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Interoperability and ecosystems: Assembling the industrial metaverse

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Building the industrial metaverse is not just a matter of having the right technologies. It also requires their seamless integration. This, however, is a complex challenge. Peter Körte, chief technology and strategy officer at Siemens, highlights the critical role of collaboration in this process: "This is about bringing together diverse industry players with their unique strengths – be it computing power, AI, cloud and edge capabilities, spatial content creation, software, or specialized domain knowledge." Four essential elements are required to piece together this complex puzzle: interoperability, standardization, open APIs for data integration, and ecosystems.

Combining the real and digital worlds

The foundation of the industrial metaverse lies in developing and visualizing digital twins of real-world objects. These systems are dynamic, requiring a continuous feedback loop that integrates and analyzes data, monitoring and managing real assets. This process also enables interactive evaluation, simulation, and prediction with the digital twin. It's a complicated interplay between information technology (IT) and operational technology (OT), where physical data collected by sensors and IoT devices is merged with the analytical capabilities of advanced software, including data analytics and AI models.

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Interoperability enables innovation and efficiency: As real-world systems and their digital twins grow in complexity, the challenge of interoperability intensifies. However, embracing interoperability and openness can create new opportunities for innovation and efficiency. Connected digital twins, for instance, can enhance supply chain collaboration, allowing for real-time tracking and optimization at every stage, from raw material sourcing and manufacturing to delivery, recycling, or repurposing of products.

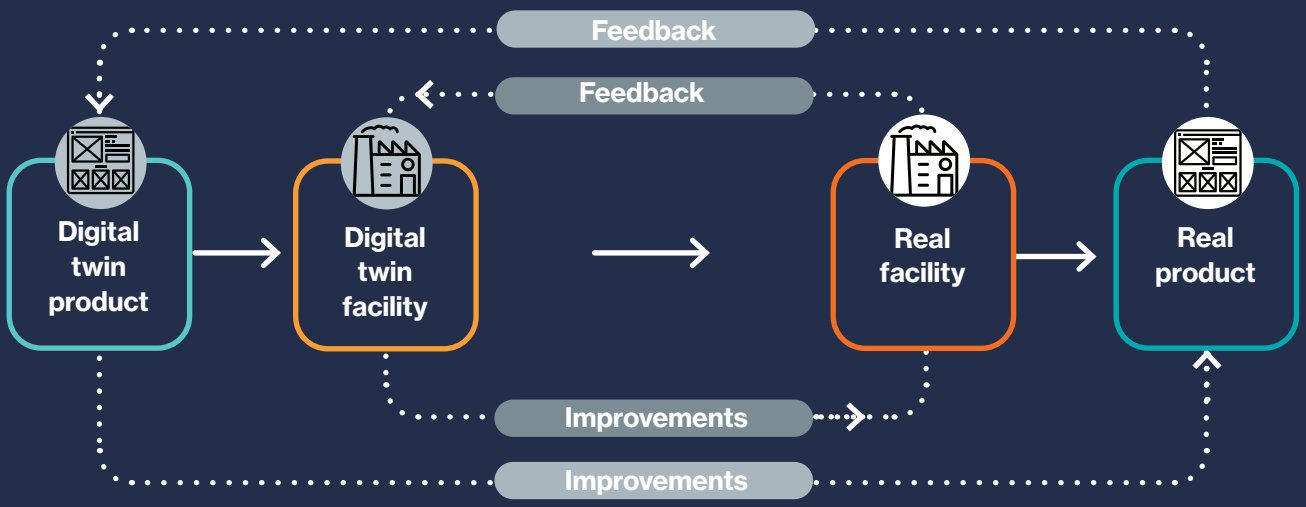
Take, for instance, Bentley Systems' work on infrastructure digital twins, enabling the integration of data from different systems and sources to optimize infrastructure delivery and performance. One example is Singapore, which uses a national digital twin, built on Bentley's technology, to improve data availability, information extraction, and urban planning. "Infrastructure digital twins provide a single view of truth, allowing users to visualize, simulate, and monitor the current state and future projections in areas like transportation, energy, and water," says Mike Campbell, chief product officer at Bentley Systems. "By connecting the physical and virtual worlds, engineering firms and infrastructure owners can make better, data-driven decisions."

Standardizing the future: To facilitate and enhance the integration of IT and OT – and to enable the industrial metaverse – key players across industries are actively working to develop, refine, and optimize standards. "Just as the internet thrived on open standards like HTML and TCP/IP, these efforts are necessary to enable seamless interoperability and integration of diverse industrial systems," says Rev Lebaredian, vice president of Omniverse and simulation technology at NVIDIA.

One such initiative is the Alliance for Open USD, which is evolving the Universal Scene Description (USD) standard. Originally developed for the movie industry, and later adopted by the gaming sector, USD is now being enhanced for industrial applications. This involves adding physical properties, such as density and behavior under physical stress, to 3D objects. Complementarily, within the Metaverse Standards Forum, the Industrial Metaverse Interoperability Group brings together a diverse group of companies that are working to create a unified and standardized environment for the industrial metaverse.

The comprehensive digital twin closes the loop

A digital twin product can be used to create specifications for a digital twin facility. This leads to the creation of a real facility used to produce the real product. Real-world feedback and changing conditions from the real product and real facility are fed back to the digital twin product and digital twin facility, which continuously update and then supply specifications for ongoing improvement to the real facility and product.



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Building the industrial metaverse: A step-by-step approach

As industries collaborate to standardize and integrate IT and OT systems, businesses are also exploring how to practically build the industrial metaverse. The potential is enormous. After all, "the industrial sector is producing the largest amount of data," notes Douglas Bellin, global lead of business development for smart factories at AWS, "but often only a fraction of that data is actively used." The key to unlock this potential is a step-by-step approach, beginning with laying the foundations for interoperability: robust data integration.

Leveraging open APIs and data management:
The journey to an interoperable industrial metaverse requires robust data integration. "Leveraging open APIs is essential," says Selim Köklü, digitalization lead at Siemens Mobility Turnkey. "They are like doors to access data – but then you have to be able to work with what you find behind these doors. In this process, standardization and robust data governance are crucial, ensuring data quality, security, and compliance across systems."

For businesses, especially those grappling with legacy systems, developing a solid data strategy, one that ensures data accessibility and governance,

is fundamental. This, in turn, will lay the groundwork for efficient data management through data lakes or warehouses, which will be instrumental in facilitating the development of analytics, AI models, digital twins, and industrial metaverse applications, benefiting the entire organization.

Embracing ecosystems and platforms: For businesses to effectively enable interoperability, they must also integrate into open, collaborative ecosystems. These ecosystems, often anchored in robust, open platforms, lay the groundwork for cross-industry collaboration and recombinant innovation.

Marshall Van Alstyne, a digital fellow with the MIT Initiative on the Digital Economy and Questrom Chair at Boston University, highlights the intrinsic value of such platforms: "Platforms are not just about cost and speed efficiencies; they open up avenues for recombinant innovation. By enabling different components and subcomponents to be recombined in new ways, platforms become a powerful tool for innovation."

Siemens Xcelerator exemplifies this ecosystem approach. This open digital business platform offers flexible solutions that integrate with existing systems. In addition to addressing the challenges of technology scaling and data integration, the platform's marketplace and developer portal foster a collaborative environment for innovation, providing access to a rich ecosystem of know-how, resources, and open APIs.

The software company Youl Systems has leveraged Siemens Xcelerator's open APIs to develop custom digital twins. These advanced solutions are now being used by KHNP, one of South Korea's leading energy companies, which supplies about a quarter of the nation's energy.

Interoperability and ecosystems: A strategic imperative

In shaping the industrial metaverse, interoperability and collaborative ecosystems are not just beneficial. They are the necessary foundation upon which this digital world is being built, allowing diverse technologies and processes to come together. Embracing these principles is imperative for any digitalization strategy meant to enable participation in the industrial metaverse – and the innovation, operational efficiency, and competitive edge it is about to bring.

The potential of recombinant innovation

Innovation often emerges not from a singular technological breakthrough but rather from a creative fusion of existing concepts. This process, known as recombinant innovation, brings together ideas from across fields or contexts, creating something entirely new.

These innovations range from the mundane, such as fast food (a synthesis of assembly-line efficiency and the restaurant) and the rolling suitcase (the combination of luggage with wheels), to some of today's most disruptive technological innovations.

The smartphone, for instance, was not just about combining functionalities including a music player, watch, and camera. More fundamentally, it emerged from the advanced integration of key technologies such as miniaturized processors, high-density batteries, touch-screen displays, and fast, reliable connectivity – and catalyzed a revolution not just in communication but in how we interact with information and one another.

In the industrial domain, recombinant innovation has been a transformative force since the first industrial revolution, which witnessed the fusion of steam power with mechanical manufacturing. The 20th century saw the combination of electrical energy and assembly-line techniques, enabling an era of mass production. And this evolution continued with the integration of computer technology and automation, leading to the advent of robotics and digital manufacturing.

Today, the advancement and convergence of technologies including digital twins, AI, and the IoT is about to spark the next transformational recombinant innovation: the industrial metaverse. Widespread interoperability and the rise of collaborative ecosystems will help assemble this new digital world and unlock its potential to foster the next wave of recombinant innovation.