthcare Logistics

Crossing the digital Rubicon: one shipment at a time

Digital twins

Imagine a logistics network so finely tuned that you could predict and prevent disruptions in your supply chain before they even occur.

From the desk of
Jon Chapman,
Vice President,
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Welcome to the brave new world of digital twins, a world in which a virtual, digital representation, the digital twin, simulating your supply chain, allows you to run through potential supply chain scenarios from start to finish, enabling you to determine the cause and effect of changes with hitherto unknown precision. Every adjustment in your operational system can be simulated in advance, and its impact on the overall process can be assessed based on real data harvested from previously completed shipments and activities, giving you unprecedented insights and optimisation opportunities.

In short, a digital twin is a virtual representation of a physical object or process that mirrors its real-world counterpart in real-time.
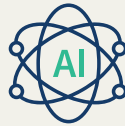
The technology behind digital twins

There are three main components to the technology on which digital twins are based:

Real-time data collected from Internet of Things (IoT) sensors, cameras, RFID tags, GPS devices, and other sources that monitor the physical state and behaviour of an object or process.
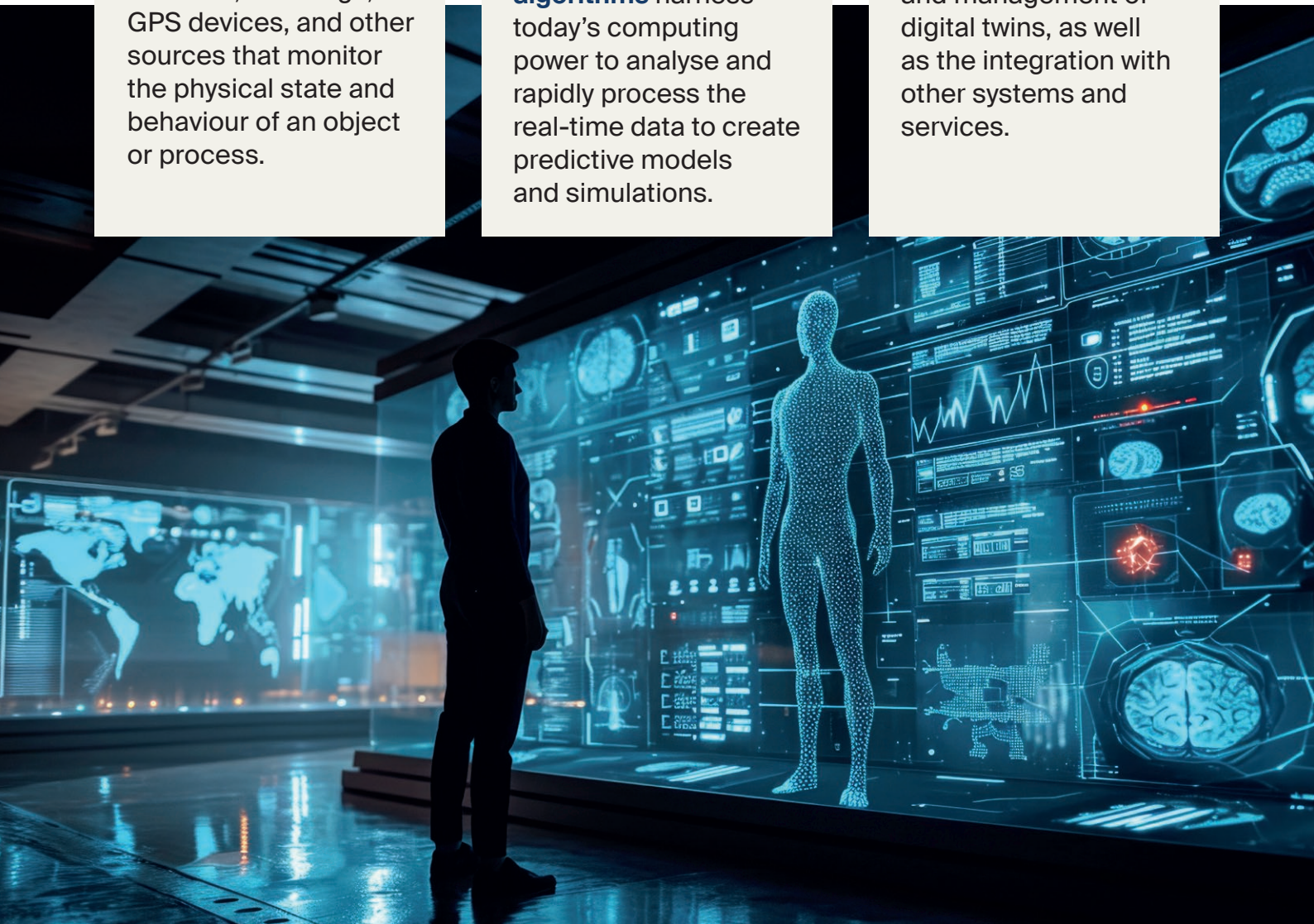
Artificial intelligence (AI) and machine learning (ML) algorithms harness today's computing power to analyse and rapidly process the real-time data to create predictive models and simulations.

Software platforms that enable the creation, visualisation and management of digital twins, as well as the integration with other systems and services.

Origin and evolution of digital twins

The concept of digital twins evolved over several decades beginning in the 1960s and 70s with the development of computer-aided design (CAD). Engineers and designers used CAD to create detailed models of products and systems that could be tested and optimised before physical production.

A precursor to digital twins can be seen in NASA's use of physical "twins" during the Apollo programme. NASA created exact replicas of spacecraft and equipment on earth to simulate and troubleshoot issues that could occur in space.

The term "digital twin" was coined by Dr Michael Grieves at the University of Michigan in 2002, during a presentation on product lifecycle management. He proposed that a virtual representation of a physical product could be used to improve the design, and the manufacturing and operation of the product throughout its lifecycle.

The widespread adoption of IoT in the 2010s significantly advanced the development of digital twins. IoT enables the collection of vast amounts of real-time data from physical assets that can be used to create and update digital twins. The integration of AI and machine learning has allowed for more sophisticated analysis, including predictive maintenance, optimisation and autonomous decision making.

The role of digital twins in logistics

The possibilities for digital twins in the logistics industry are endless. With digital twins, you can run "what-if" scenarios to test how different variables—such as changes in demand, weather conditions, or disruptions—might affect logistics operations.

A digital twin does not just show real-time data, it simulates how the physical asset or system behaves over time. For instance, a digital twin of a delivery network might simulate traffic conditions, vehicle performance, and delivery times based on both real-time data and historic patterns.

Digital twins can suggest optimised actions to take based on their prescriptive analysis. If a digital twin of a supply chain predicts a delay due to weather, it might recommend re-routing shipments or adjusting inventory levels at certain warehouses to mitigate the impact.

Digital twins use data not just to report current conditions but to predict future states. For example, a digital twin modelling a warehouse's energy usage, taking into account factors like lighting, HVAC (heating, ventilation and air conditioning) systems, and equipment operation, will predict that energy usage will spike during a particularly hot week when cooling systems will be working harder, and will, therefore, recommend adjusting HVAC settings during off-peak hours and scheduling energy intensive tasks for cooler times of the day, reducing energy costs and optimising operations efficiency.

Digital twins and Kuehne+Nagel's Healthcare Logistics services

When shipping temperature-sensitive, time-critical healthcare products, any changes in the operation of the logistics network could have catastrophic conse-quences on product integrity. Fortunately, as one of the world's largest logistics firms, Kuehne+Nagel has a wealth of historic shipment data stored in the cloud. Engineering teams based in our IT hubs in Tallinn, Porto and Hamburg, use AI algorithms and machine learning to clean the data. This data is then fed into a digital twin and, coupled with real-time public data and analysis based on PESTLE* factors, help us anticipate and mitigate against potential disruptions, and

to optimise current shipment routings. In addition, we also use the output to add a dynamic element to our digital lane risk assessment service.

Conclusion

In the healthcare logistics industry, digital twins have emerged as a transformative technology, enabling you to optimise your operations in ways that were previously unimaginable, driving innovation and improving patient outcomes in an increasingly complex and demanding environment. Embracing digital twins is not just a strategic advantage but a necessary step towards building more responsive, cost effective, sustainable and resilient supply chains.

*Political, economic, social, technological, legal and environmental

About us

With approximately 80,000 employees at almost 1,300 sites in close to 100 countries, the Kuehne+Nagel Group is one of the world's leading logistics providers. Headquartered in Switzerland, Kuehne+Nagel is listed in the Swiss blue-chip stock market index, the SMI. The Group is the global number one in air and sea logistics and has strong market positions in road and contract logistics.

Kuehne+Nagel is the logistics partner of choice for 400,000 customers worldwide. Using its global network, logistics expertise and data-based insights, the Group provides end-to-end supply chain solutions for global companies and industries. As a member of the Science Based Target Initiative (SBTi), Kuehne+Nagel is committed to sustainable logistics by reducing its own environmental footprint and by supporting its customers with low-carbon logistics solutions.

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