CatDt

The Compositional Digital-Twin Engine for North American Supply Chains

Building predictable, flexible, compositional supply-chain networks for the nearshoring era.

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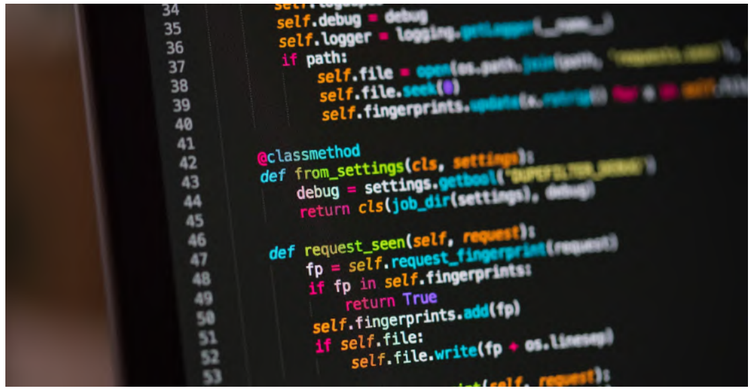
Supply chains: The Problem

Supply chains are the networks that move goods from factories to customers — a multi-trillion-dollar system that powers modern commerce. But these networks are fragile, and hard to model end-to-end



The US–Mexico–Canada corridor moves **$2T per year**, yet companies still operate with **<40% end-to-end visibility**.

Traditional numerical modeling methods fail. Small changes in one part produce unpredictable global effects.

No platform today provides a **unified, mathematically consistent representation** of supply-chain behavior

Companies cannot reliably predict disruptions or design resilient configurations, leading to costly failures and inefficiencies.

Digital Twins technology

Digital twins (DTs) are virtual replicas of physical systems.
They are a **core enabling technology** in modern manufacturing and healthcare, with a global market valued at **~$15–20B (2024)** and projected to exceed **$100B by 2030**.

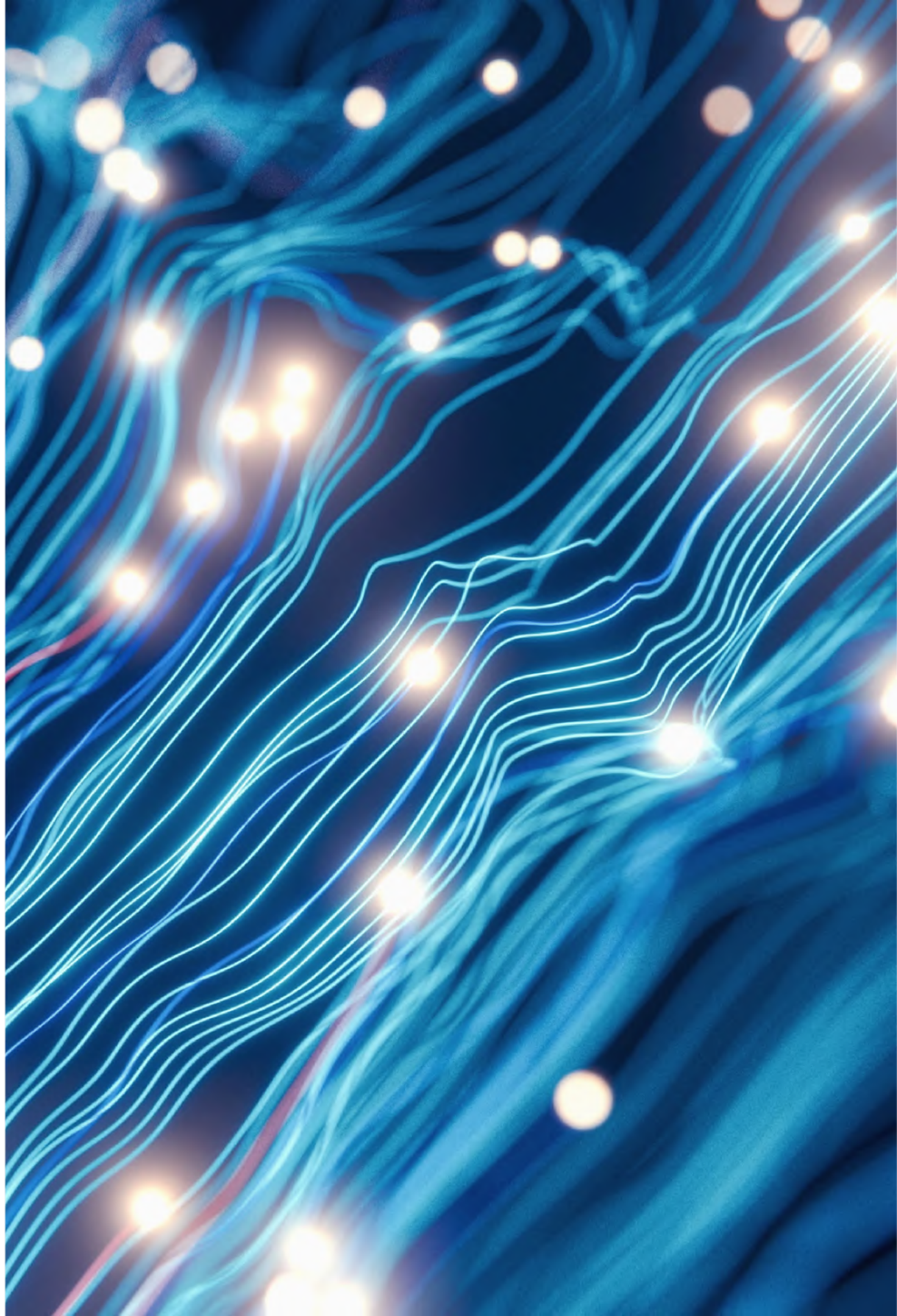
DTs are increasingly used in manufacturing and supply chains to monitor assets, simulate operations, and support decision-making. However, when supply chains are treated as end-to-end networks rather than isolated assets, today's digital-twin approaches fall short.

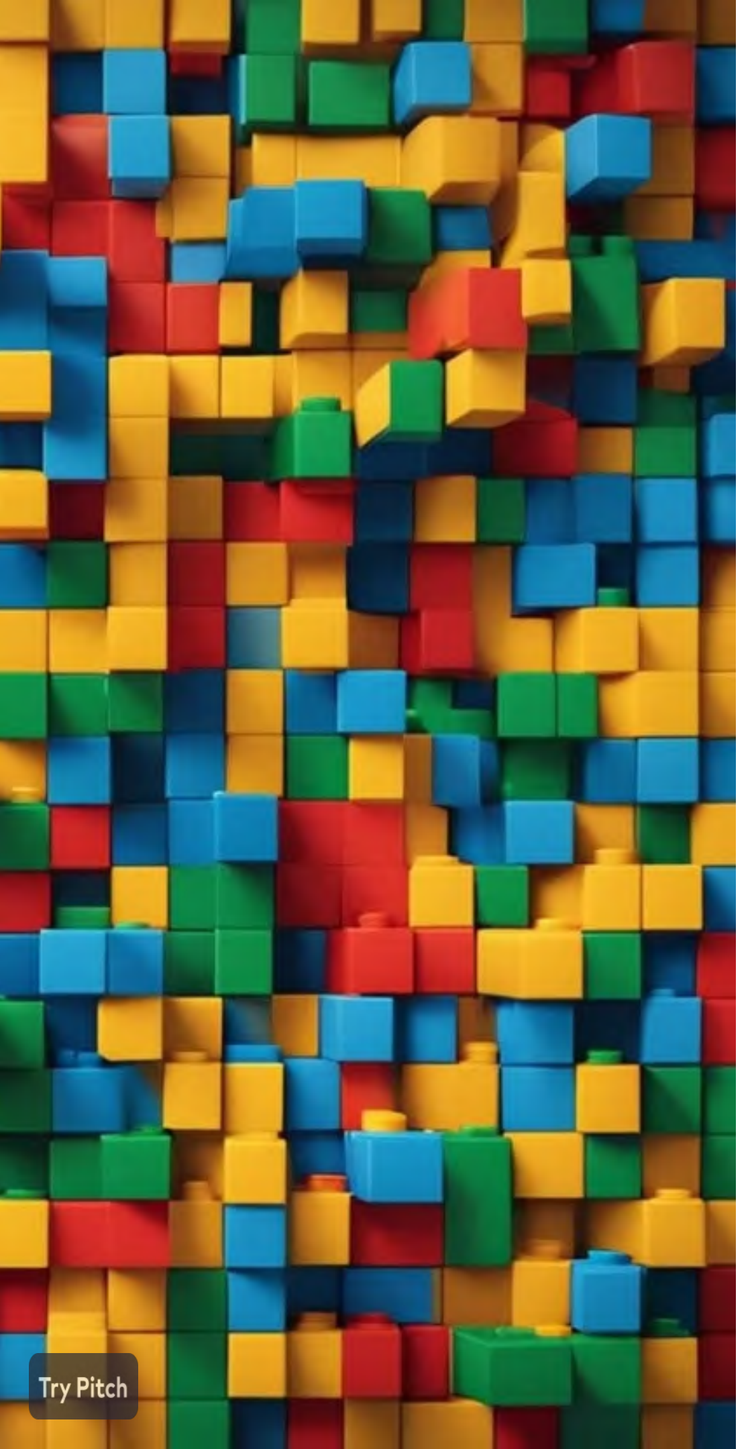
What DTs do today

- Model **machines, warehouses, factories**, or isolated processes
- Enable **real-time monitoring** and **local what-if simulations**
- Improve decisions **within** a single system

Why DTs fall short in supply chains

- Current DTs model **assets**, not **networks**
- They cannot represent how processes **interact across systems**
- They cannot be **glued together** into one consistent model
- Supply chains require **system-of-systems** modeling





CatDT: The solution

CatDT is a compositional digital-twin engine that models entire supply-chain networks. It is delivered as enterprise software that integrates with existing ERP, TMS, and WMS systems.

CatDT provides:

- A **unified mathematical architecture** for processes, flows, constraints, and events
- **Composable digital twins** of facilities, carriers, inventories, and logistics operations
- Integration across **planning → simulation → optimization → execution**
- A modular architecture that lets companies **build and reconfigure their supply chains from interoperable components — assembling them the way one constructs a system from well-fitting Lego pieces**

CatDT enables companies to design, test, and optimize supply-chain configurations *before* executing them.
This is something no current DT or supply-chain platform can do.

How CatDT Works

CatDT integrates disconnected enterprise systems into a single coherent digital twin by giving supply-chain networks a formal, compositional modeling language — a domain-specific language (DSL) grounded in category theory and implemented with modern, high-performance software tools.

Architecture Layers:

Physical Layer

Represents the real-world network: facilities, transportation links, inventories, and flows. Expressed in a **compositional DSL**, where each component has well-defined **syntax and semantics**, enabling predictable behavior when components are assembled.

Simulation Layer

Compositional, event-driven simulation that shows how local actions propagate across the entire network.

Optimization Layer

Network design, resource allocation, routing, and scheduling — all powered by the same unified model.

Execution Layer

Enterprise-grade APIs that connect back to ERP, TMS, and WMS systems, allowing CatDT to propose or execute optimized configurations.

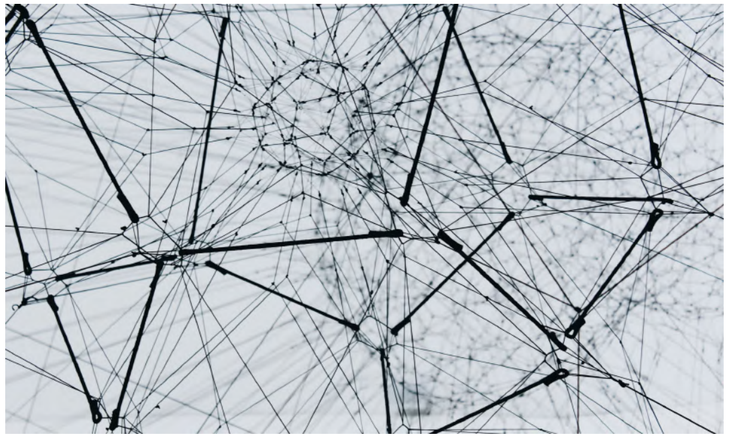
Defensibility

CatDT's compositional DSL — with precise syntax, semantics, and guaranteed system-level behavior — is technically unique in this space and extremely difficult to replicate. No existing supply-chain or digital-twin platform offers anything comparable.

Why now?

Nearshoring is accelerating across North America

Manufacturing is moving into Mexico and the U.S., creating **new facilities, new routes, and new interdependencies**. Companies urgently need tools that can model these emerging networks before committing to redesigns.



Current supply-chain tools can’t keep up

Post-COVID variability exposed the limitations of traditional planning, simulation, and optimization tools. None can model network-level behavior or capture interactions across disconnected systems.

The technology timing is finally right

Advances in **formal modeling, compositional software, cloud-native simulation, and AI-driven optimization** now make large-scale, predictable digital twins feasible. This was not practical even 5 years ago.

Why Now for CatDT

A perfect convergence of **market demand**, **nearshoring pressure**, and **new mathematical/software capabilities** creates an opportunity to define the next generation of supply-chain digital twins.

Market & Go-To-Market

Initial Target Customers

- **JB Hunt**
- **Hub Group**
- **XPO**
- **Ryder**
- **Amazon Freight**
- **Grupo México Transportes (GMT)**
- **Google Logistics / Google Supply Chain**
- **FEMSA / Solistica**

These organizations are deeply involved in nearshoring, multimodal logistics, and large-scale network design. They represent ideal early adopters — both for initial pilots and long-term enterprise deployment of CatDT.

Market Context

North American nearshoring is reshaping manufacturing and logistics networks across the US–Mexico corridor. Companies are actively redesigning their end-to-end operations and require predictive, system-level modeling capabilities that current tools cannot provide.

Go-To-Market Strategy

CatDT will begin with targeted pilots that demonstrate the benefits of compositional modeling in real operational environments. Successful pilots transition into enterprise adoption through SaaS licensing, integrations, and supply-chain design consulting. **Over time, CatDT will support a marketplace of composable supply-chain modules built on top of its DSL.**

Milestones

Milestone 1
Core Engine (Q1)

- Compositional DSL with defined syntax and semantics
- Physical + Simulation layers implemented
- Internal validation of modeling framework

Milestone 2
CatDT v0.1 Prototype (Q2)

- First operational prototype (modeling + simulation stack)
- Initial data onboarding with selected operators
- Whitepaper draft completed

Milestone 3
Pilot Deployments (Q3)

- Execute **1–2 pilots** with mid-tier logistics operators
- Collect performance data and produce case studies
- ERP/TMS/WMS integration layer extended

Milestone 4 — Traction & Pre-Seed Preparation (Q4)

- Publish technical whitepaper + pilot results
- Form strategic partnerships (logistics + tech)
- Finalize materials for a **pre-seed raise**

Use of Funds — $90k SAFE

- Part-time PhD-level engineer (Julia/Python)
- Junior engineer (data + visualization)
- Supply-chain consultant
- Founder runway
- Cloud infrastructure for prototype + pilots
- Branding + investor materials

Purpose of This Round

Achieve **technical validation**, execute **pilot deployments**, and create the foundation for a scalable compositional digital-twin platform leading into a strong **pre-seed round**.

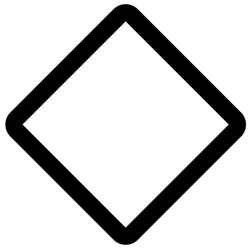
Founding team and technical contributors

Juan Orendain, PhD — Founder & Architect

- Mathematician specializing in compositional modeling, higher categories, and DSLs
- 10+ years research & teaching across US, Mexico, Japan, Germany, UK
- Designs CatDT's architecture, DSL, and technical roadmap

Ruben Maldonado Herrera, PhD — Technical contributor

- Expert in higher category theory, formal semantics, and compositional structures
- Expert in Julia, Python, and Catlab programming
- Supports DSL formalization and engine implementation



Fernando Herrera Ferreyra, M.S.C — Technical contributor

- Experienced in higher category theory, formal semantics, and compositional structures
- Expert in Python and DisCoPy programming
- Works on data pipelines, simulation testing, and visualization tools

Together, the team combines advanced mathematical expertise with practical modeling and software development capability — enabling CatDT to build technology that does not exist elsewhere.