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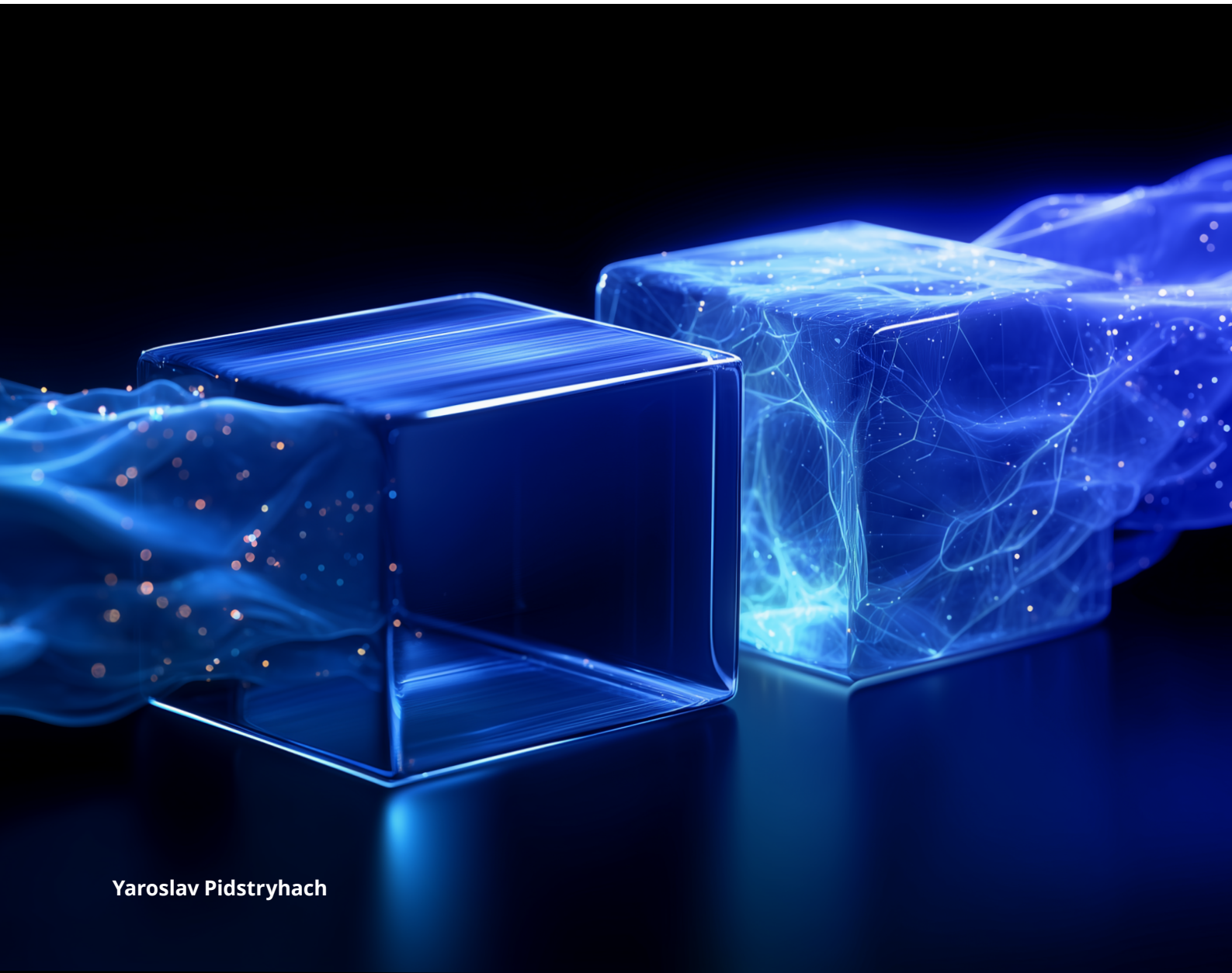
MOVE BEYOND ONE MODEL: EMBRACE MULTI-DIMENSIONAL VIEWS IN INDUSTRIAL IOT



Yaroslav Pidstryhach

Industrial operations are complex, with different teams needing different views of the same data. This white paper explains why a single, one-size-fits-all model often fails and how multi-dimensional views can solve this problem. We invite you to explore modern tools like IIoT platforms and digital twins that help teams share data without creating silos. Engineers, architects, and decision-makers will find practical ideas to improve collaboration and make better use of their data.

Rethink the one-model approach

As a manufacturing company, your shop floor is filled with machines, lines, utilities, warehouse locations, material flows, and work orders. You also have digital records of your assets and the measurements you collect. But if you don't want to settle for a scattered collection of data points, you need to build a higher-level model that reflects the reality of your operations.

Here's the challenge: In Industry 4.0, it's tempting to believe there's a single, perfect model of the plant waiting to be found. Organizations often invest heavily in standardizing one way to view assets and processes, hoping for a universal perspective that works for everyone. It's an appealing idea — but is it practical?

Consider these complexities:

1. Entities can belong to multiple categories. A pump might be part of a physical line, a maintenance route, and an energy group. Processes overlap — batches may involve mixers, tanks, and sensors that serve other workflows. A line's throughput might depend on several machines, each tied to different cost centers.

2. Some entities are logical, not physical. A virtual line might group machines for reporting, even if they aren't physically arranged that way. Metrics like health scores or quality risk indexes exist as calculated values, not physical objects.

3. Different users need different views. Operators focus on status, alarms, and throughput. Maintenance teams prioritize asset health and intervention cycles. Quality teams track process capability and traceability. Management looks at cost, utilization, and CO_2 output over time.

Clearly, multiple perspectives are more valuable than a single one.
The real question is: How well do today's industrial systems support this need?

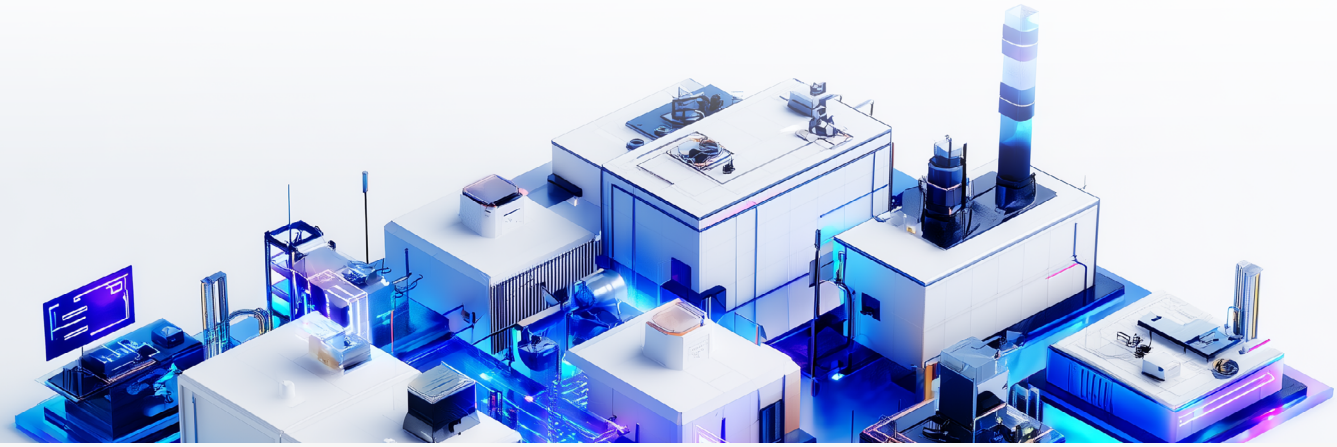
From tag lists to asset models

Industrial systems were not designed with flexibility in mind. Traditional SCADA, DCS, and HMI systems focused on tags — signals from PLCs — paired with manually drawn screens. The plant's model existed only in naming conventions and graphics, limiting its usefulness.

Enterprise time-series historians improved this by centralizing data from multiple systems, enabling trends and reports. However, the data remained basic: "tags plus time."

The shift began when vendors introduced asset-centric modeling on top of historians. For instance, PI Asset Framework (AF) provides a repository for asset models, hierarchies, objects, and equipment layered over the PI Data Archive. With AF, you can create asset templates, replicate them across sites, and organize them into hierarchies.

This marked progress from raw tag lists to semantic models. Yet even these systems often rely on a single dominant hierarchy, with one view prioritized for navigation and governance.



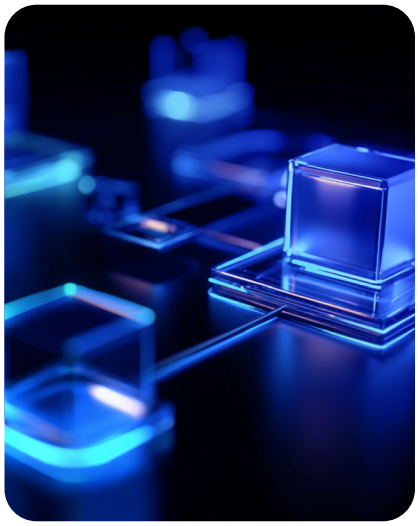
Modern tools for multi-dimensional views

Modern IIoT platforms and digital twin systems aim to solve a critical challenge: shared data with multiple perspectives.

Let's explore a few examples, noting three key principles they often share:

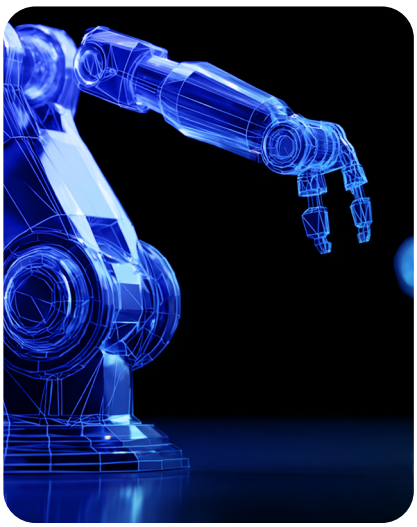
1. A richer information model that includes assets, processes, measurable parameters, and relationships — not just tags.
2. Support for synthetic attributes and metrics as core features.
3. The ability to project or reflect the model into different, tailored views.

OPC UA: Multi-Dimensional Views as a Standard



OPC UA introduces an AddressSpace where servers represent objects, variables, methods, and their relationships in a unified model. Beyond this, the standard defines Views — subsets of nodes within the AddressSpace. Each View highlights only the parts and relationships relevant to a specific use case.

This approach allows the same underlying model to serve different clients with tailored subsets and relationships. It's multi-dimensionality built into the protocol itself, not just a feature of the user interface.



Digital Twins: Entity Relationship Graphs

Cloud-based digital twin platforms take this concept further by treating environments as graphs. For instance, Azure Digital Twins represents each entity as a twin based on a defined model. Twins connect through relationships to form a graph that mirrors your environment. You can attach observed or synthetic properties to each twin and query the graph in various ways, offering flexible and dynamic perspectives.

Asset Models in IIoT Platforms

Platforms like AWS IoT SiteWise let you create asset models that represent equipment, processes, and facilities. These models include properties, hierarchies, transforms, and metrics. You can define assets at different levels — such as turbine, line, or plant — and organize them into hierarchies. The platform also supports transforms (calculations on incoming data) and metrics (aggregates over time or across hierarchies). Recent updates even allow for separate hierarchies for assets and interfaces, hinting at the potential for multiple view hierarchies over the same data.

Are Today's Platforms Perfect?

Not quite. Many still rely on a primary hierarchy for navigation or permissions, even when multiple hierarchies are technically possible. Some make it easy to create derived metrics but difficult to share them consistently. Crossing system boundaries — like OT to MES, MES to ERP, or ERP to analytics — remains a significant challenge.

However, compared to traditional SCADA systems and flat historians, these tools align much better with the concept of multi-dimensional views. For IoT architects working on enterprise industrial IoT solutions, embracing these tools and prioritizing multi-dimensionality from the start is essential.

Cross-functional impact

How do architectures that support multi-dimensional views benefit cross-functional teams?

When done right, they reduce the need for teams to create their own isolated data stacks, build separate pipelines, or guard data in silos. Teams can still develop specialized dashboards and reports, but these are grounded in the same shared model and unified technical foundation.

Another key advantage is the reduced burden on OT teams managing the operational data layer. With a flexible semantic layer above the raw signals, the underlying equipment, tag structures, and data pipelines can evolve without disrupting downstream views. This allows OT teams to focus on reliable data capture, while the semantic layer ensures user-facing perspectives remain stable and consistent.

Final thoughts and next steps

There's much more to explore on this topic — like planning and simulation twins or predictive models that feed back into the twin graph. These innovations continue to expand the potential of multi-dimensional views.

For now, the takeaway is clear: supporting multi-dimensional views provides cross-functional teams with a consistent foundation. It shifts the focus from debating whose data perspective is correct to solving real business challenges together.

SoftServe can guide your organization in navigating the complexities of multi-dimensional data and modern IIoT solutions. With expertise across diverse industries, we help tailor strategies that align with your unique needs.

Let's arrange a call to discuss how to break down data silos and build solutions that give your team the views they need to solve real business challenges.

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About Us

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We expand the horizon of new technologies to solve today's complex business challenges and achieve meaningful outcomes for our clients. Our boundless curiosity drives us to explore and reimagine the art of the possible. Clients confidently rely on SoftServe to architect and execute mature and innovative capabilities, such as digital engineering, data and analytics, cloud, and AI/ML.

Our global reputation is gained from more than 30 years of experience delivering superior digital solutions at exceptional speed by top-tier engineering talent to enterprise industries, including high tech, financial services, healthcare, life sciences, retail, energy, and manufacturing.

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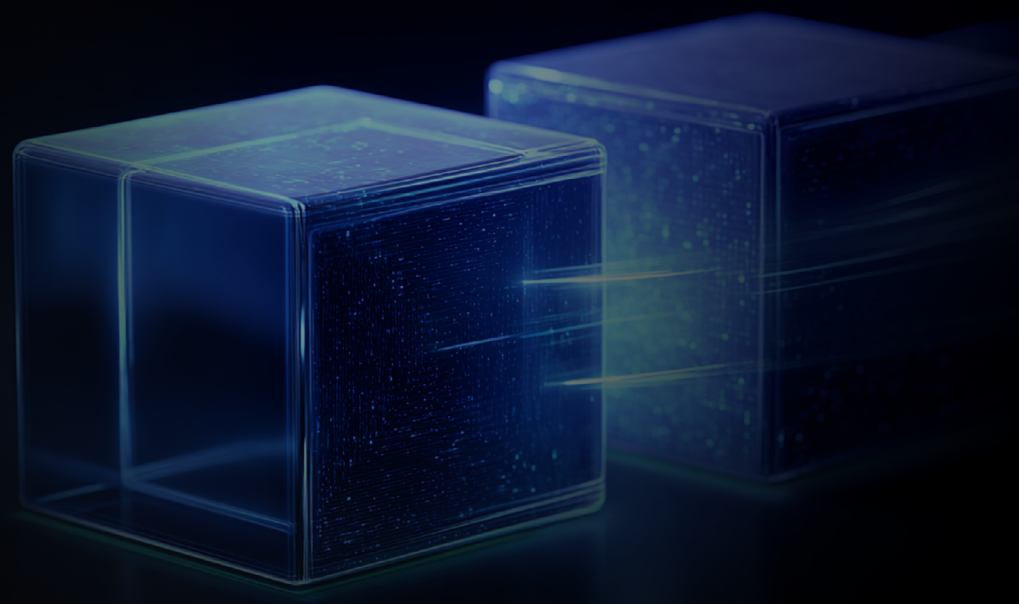

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