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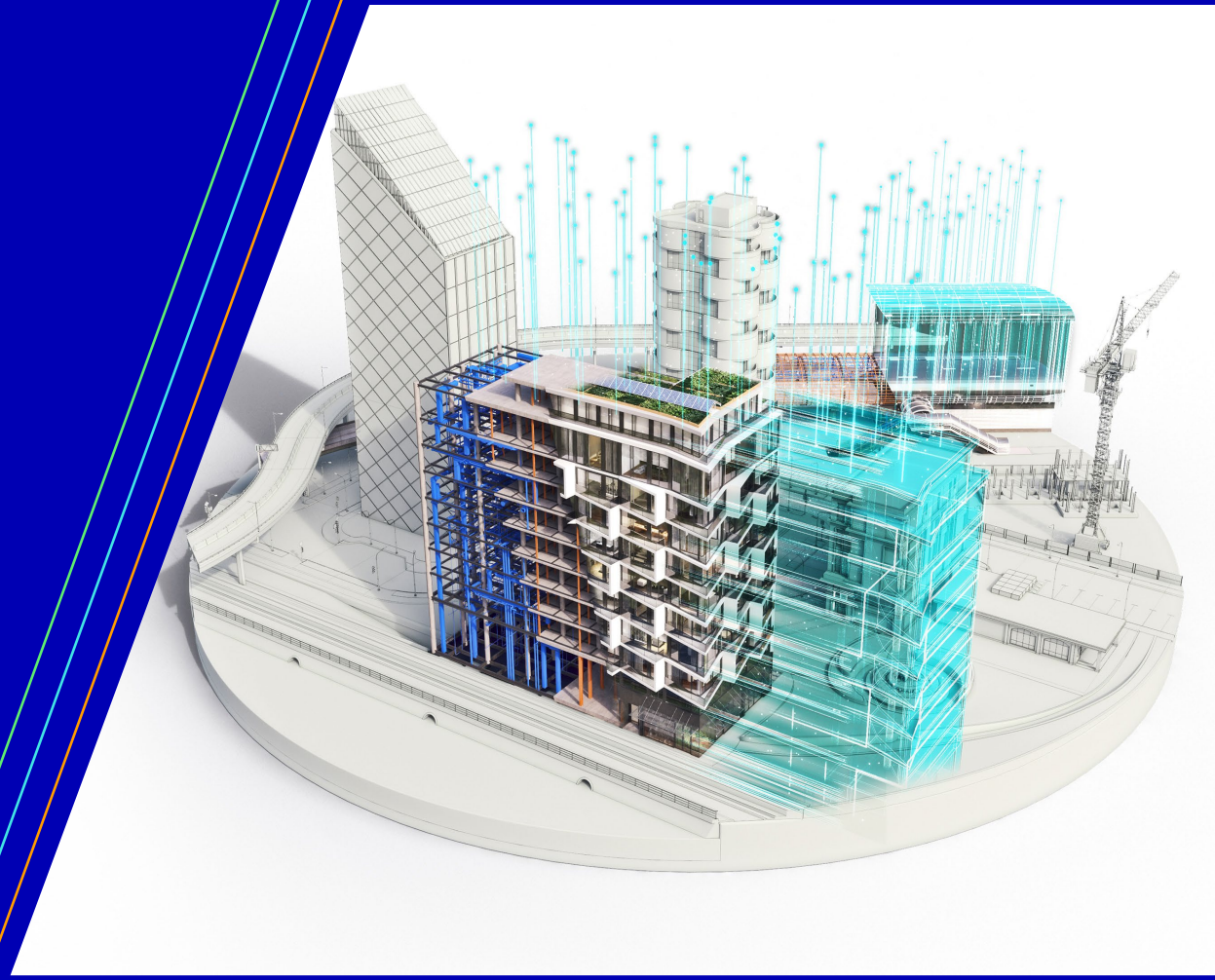
Digital Twins: A Practical Guide for Modern Product Development

Moving beyond the hype to actionable value across the lifecycle



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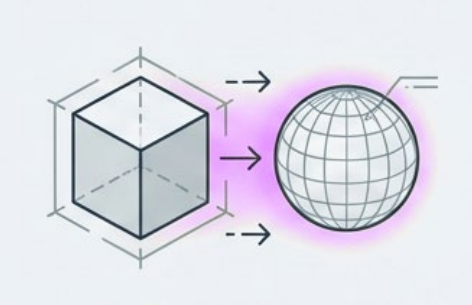
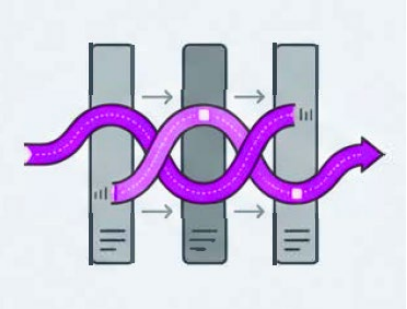
Executive Summary: The Strategic Case for Digital Twins



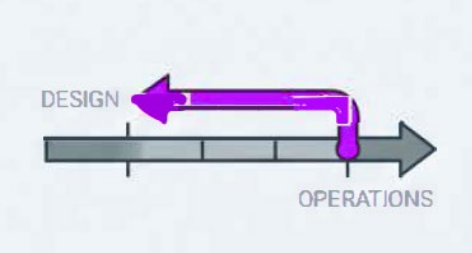
The Definition

Digital twins are living representations, not static models. They reflect behavior, build processes, and history-evolving alongside the physical product.



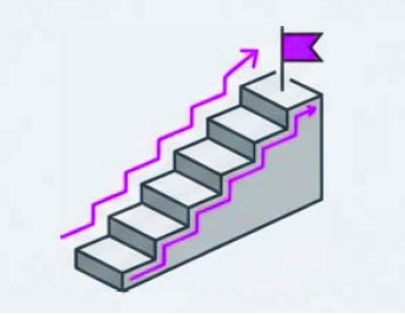
The Enabler

The "Digital Thread" is the prerequisite. It is the connected flow of data that ensures the Twin remains accurate, trustworthy, and current across teams.



The Value

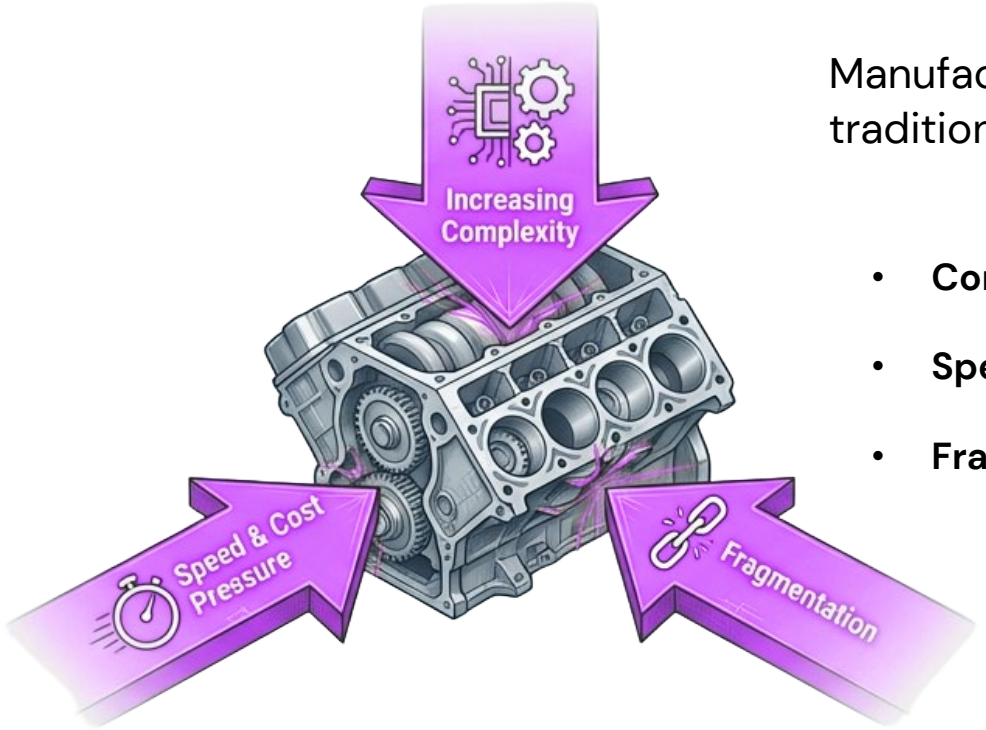
The primary ROI comes from "Shifting Left"-moving validation to the design and manufacturing planning phases to catch issues when they are cheapest to fix.



The Execution

Success does not require a massive IT overhaul. Most organizations succeed by starting with focused, high-value use cases rather than trying to implement everything at once.

The Modern Manufacturing Pressure



Manufacturers today face a "Perfect Storm" of converging challenges that traditional silos cannot manage.

- **Complexity:** Blending mechanical, electrical, and software components.
- **Speed:** Immense pressure to deliver faster while strictly managing risk.
- **Fragmentation:** Teams spread across functions, locations, and disparate systems.

Key Insight: In this environment, disconnected data leads to late-stage discovery of errors. Digital Twins address these challenges by enabling earlier validation and better collaboration.

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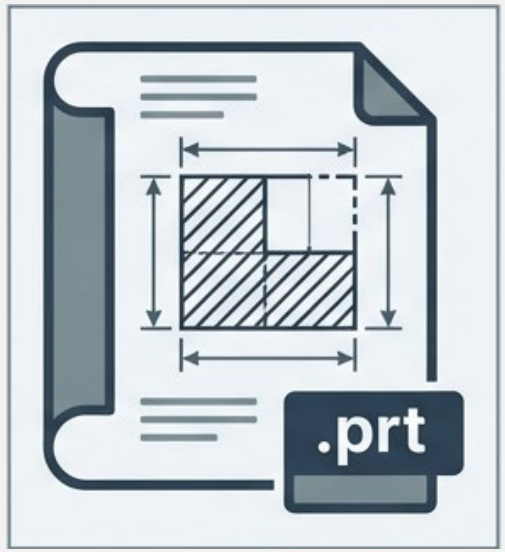
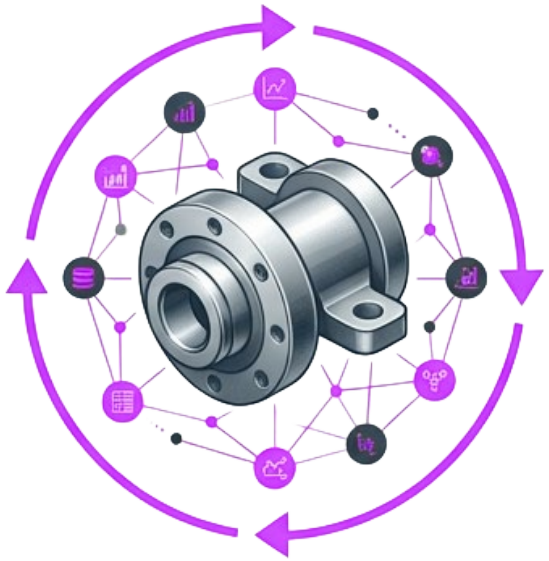
A Living Entity, Not a Static

What it is not



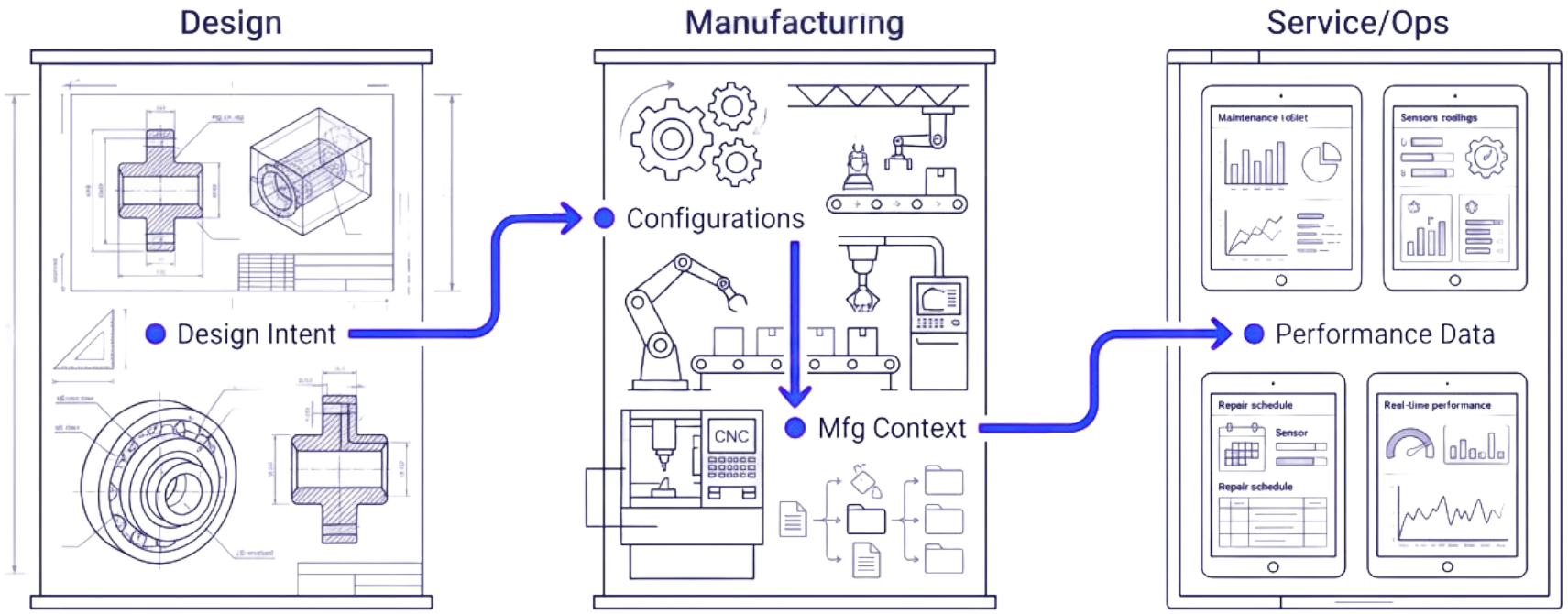
- **Not just a 3D Model:** A CAD file is a representation of geometry at a fixed point in time.
- **Not a One-Time Simulation:** An isolated test does not capture the evolving context.

What it is



- **A Living Representation:** Evolves throughout the lifecycle.
- **Behavior & Context:** Reflects how it behaves, how it is built, and how it changes.
- **Continuous Feedback:** Informed by product data and manufacturing insights.

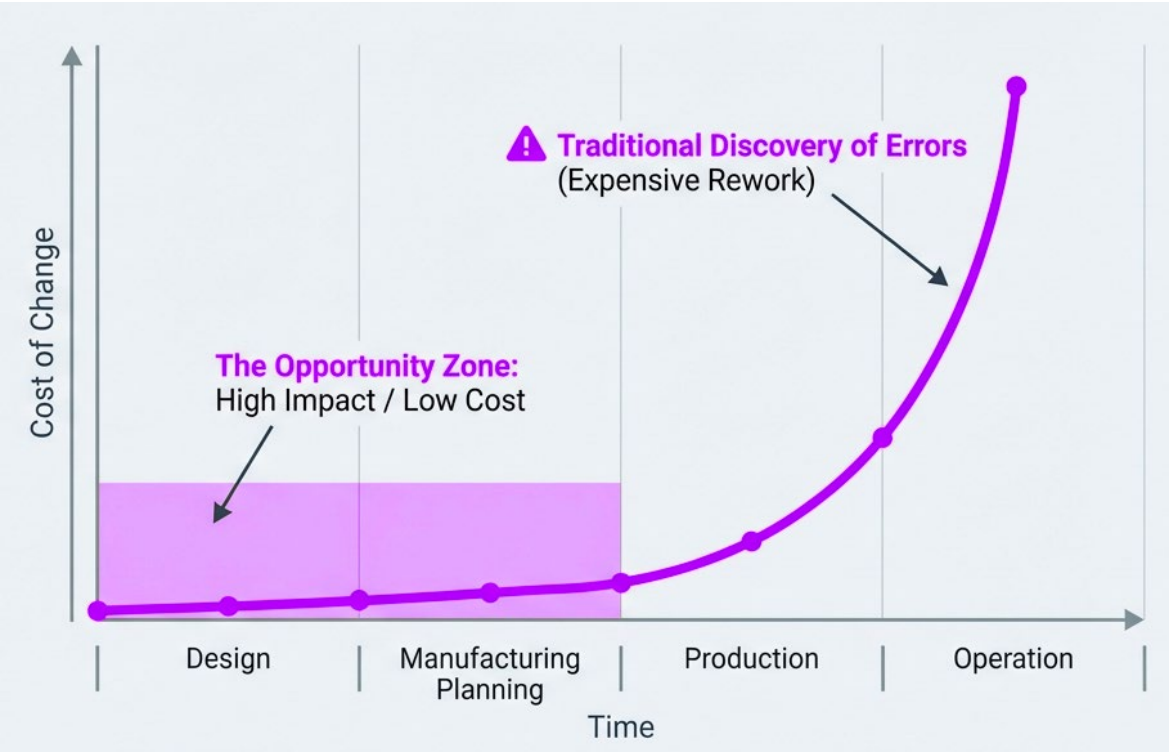
The Digital Thread Is the Foundation Behind the Twin



Core Concept: A digital twin is only as effective as the data behind it. To remain accurate, it relies on the Digital Thread-the connected flow of product data across teams, systems, and lifecycle stages.

Without the thread, Twins become outdated static models, and teams lose confidence in the data.

Shifting Insight 'Left' to Reduce Cost and Risk

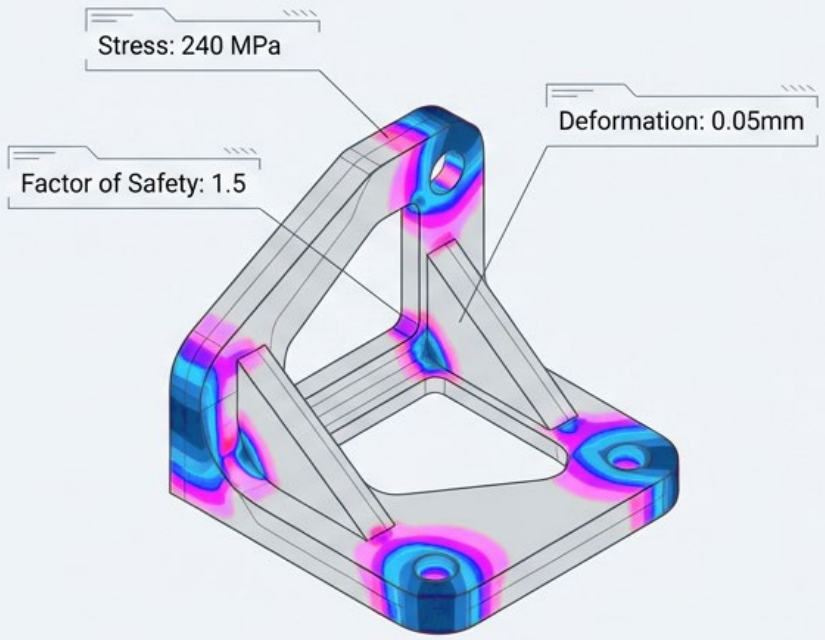


By shifting insight earlier in the lifecycle, digital twins help organizations make decisions when change is least expensive.

- Earlier Validation: Validate before prototypes exist.
- Reduced Rework: Catch errors virtually.
- Faster Time to Market: Proceed with confidence.

Application: Design & Engineering

Deep Dive 1 of 3



Identifying stress concentrations before metal is cut.

Focus: Validating concepts and identifying risks in the virtual domain.

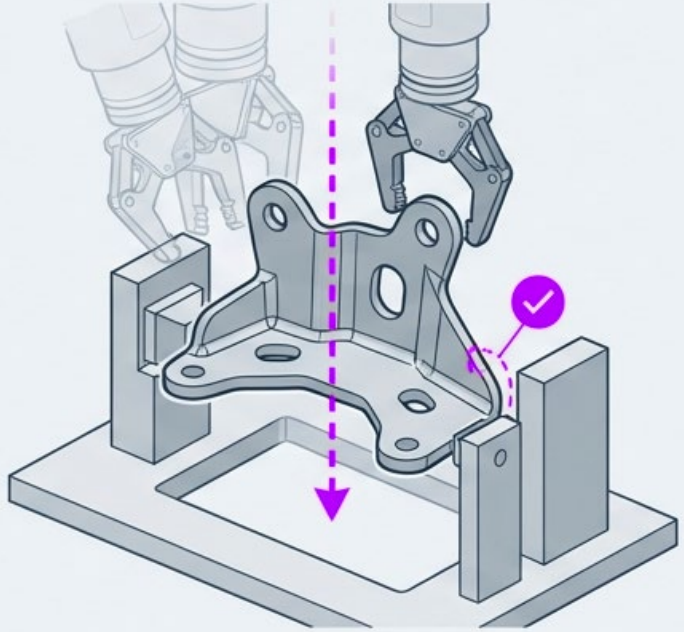
Use Cases:

- Virtual Prototyping: Validate concepts earlier using simulation.
- Risk Identification: Identify performance issues and design risks before physical prototypes are built.

Outcome: The 'As-Designed' view becomes a reliable predictor of reality. z

Application: Manufacturing Planning

Deep Dive 2 of 3



Simulating assembly paths to ensure clearance and tool access.

Focus: Assessing feasibility and readiness.

Use Cases:

- Manufacturability Assessment: Assess assembly feasibility and production readiness earlier in the process.
- Surprise Reduction: Reduce downstream surprises and costly last-minute changes on the shop floor.

Outcome: Better collaboration between engineering and manufacturing teams.

Application: Operations & Continuous Improvement

Deep Dive 3 of 3

Real-world operational data feeding back to Engineering.

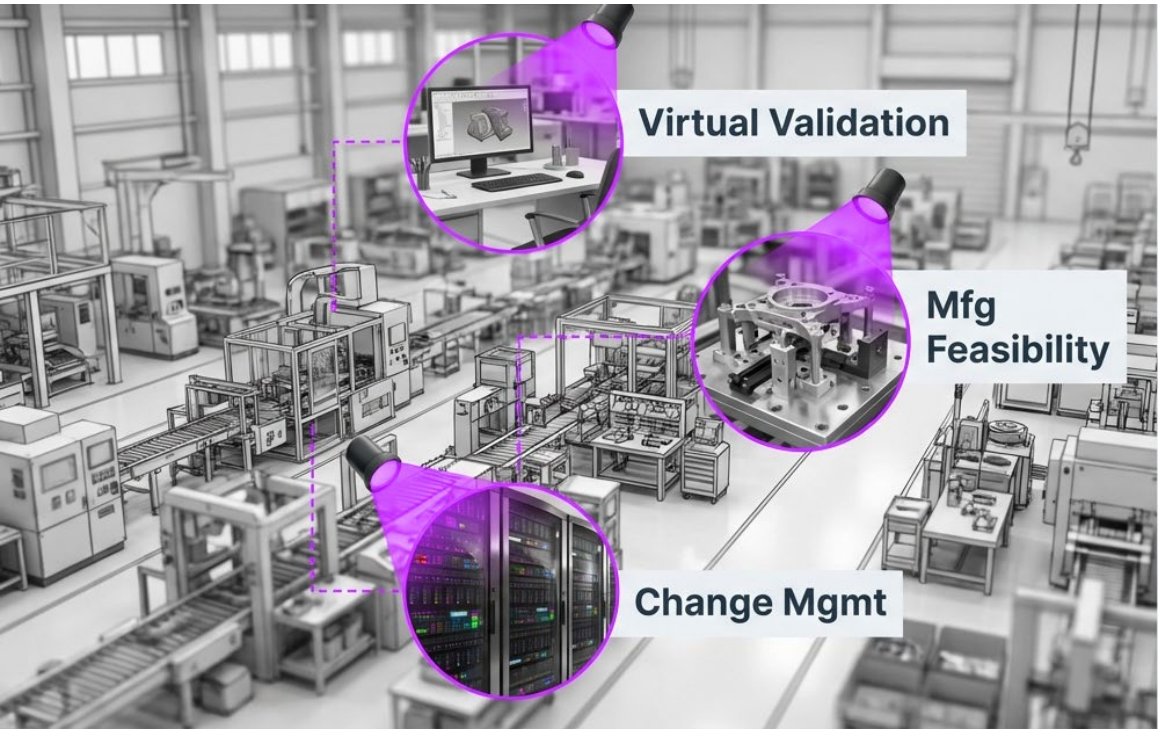
Focus: Managing change and closing the feedback loop.

Change Management: Maintain alignment as designs evolve. Ensure changes are traceable.

Continuous Improvement: Use lifecycle insight to inform service strategies and feed operational data back into Design.

Key Takeaway: The value increases as it moves beyond a single phase.

Where Companies Actually Start



Insight: Despite the hype, most organizations do not begin with a fully realized, end-to-end digital twin. Successful initiatives start small.

Recommended starting points:

1. Virtual Design Validation
2. Manufacturing Feasibility
3. Change Management

Navigating the Transformation: Pitfalls & Antidotes

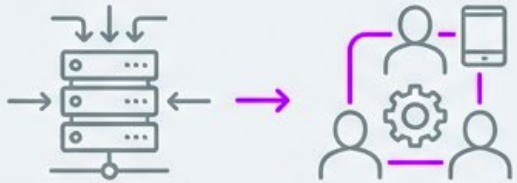
The "Big Bang" Approach

Chaotic Implementation → Focused Use Case

Pitfall
Mistake: Trying to implement everything at once.

Antidote
Correction: Start with a focused, high-value use case.

The "IT Project" Trap

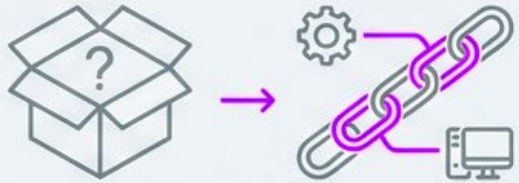


Pure Technical Initiative → People, Process, & Data Readiness

Pitfall
Mistake: Treating digital twins as a purely technical IT initiative.

Antidote
Correction: Balance technology with people, process, and data readiness.

The Data Void



Unclear Data Ownership → Established Digital Thread

Pitfall
Mistake: Overlooking data ownership and governance.

Antidote
Correction: Establish clear ownership and the 'Digital Thread' early.

Starting the Conversation

The right approach looks different for every organization. Do not start by selecting tools. Start by assessing:

1. Identify Value: Where is value created today in your specific workflow?
2. Connect Processes: How disconnected are our current processes and data?
3. Assess Readiness: Have a focused discussion around lifecycle goals.

Final Thought: The goal is a consistent, current view of the product to drive better decisions.

Contact us for more information!

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