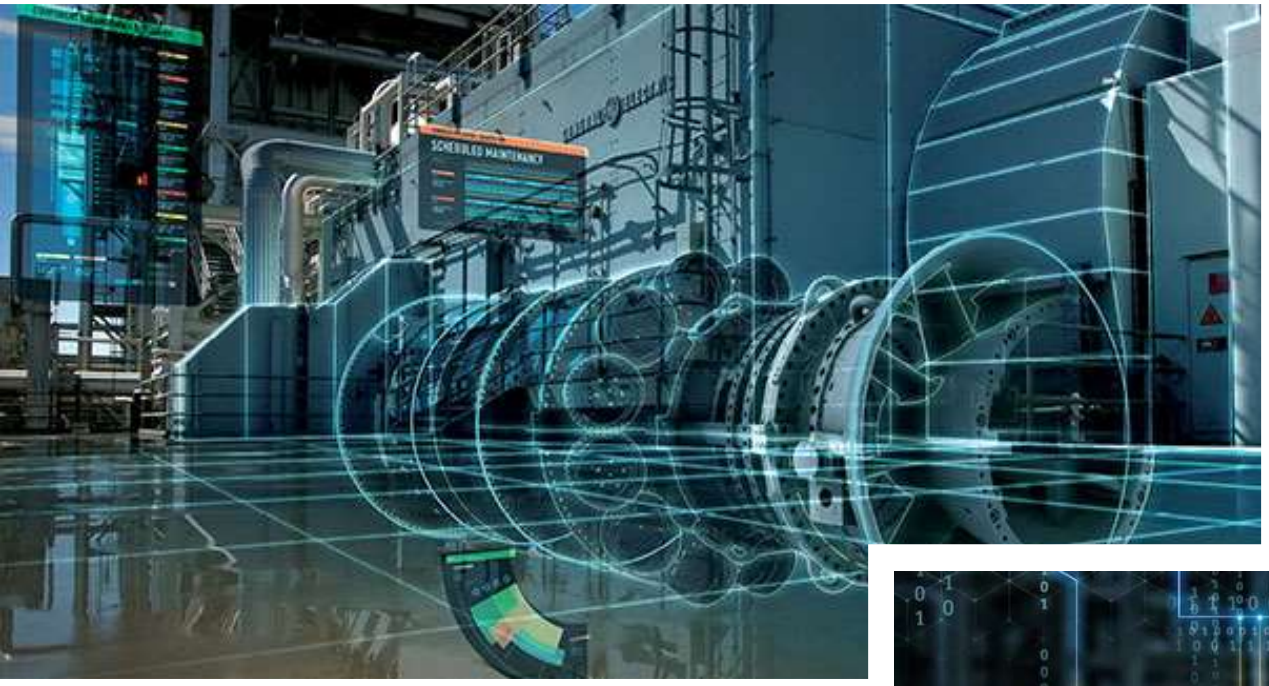

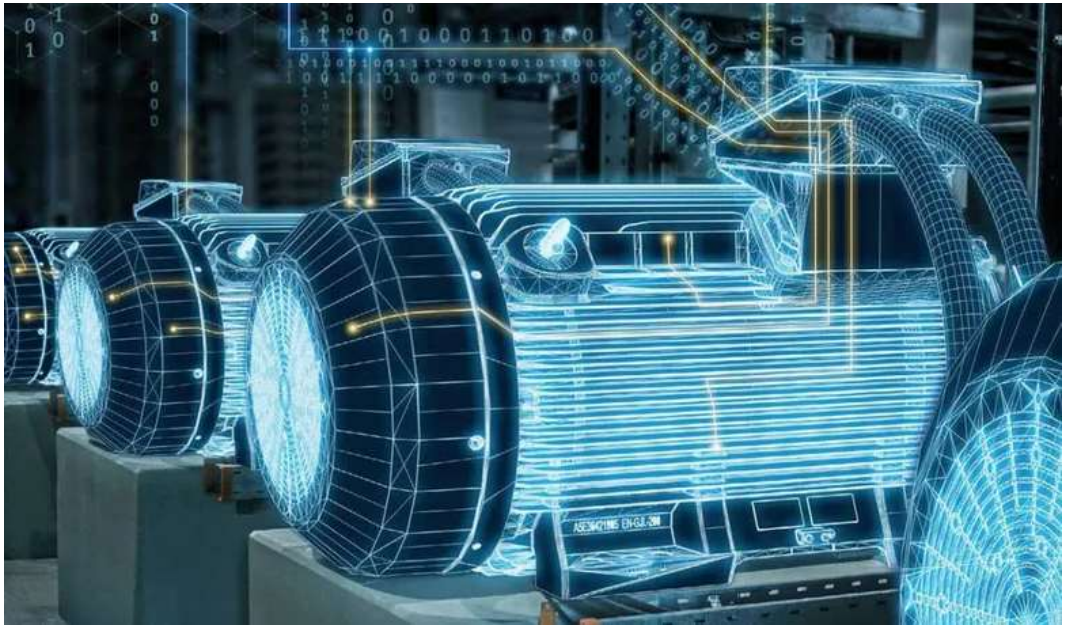

# Digital Twin & The Future of Industrial Metaverse

**Presenter: Brian Breuhan**

## Speaker Bio:

**Brian Breuhan has over 20 years of experience working in mechanical design, project engineering and project management within the engineering/manufacturing industry.**

**Brian has held various professional leadership roles for nonprofits, including, Executive Board Member for the American Society of Mechanical Engineers (ASME) Metro Detroit, Industry 4.0 Advisory Council for Automation Alley and a member of the Industrial Advisory Board for Wayne State University. He holds a Bachelor of Science in Mechanical Engineering Technology from Wayne State University and a Master of Science in Engineering Management from Central Michigan University.**

**Currently, Brian works in the Advanced Technology Manufacturing Engineering Group for Global Vehicle Systems at General Motors.**

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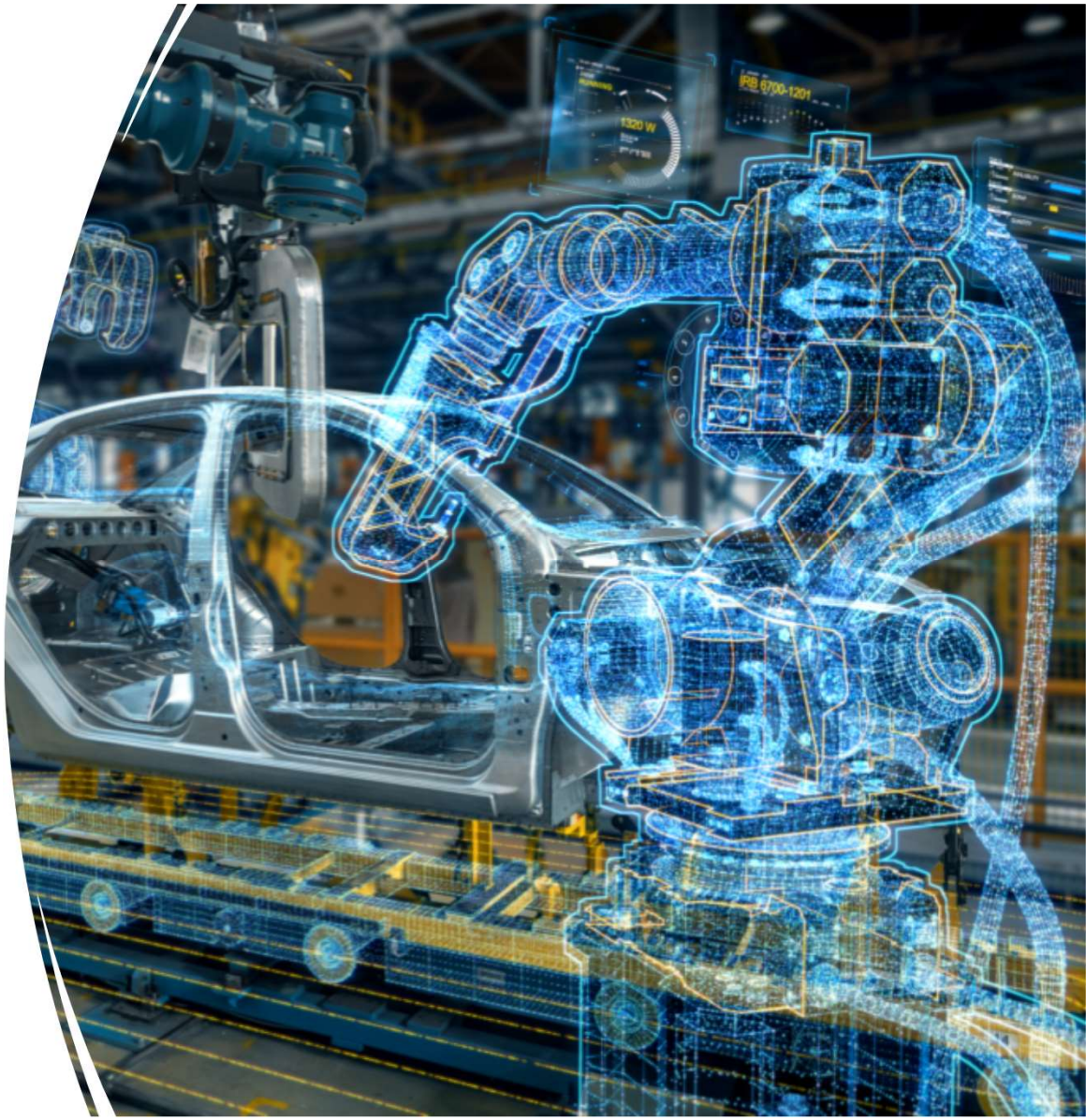
# AGENDA

1. **What is Digital Twin?**
2. **Digital Twin Advantages**
3. **Examples of Industry Use Cases**
   a. **Mercedes-Benz – MO360 Digital Ecosystem**
   b. **Anheuser-Busch – Digital Factory and Digital Supply Chain Control**
   c. **BMW – iFactory (Factory of the Future) Initiative**
4. **Industrial Metaverse (Future)**



# What is Digital Twin?

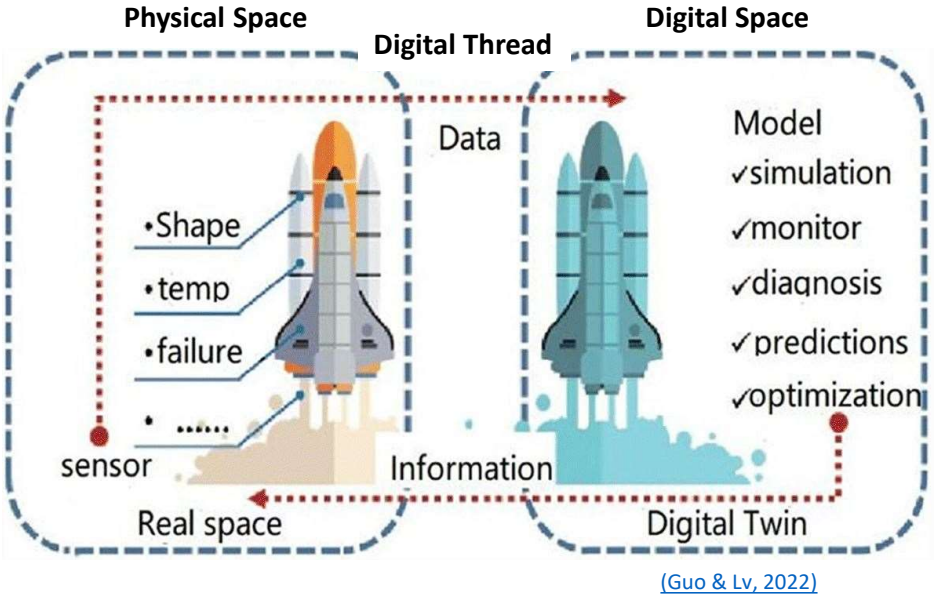
**Digital Twin (DT)**, in simplest terms, is an exact virtual representation of a physical counterpart. Everything that makes up the Physical Counterpart (or Physical Twin) is represented in the Digital Twin. This includes:

- Part Numbers / Serial Numbers
- Models / CAD
- Simulations
- FMEAs
- Maintenance History
- Operational History
- ….etc.

**The Digital Twin Model shown here is made up of three main elements** (Grieves, 2022):

1. Physical Twin (Left Side / Physical Space)
2. Digital Twin (Right Side / Digital Space)
3. Digital Thread (Center / Data Channel)

Digital Twin concept was developed to digitally collect and store data during a product or systems lifecycle.
Product Lifecycle Management (PLM) Tool




(Guo & Lv, 2022)

**Digital Twin Model**

# What is Digital Twin?

**Two Key People in the development of the Digital Twin Model / Concept**

**Dr. Michael Grieves, Executive Director, Chief Scientist at Digital Twin Institute**

2002, developed the concept and model of the Digital Twin (not called Digital Twin at the time). This model was first introduced in 2002 at a Society of Manufacturing Engineers (SME) conference in Troy, Michigan, USA

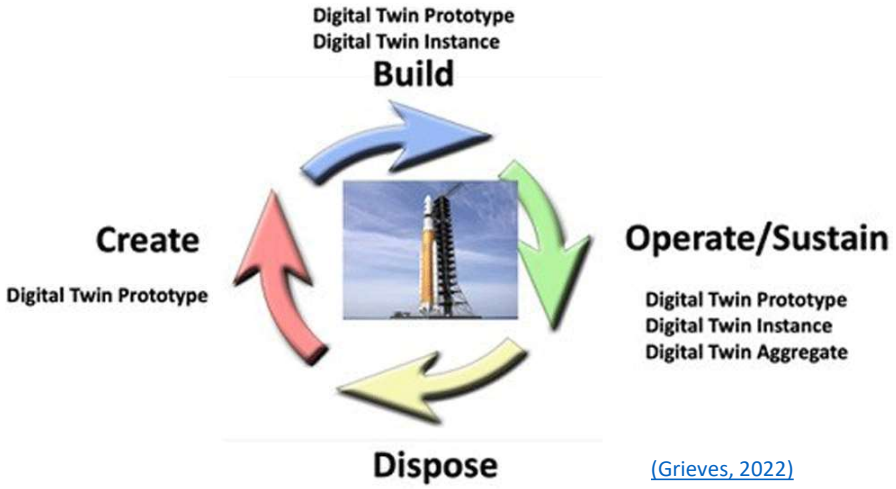
**John Vickers, Associate Director of Mfg. Materials and Processes at NASA**

2010, while working on projects with Dr. Grieves, Vickers completed a NASA 2010 Roadmap Report which officially coined the name “Digital Twin” for the model / concept. The name stuck and has been called Digital Twin since.

# What is Digital Twin?

**Types of Digital Twin seen through the four phases of a product Lifecycle:**

1. Digital Twin Prototype (DTP): The prototypical product w/variants or all the products that can be built
2. Digital Twin Instance (DTI): Individual products themselves or all the products that are built
3. Digital Twin Aggregate (DTA): Aggregate of all the DTIs or all the products that have been built (Data Collection)




(Grieves, 2022)

**Five reasons a Digital Twin does not require a physical counterpart before the digital twin exists:**

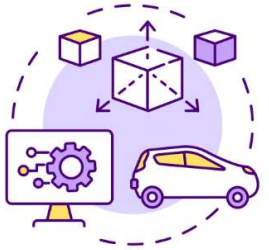
1. Digital Twin framework should cover the entire product lifecycle
2. Digital Twin is valuable during the create phase
3. Digital Twin does exist prior to the physical counterpart but has a different name (Digital Model or Digital Design for example)
4. Digital Twin regresses to being functionally siloed if there is no digital twin prior to the physical counterpart
5. Digital Twin existing only after there is a physical counterpart is conceptually inelegant and a piecemeal

(Grieves, 2022)

# Digital Twin Advantages

Digital Twin has extreme value across the entire lifecycle of the product but is especially valuable during the create phase. This is where you can move many of the physical testing and validation to the virtual world with a Digital Twin Prototype. This will help improve:

- Reduce the wasting of valuable physical resources (material, energy and labor)
- Reduce the time for development, testing & validation
- Improve Quality
- Reduce Cost Over the Lifecyle
- Being able to bring a product to market faster



Digital Twin Prototype

In the virtual world you also have the advantage of manipulating time. Simulations can be run forward and backward in time to better understand how a product or system will react or degrade. Assuming the  educated assumptions of how the system is used and the proper physics put in place in the digital model.

# Digital Twin Use Case: Mercedes-Benz


Video Clip Length 2m 8s

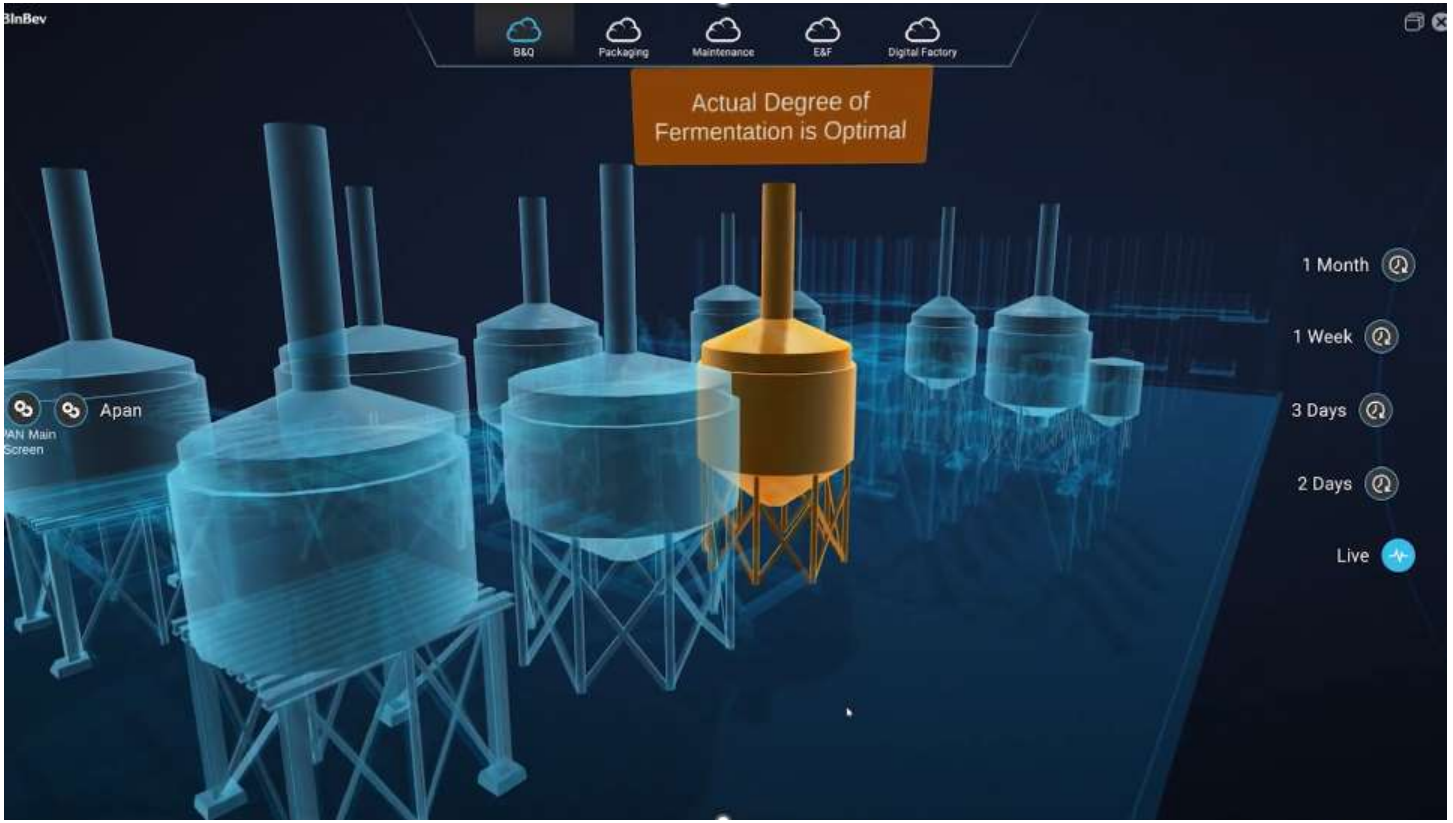
*MO360* Data Platform is the "**digital twin of production**". MO360 is a digital ecosystem comprised of software applications that are connected through a range of shared interfaces and standardized user interfaces to provide key performance indicators (KPI)-based production control & provides employees with individual needs-based information and work instructions in real-time.

# Digital Twin Use Case: Mercedes-Benz

## Key Takeaways from Video

- System: MO360 – Digital Twin of Production
- Developed with Microsoft Azure
- Paperless Factory
- Needs Based Vehicle Production Tracking
- IIoT Connection for Tools
- Handheld Devices / Scanners
- Quality Management Analytics
- Digital Shop Floor Management
- Digital Communication Boards


# Digital Twin Use Case: Anheuser-Busch – Digital Factory and Supply Chain



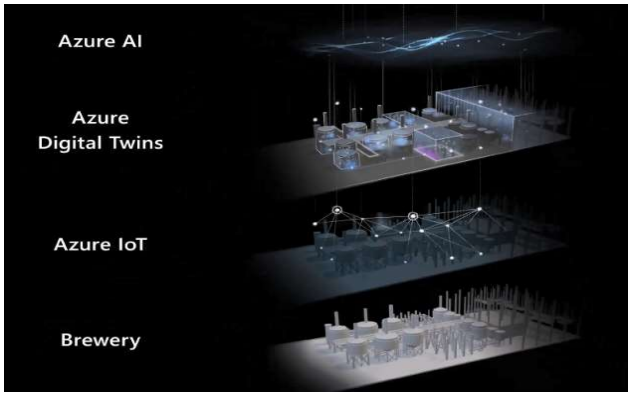

Video Clip Length 2m 16s

Looking outside of Automotive: Anheuser-Busch claims to have created a digital twin of its entire supply chain and brewing facilities to provide insight and production control from material sourcing to the finished product reaching its customers

# Digital Twin Use Case: Anheuser-Busch – Digital Factory and Supply Chain

## Key Takeaways from Video

- System: Microsoft Azure
- Business Data Automation
- Manufacturing Data Tracking and Feedback
- Operation can Monitor Quality & Traceability Realtime
- Energy and Utility Management for Sustainability
- AI Used for Line Balancing
- Predictive Maintenance
- Supply Chain Tracking



# Digital Twin Use Case: BMW – iFactory (Factory of the Future)

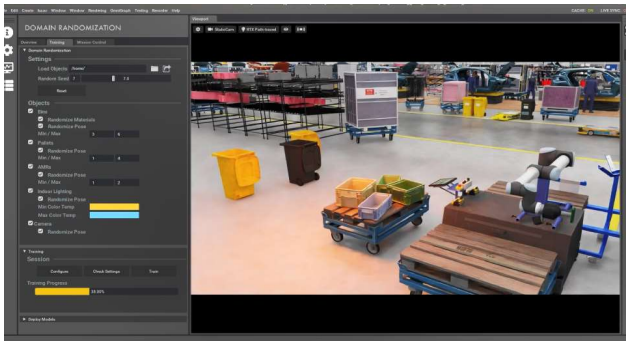
Video Clip Length 2m 34s

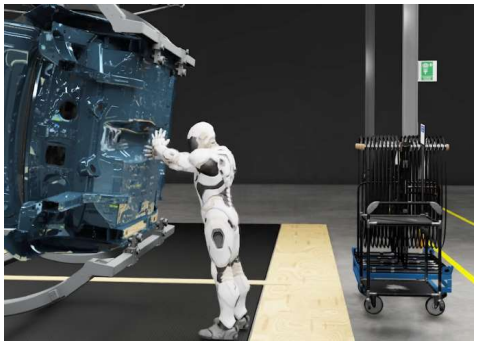
Initiative called iFactory to make BMW factories “Lean, Green, & Digital”. BMW is working with Siemens, Epic Games Unreal Engine and NVIDA with the effort to combine NVIDIA’s Omniverse ecosystem with Siemens Xcelerator (open digital platform) to advance **digital twins** to what Siemens refers to as the “**Industrial Metaverse**”

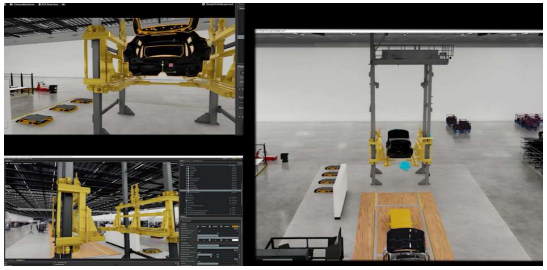
# Digital Twin Use Case: BMW – iFactory (Factory of the Future)

## Key Takeaways from Video

- System: NVIDIA Omniverse & Siemens Xcelerator
- Entire Factory in Simulation
- High Resolution Simulation
- Collaboration Globally on Projects
- Immersive Technology within Simulation
- Digital Human Simulations
- Simulation Based AI Teaching Through Domain Randomization and Synthetic Images



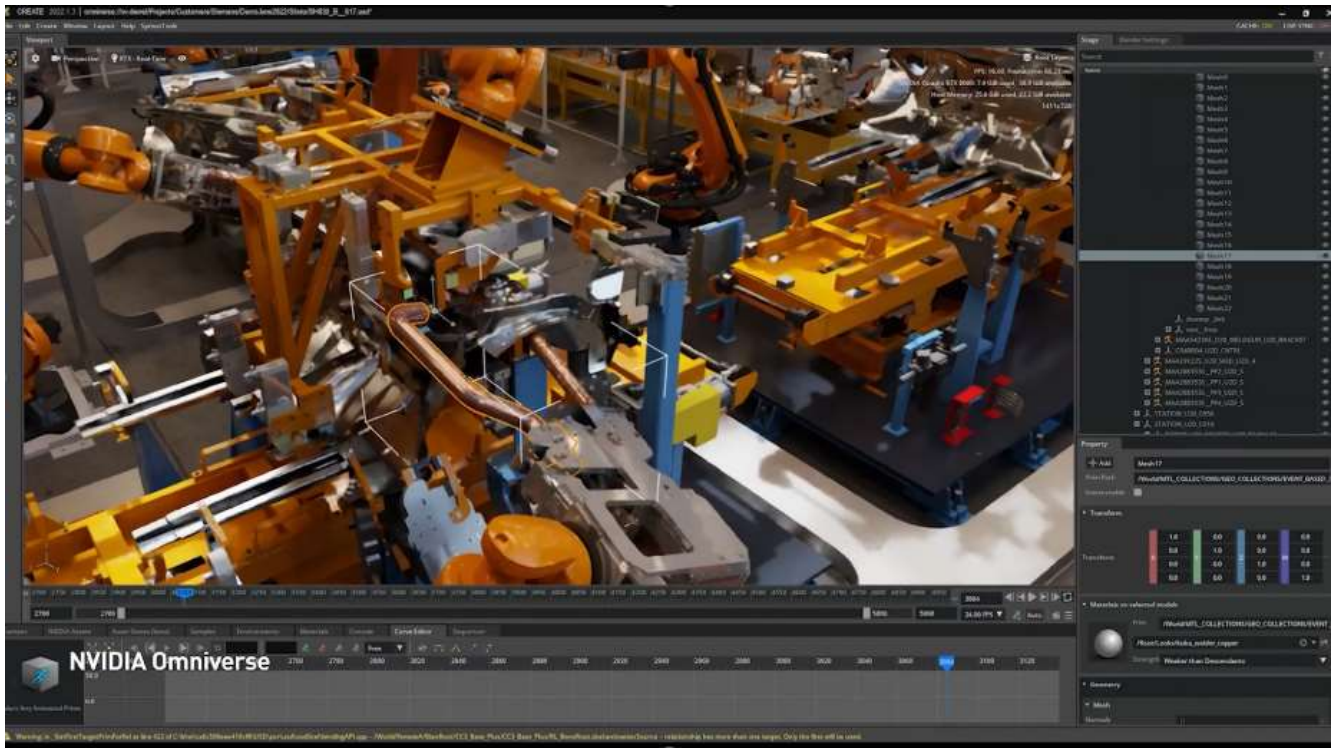





# Digital Twin Future – Industrial Metaverse

What is the Industrial Metaverse?

**Industrial Metaverse** is a network of digital twins that links physical assets and the digital world. It enables manufacturers to connect their digital twins with their customers and suppliers so they can work together and get insights based on real time data.




Video Clip Length 2m 54s

# Digital Twin Future – Industrial Metaverse

***The Pie-In-The-Sky Virtual World***

The **Industrial Metaverse** sits at the crossroads of Industrial Internet of Things (IIoT), Extended Reality (AR/MR/VR), and the creation of digital twins to enable the rich blending of real-world elements with contextualized and meaningful data to help decision makers stay better informed and to keep business processes operating at peak efficiency. Allowing users to move between the real-world and virtual-world seamlessly.


**Companies with Initiatives to move closer to an "Industrial Metaverse":**

- BMW – (iFactory – Moved Past Proof of Concept and Scaling from EU to USA)
- Boeing – ($15B Investment to Digital Design through Production)
- Kraft Heinz – (Supply Chain Metaverse)
- Kawasaki – (Group Vision 2030 Initiative)

# Digital Twin Future – Industrial Metaverse

***Building the Metaverse: Key Areas of Focus***

Image: Möller, 2023

- **Deeply Human-Centric (Focus on the Users)**
  - Improve Productivity
  - Reduce Waste
  - Maximize Output and Efficiency

Image: Siemens & NVIDA, 2022

- **Digital Twin Scope for Strong Collaboration & Alignment Across the Organization**
  - Vision - *Motivation & Aspiration*
  - Strategic - *Long-Term Objectives*
  - Tactical - *Focused Actions that Support the Overall Strategy*
  - Operational - *Detailed Level for Specific Outcomes*
  - Real-Time - *Data to Improve Efficiency & Predict*

- **Metaverse for Different Domains**
  - Customer (Products, Services, etc.)
  - Enterprise (Commercial / Business)
  - ***Industrial (Factory, Supply Chain, etc.)***

Image: Strong, 2022

- **Industrial Metaverse Lifecycle – Connecting the Physical and Digital Worlds**
  - Design - *Focus on User Experience & Long-Term Objectives*
  - Build - *Technologies, Engagement, Content, etc.*
  - Operate - *Collaboration, Data Collection, Management, etc.*
  - Optimize / Scale - *Continuous Improvement & Expansion*

# Digital Twin Future – Industrial Metaverse

## *Advantages & Opportunities*

- Training of Employees is Faster and Safer
- Full Integration of Immersive Technology
- Monitor & Analyze Data
- Scaled Simulation of Production
- Collaboration Across the Globe
- Ultra High Customization & Customer Experience
- Supply Chain Transparency
- Remote Field Service
- Deployment of AI Applications (Quality, Production, Maintenance, …, etc.)
- Virtual / Physical Services (New Sources of Revenue)

## *Risks & Challenges*

- Initial Cost (Talent Sourcing, Infrastructure, Hardware, etc.)
- Scaling Technology Outside of Proof of Concept (POC)
- Culture and Maintenance of the Digital Twins
- Cross-functional Alignment, Leadership & Change Management
- Cybersecurity & Data Ownership
- Brownfield Implementation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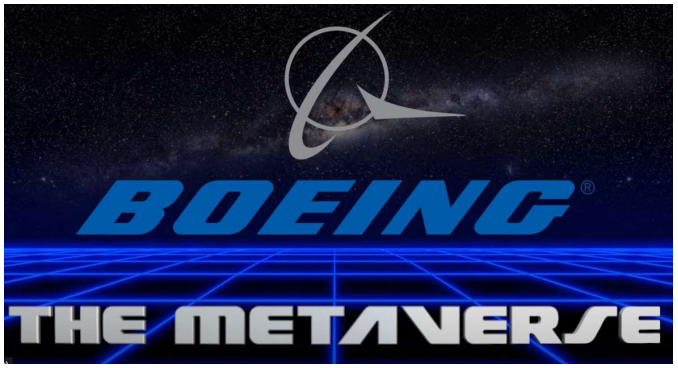
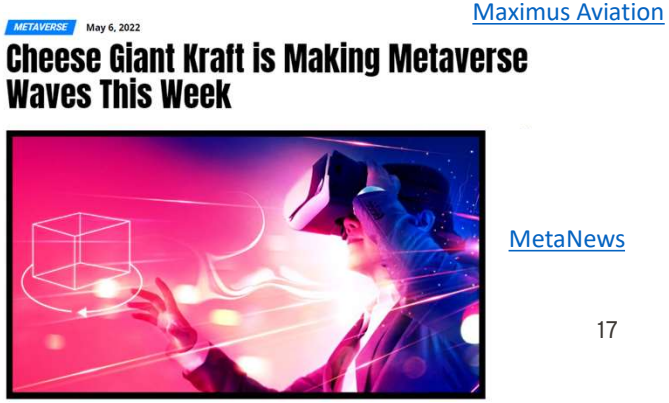



Maximus Aviation

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# Digital Twin & Industrial Metaverse

THANK YOU !!