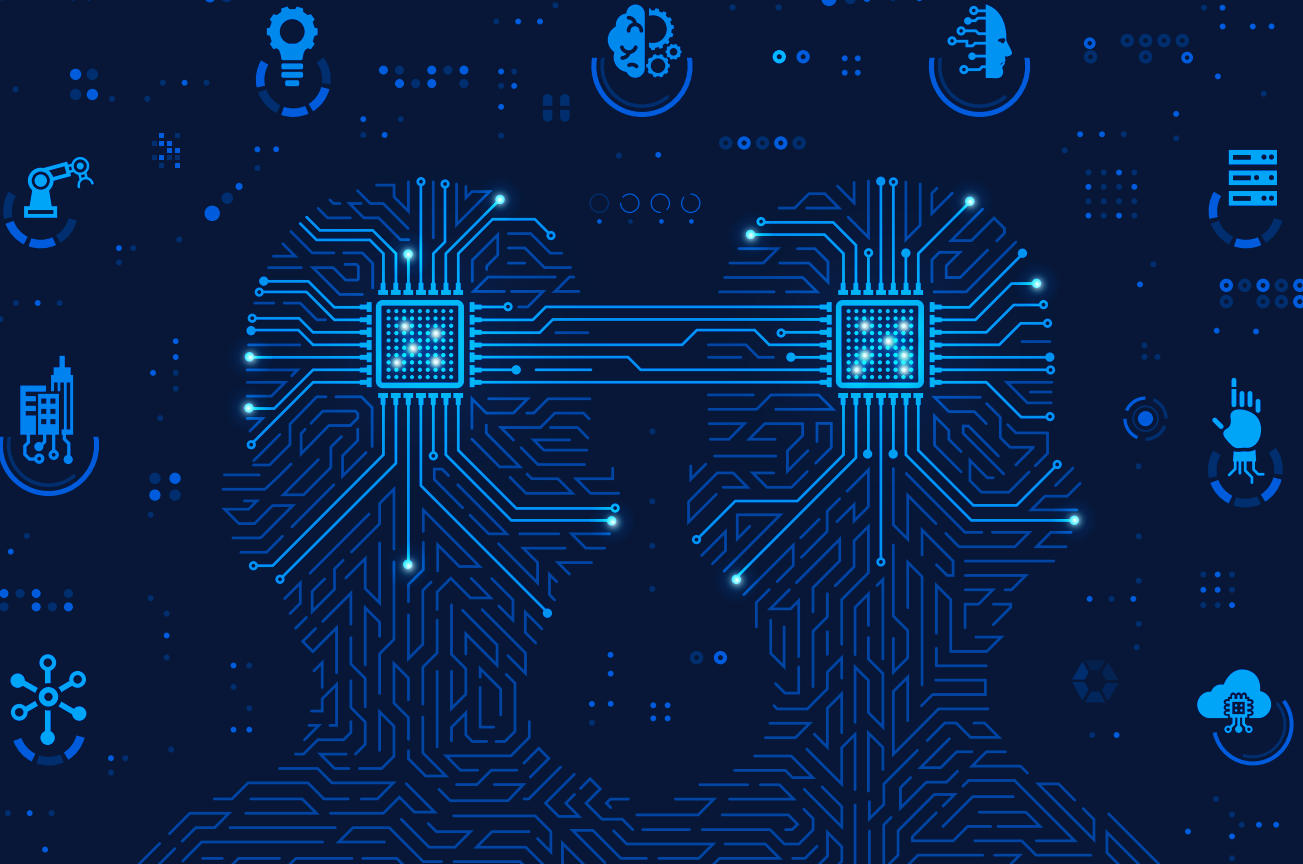


Embracing the Digital Twin Technology

Special Edition for **Manufacturers, Logistics Professionals, and Supply Chain Managers**



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The Industrial Internet of Things (IIoT) has extended access to big data with powerful sensors embedded across the ecosystem. As digital intelligence meets physical assets, companies quickly learn to improve productivity and reduce costs. Digital twin technology is revolutionizing product development, and its ripple effect is being felt across the supply chain. Read this e-book written by **Sudha N Bharadwaj** to stay attuned.

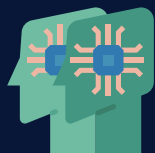
You Will Learn About:



The advent of the Fourth Industrial Revolution & the IIoT



The significant role of sensors and big data



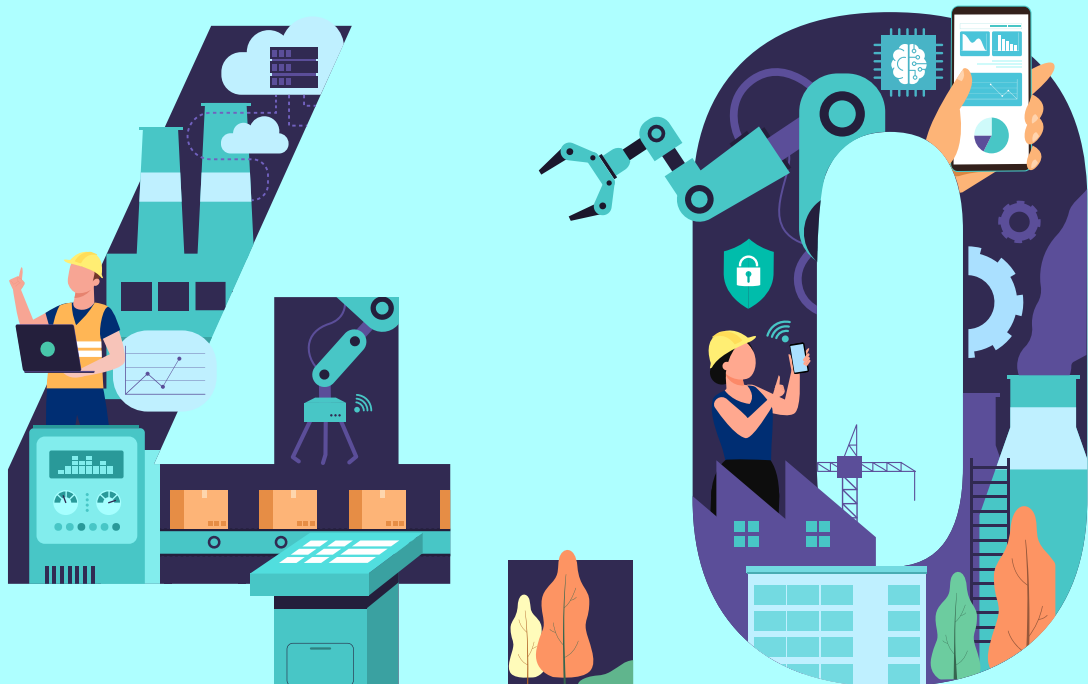
The revolutionary digital twin technology



The scope for digital twins in logistics and supply chain management

Chapter 1

Origins of the Fourth Industrial Revolution



We often do not recognize and act upon the changes that occur under our noses. For the past decade, you may have noticed the following technological advances:



Digitalization – The use of digitized data and technologies to improve industrial processes



Automation – The minimization of human intervention to carry out mechanical & repetitive tasks



Cloud Computing – The use of information and communication technologies over the internet to boost business performance



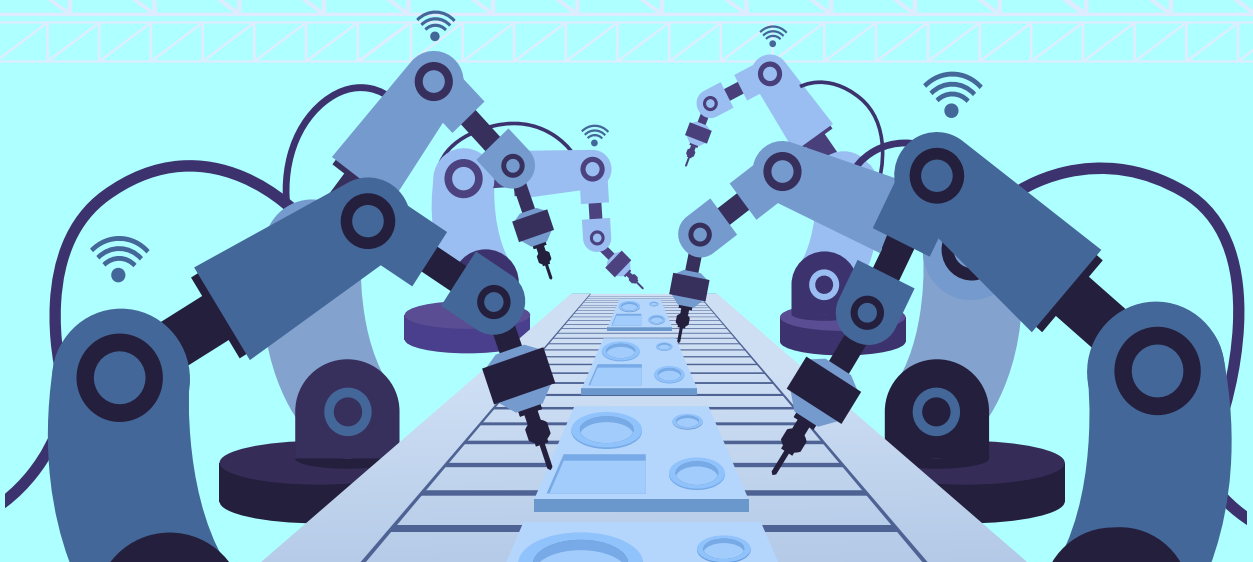
Pervasive Computing – The use of wireless, embedded, and internet technologies to enable everyday objects to become digital mediums

Many of you may not realize even now that it is these trends that have given shape to the Fourth Industrial Revolution. Maybe you skipped that post-lunch seminar session a couple of years ago on the Internet of Things (IoT). Perhaps you dismissed Artificial Intelligence (AI) as an R&D subject. If you are a logistics and supply chain manager, we bet you thought Big Data was hype, and all you need is an ear to the ground.

Well! Think again.

Chapter 2

Industry 4.0 and the IIoT



Industry 4.0 is alive and kicking. It is about real-time data and insights, and an explosion of technologies is powering it.



AI (human-like capabilities in machines)



Machine learning (algorithms that learn)



Cyber-physical systems (computational links between cyber and physical world)



IIoT (Industrial IoT) and operational technology come together for efficiency



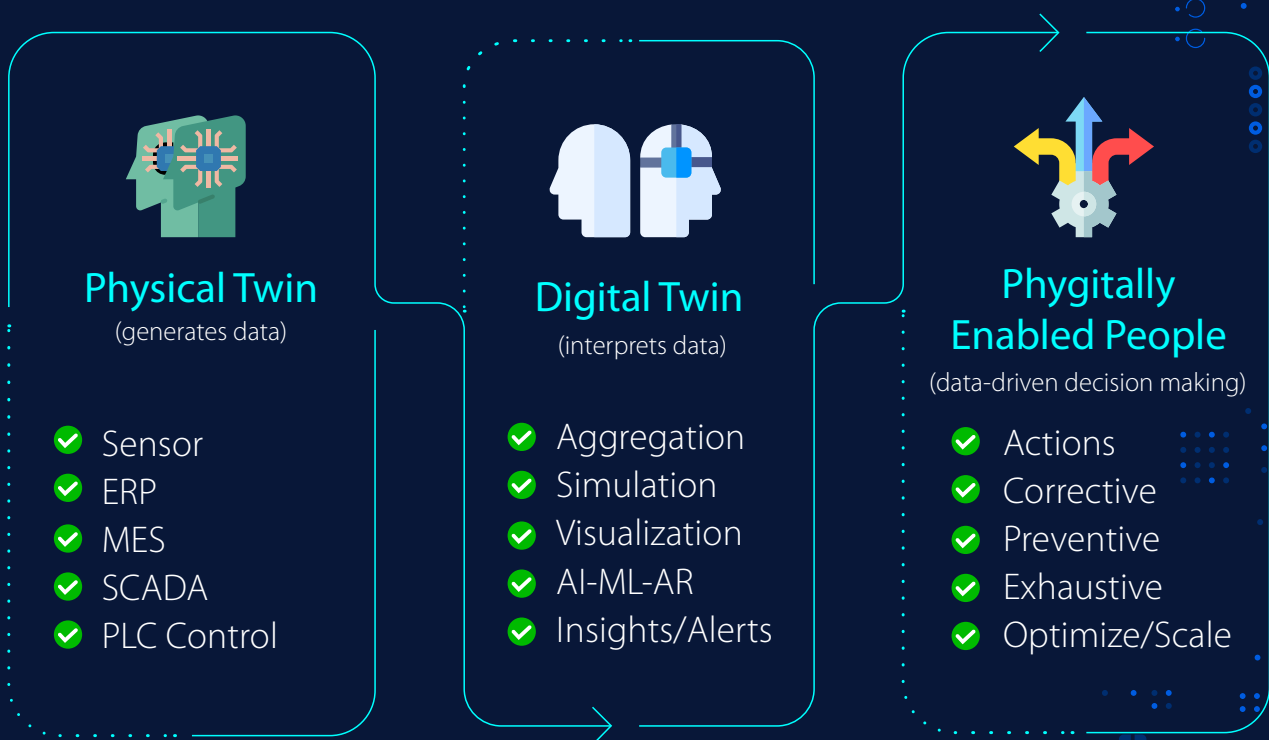
Augmented reality (digital simulation as an extension of the physical world)

Specifically, the multitude of sensors in the Industrial Internet of Things (IIoT) has disrupted the industry, adding the power of data to domain knowledge.

An amazing technology called digital twin is already making this happen across production plants, supply chain and logistics network in the oil and gas, utilities, smart cities, pharmaceuticals, aviation, automobile, and retail sectors.

Digital twin is a virtual simulation of any physical asset or activity – a machine, a manufacturing process, or an entire network. It is endowed with real-time intelligence on the status of the physical asset, its production space, and work environment and is capable of deep insights that include:

- ✓ Early warnings on failures
- ✓ Continuous prediction of possible events
- ✓ Options to optimize outcomes



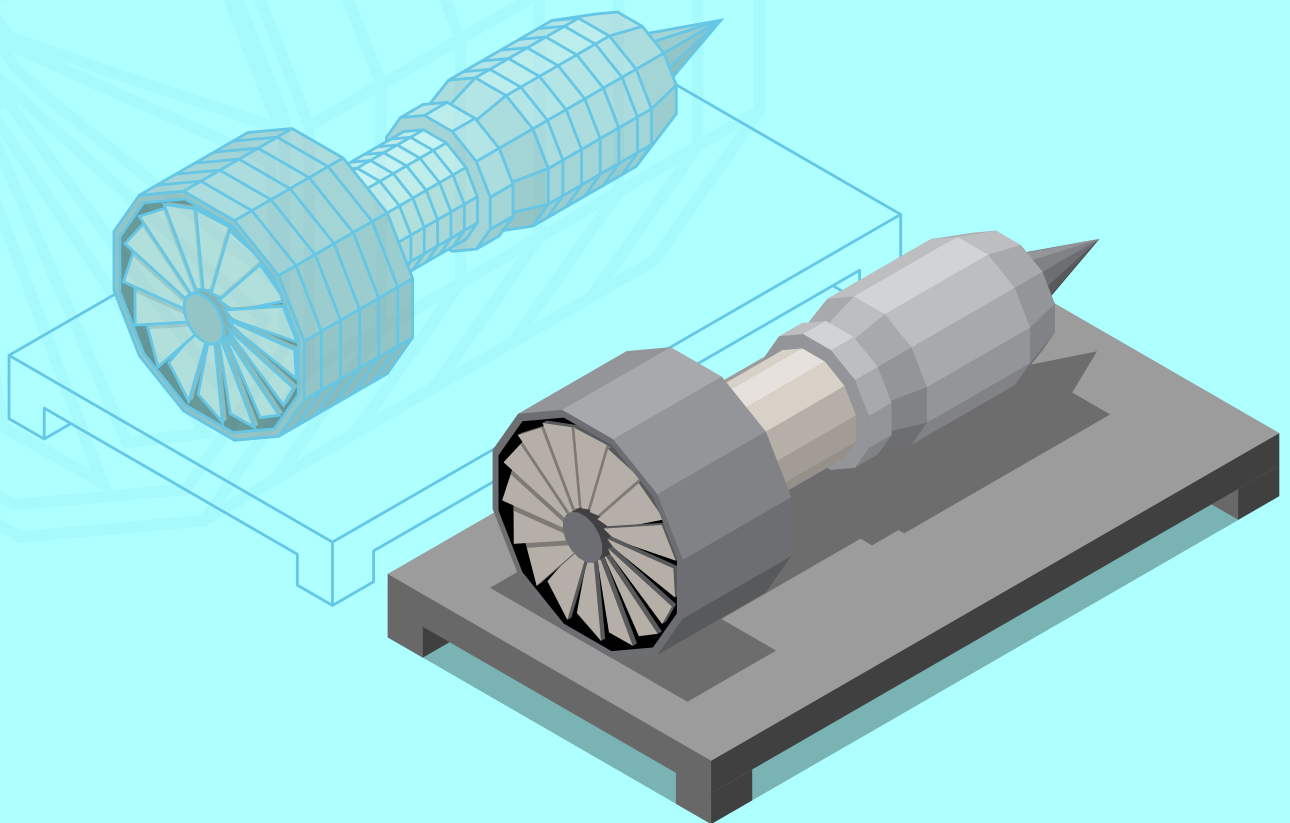
The digital twin has three building blocks - Data, Connections, and Output. It is seen as a precursor to the Industrial Metaverse.

So, leverage digital twin technology now. Your competitors and partners are already doing it.

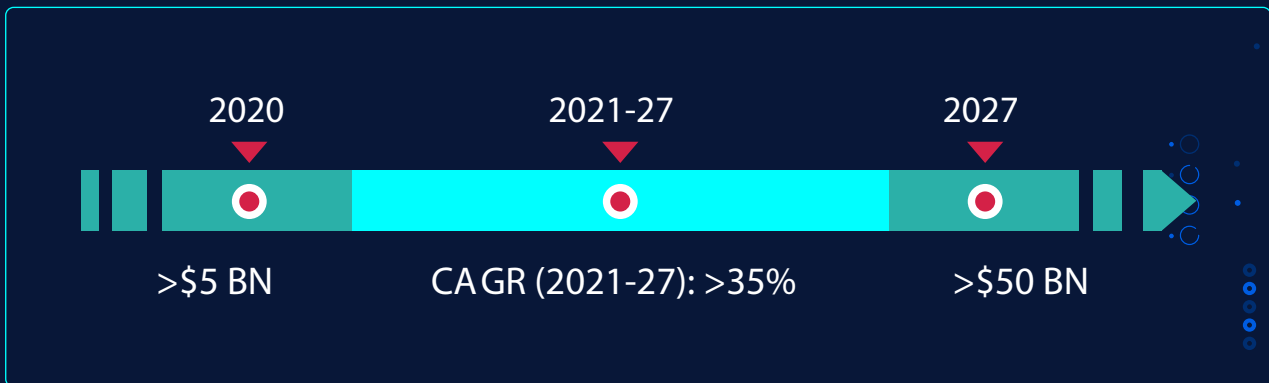
[IDC](#) has predicted that, by 2025, 80% of industry ecosystem participants will leverage their product, assets and process digital twins to share data and insight with other participants.

Chapter 3

The Digital Twin Market



Global Market Insights, the market research and consulting firm, reported that [the digital twin market exceeded \\$5 billion in 2020](#). Between 2021 & 2027, it is expected to reach \$50 billion in value, growing at a CAGR of 35%. The growing adoption of digital twins in supply chain management is one of the main drivers of growth.



10 Benefits of Digital Twins Adoption

- 01 Improves efficiency
- 02 Saves costs
- 03 Simplifies processes and workflows
- 04 Reduces time to market
- 05 Initiates new business models
- 06 Increases sales
- 07 Promotes customer centricity
- 08 Advances the use of technology
- 09 Contributes to sustainability
- 10 Empowers & protects the workforce

Digital Twins: A Snapshot of Use Cases

Manufacturing

- ✓ Yield optimization
- ✓ Overall equipment efficiency
- ✓ Predictive maintenance
- ✓ Process optimization



Healthcare

- ✓ Design of drugs & devices
- ✓ Personalized medicine
- ✓ Virtual organ simulation
- ✓ Surgical procedure planning



Oil & Gas

- ✓ Real-time oil field monitoring
- ✓ Reduced drilling time
- ✓ Workforce fatigue detection
- ✓ What-ifs asset performance



Automotive

- ✓ Assembly line simulation
- ✓ Vehicle trials, test, & tracking
- ✓ Visualized buyer preferences
- ✓ Vehicle health records



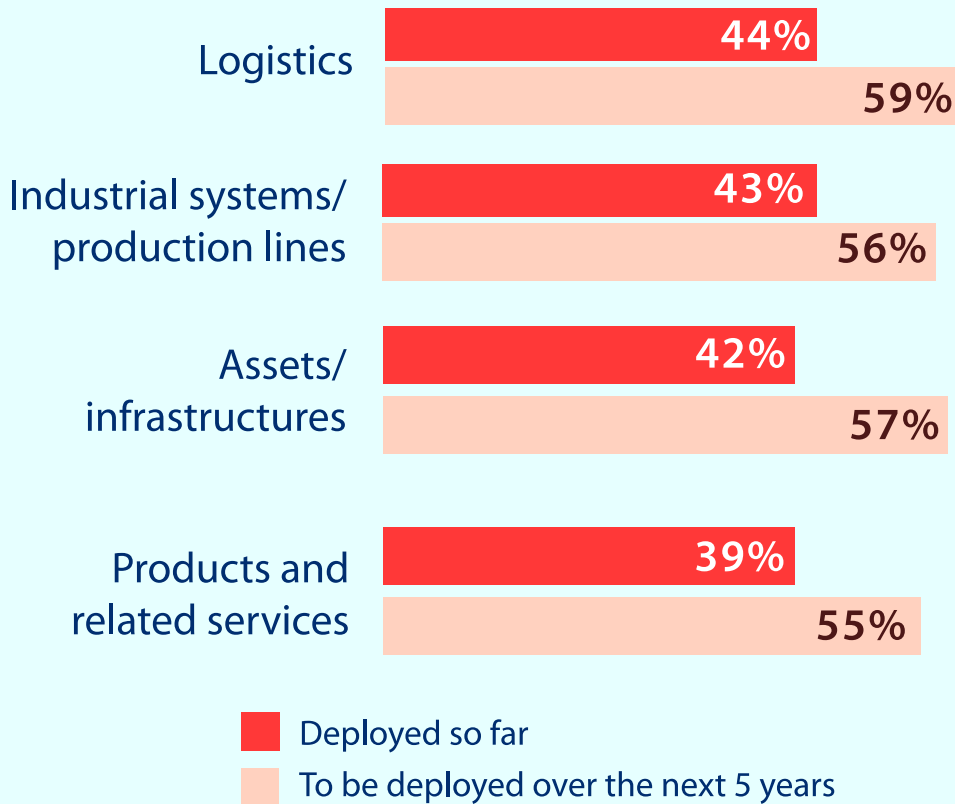
Logistics

- ✓ Packaging material feasibility
- ✓ Minimized product damage
- ✓ Smart warehousing systems
- ✓ Cargo, container hub optimization



The Capgemini Research Institute has found that logistics tops the list of implementations among the organizations that have already deployed the digital twin technology.

Organizations already working on digital twins are set to increase their deployments



Source: Capgemini Research Institute, Digital Twins survey, September–October 2021, N=800 organizations with ongoing digital twin programs.

Gramener has also made an impact with its digital twin solution, which has helped improve the manufacturing process in the [pharmaceutical industry](#).

We are offering new and innovative solutions for the logistics and supply chain industry. We are ready to partner with you to spruce up your shop floor, optimize your warehouse, improve your packaging operations, and perform predictive maintenance to augment overall equipment efficiency.

Gramener has a highly qualified band of digital twin engineers who follow great rigor in the building process of the digital twin - be it a part, product, asset, process, or system digital twin. We have the capabilities and experience in building digital twins to achieve real-time, predictive, and prescriptive analytics through:

Status Twin

Created with visualization tools, it gives a status report of operating parameters, identifies bottlenecks with real-time monitoring of production and sound alarms, and sends alerts on dashboards and through alerting systems.

Operational Twin

Provides decision-support to engineers to make changes to operating parameters for a set of actions or workflows based on AI-driven recommendations and diagnoses.

Simulation Twin

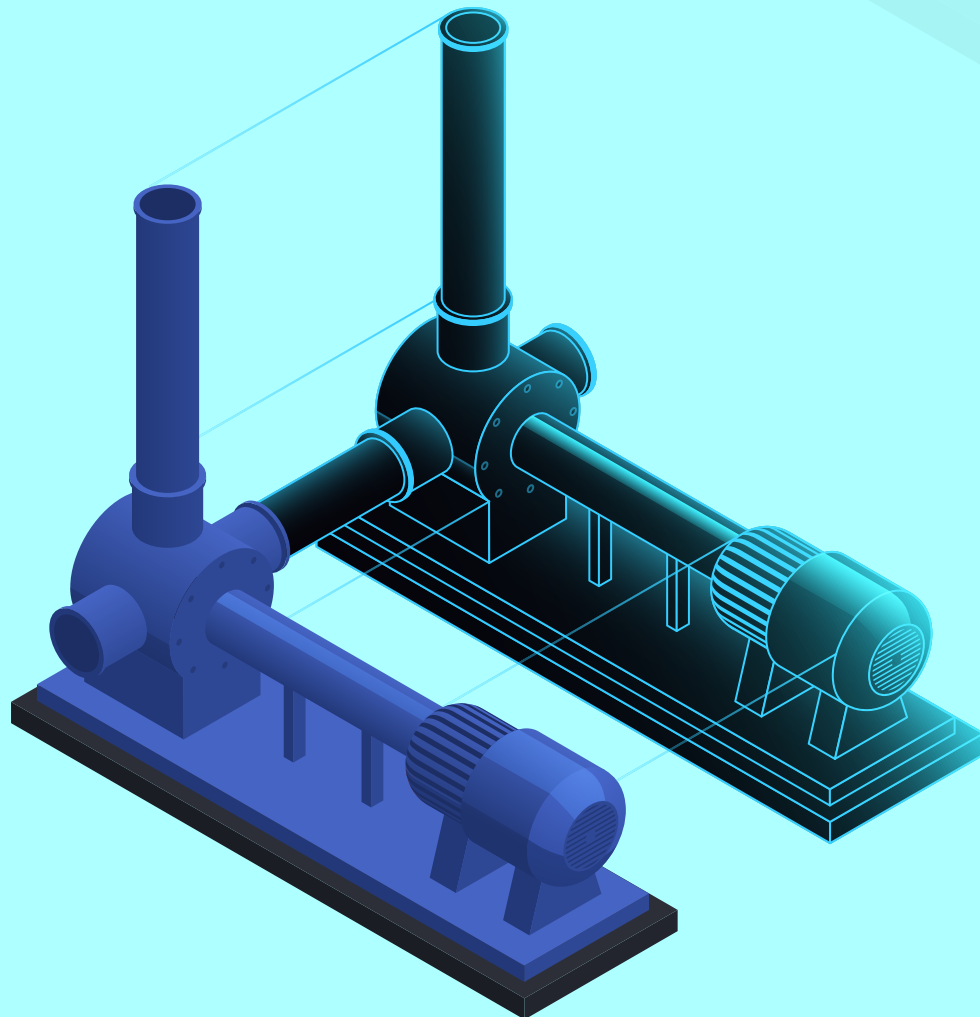
Provides step-by-step process support with different simulations in real-time and controls the outcome, preventing bad batches.

Predictive Twin

Provides insights into future outcomes based on AI-ML forecasting models that simulate different combinations of variables before the actual process or production run.

Chapter 4

Building a Digital Twin



After identifying the business problem, Gramener works extensively with data to:

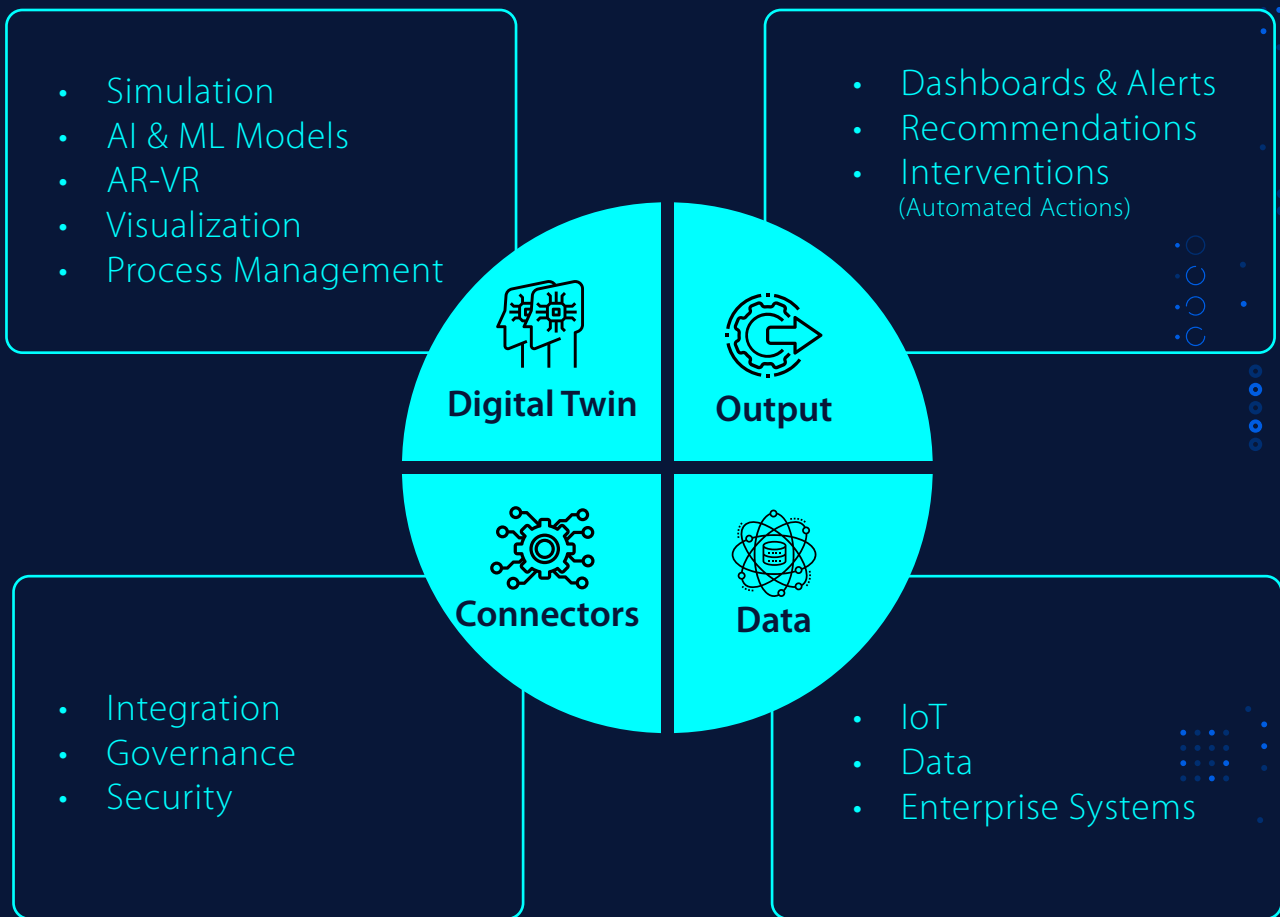
- ✓ **Capture** the data flow from sensors attached to the asset and integrate information flow from enterprise systems used for transactions and operations.
- ✓ **Determine** what kind of data is needed from the physical asset. From which stage of the lifecycle of the asset is it required? And what parameters and attributes need to be tracked?
- ✓ **Secure** access to the digital twin and control the physical asset through it with fool-proof authentication and encryption.
- ✓ **Operate** the functionality of the digital twin and finetune it needs to do. That is where sophisticated use of AI & ML will kick in.
- ✓ **Augment** the digital twin simulation by refining the model and adding more functionalities.

How We Execute a Digital Twin Solution

1. Once data patterns are established, the model is scored, validated, and evaluated for accuracy.
2. Hyper-parameters refine the model for utmost precision.
3. Tried and tested models are built into the digital twin.
4. Real-time data is tapped to uncover actionable insights into a business problem, predict outcomes and recommend options to aid decision-making.

Here is a reference architecture used to build digital twin solutions:

Virtual World (Process Twin with Attributes)



Real World (Devices, Assets)

At Gramener we have honed our [data modeling](#) skills by undertaking several projects for clients and we are using this expertise to carry out successful digital twinning with the low-code approach.

Chapter 5

Low-Code Digital Twins



Building a digital twin on a low code platform is simpler, faster, and more flexible. Updating and maintaining it is also cost-effective. Using pre-built code components and a domain-specific array of microservices, functional heads across industries can participate in building the digital twin with agility.

Data Science + Low Code = Gramener Digital Twin offering

Gramener has developed Gramex, a low-code digital twin building SaaS platform with an open code, modular approach to data analytics applications. Watch this introductory [video](#) of our offering.

- ✓ Minimal hand-coding: Drag-and-drop feature
- ✓ Visually intensive & interactive programming
- ✓ 5X cost reduction: Beats custom-built, commercial off-the-shelf, & OEM offerings
- ✓ Go to market in weeks: Better than the industry average by half
- ✓ Robust security features: Easy integration

Gramex

Advantages

- Low code fosters continuous improvement, which means that the feedback loops to the physical twin remain dynamic.
- It extends collaboration and integration across different IT systems, simplifying workflows and facilitating data migration across digital platforms.
- It drives consistency across the digital thread and organization in comprehending data intelligence and linking it to business outcomes.
- It promotes accessibility and a culture of sharing and reuse across multiple digital twins, which in turn helps to scale faster.
- It encourages innovation, as there is no need to develop physical prototypes and run costly tests.

What Gramener Team Does

- ✓ Extracts raw data from the client environment
- ✓ Cleans data
- ✓ Correlates data to a business problem
- ✓ Uploads it on Gramex
- ✓ Applies AI-ML models to resolve the issue and train for accuracy
- ✓ Completes the digital twin layout for an optimized process
- ✓ Readies the application for deployment

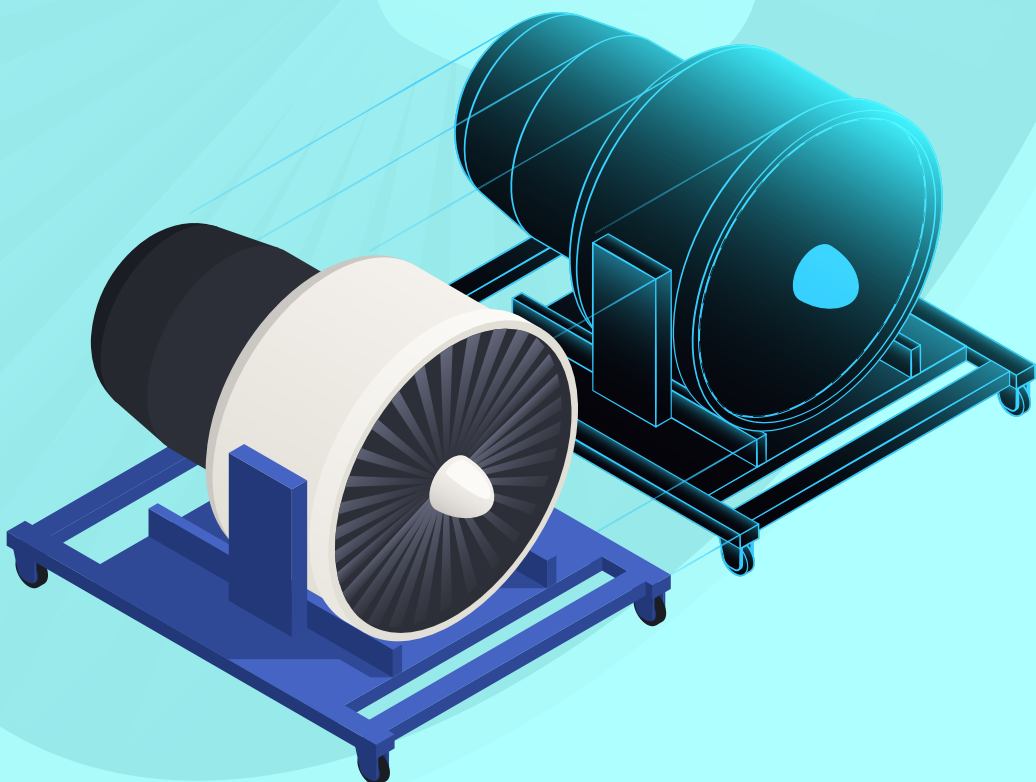
What Client Organizations Get

- ✓ 45% reduction in efforts
- ✓ User-friendly high-end digital twin solutions
- ✓ Ability to test multiple solutions in parallel
- ✓ Customized solutions for specific industrial setups
- ✓ Freedom to experiment with processes outside the shop floor
- ✓ Innovate and test what works best without risk
- ✓ Empowered engineers who ensure a competitive edge

Reach out to us for a customized digital twin solution with the unbeatable benefits of being “Built on Gramex.”

Chapter 6

How Does Gramener Work with Digital Twins?



Gramener has proven expertise in digital twins. We have handled [process twinning](#) of the manufacturing process to achieve:

- ✔ **Yield Optimization:** We put a simulator twin and predictive twin into action on a virtual shop floor and analyzed machine and sensor data to help a pharmaceutical major achieve a 2.6% increase in output and \$ 6 million in annual savings.

This is how we did it:

Pharma client pain point: unable to maintain high quality in drug manufacture

- ✔ Gramener analyzed batch process datasets to pinpoint anomaly with Exploratory Data Analysis
- ✔ Tracked golden batch parameters at different process stages with AI/ML

Developed an accurate model & built a process simulator digital twin on Gramex

- ✔ Production manager could see effects of temperature changes when optimizing processes
- ✔ Achieved 13% reduction in wastage and 11% increase in production yield

Our digital twin led to a quality predictor for use on the shop floor to control variables

- ✔ Senior executives could intuitively use it to tweak processes and improve yield
- ✔ Saved on energy and production costs, and improved on efficiencies

Value: The pharmaceutical client was able to correlate operational and material parameters and improve the production yield of ten compounds, replicating the digital twin solution.



Equipment setup time reduction

With another pharmaceutical client, Gramener's digital twin solution helped to reduce equipment setup time by 67%.



Downtime reduction

At a milling site, Gramener installed vibration and ultrasonic sensors, data from which helped the Gramener digital twin tool identify fragility in spindles. A Dynamic Dashboard and an Alert System now monitor the health of the machinery and ensure timely maintenance.



Predictive maintenance

A beverage company grappled with clogged pipelines that affected heat flow. Gramener analyzed data from heat flow and temperature sensors to determine threshold values, and our digital twin solution sounded an alarm, prompting maintenance.



Optimizing warehouse management

A 3PL provider wanted to explore the impact of overtime on its facility. A digital twin simulation analyzed staff deployment, inbound loads, and outbound turnaround time to warn the company of the impending customer service failure, with inbound loads piling up. It also recommended training and efficiency improvement measures to handle problems efficiently.

Chapter 7

Build a Digital Twin of Your Supply Chain & Logistics Network



Digital twins not only enhance production and process efficiencies but also provide visibility of a product across its lifecycle. Organizations must take a more holistic view of products and the supply chain that props them up. Inventory costs, availability, and lead times of supply chain networks have to be factored in. Faster and flexible manufacturing will place demands on inbound and in-plant material flows, and there will also be a need for superior logistics management.

Did you know that a real-time digital twin can

- ✔ Remove supply chain bottlenecks
- ✔ Suggest warehouse layout improvements
- ✔ Protect shipments by tracking products and packaging data
- ✔ Alert you to natural disasters and accidents and re-route you

If you didn't before, you do now. Reach out to Gramener for a [demo](#) and join the growing community of digital win technology adopters.



Let's Connect

Learn more about Gramener's custom digital twin solutions

[BOOK A CALL](#)

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