ENERGY MANAGEMENT ASSOCIATION

WEBINAR

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Utilizing Digital Twins of Operational Data

With your speakers

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AIA Continuing Education Provider

Utilizing Digital Twins of Operational Data

Utilizing Digital Replicas of Facility Operational Data, Analytic Results, and KPIs for Optimal Facility Management

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Agenda

1. Digital Twins: Why The Confusion?
2. Defining Digital Twins & Replicas
3. How to get started?

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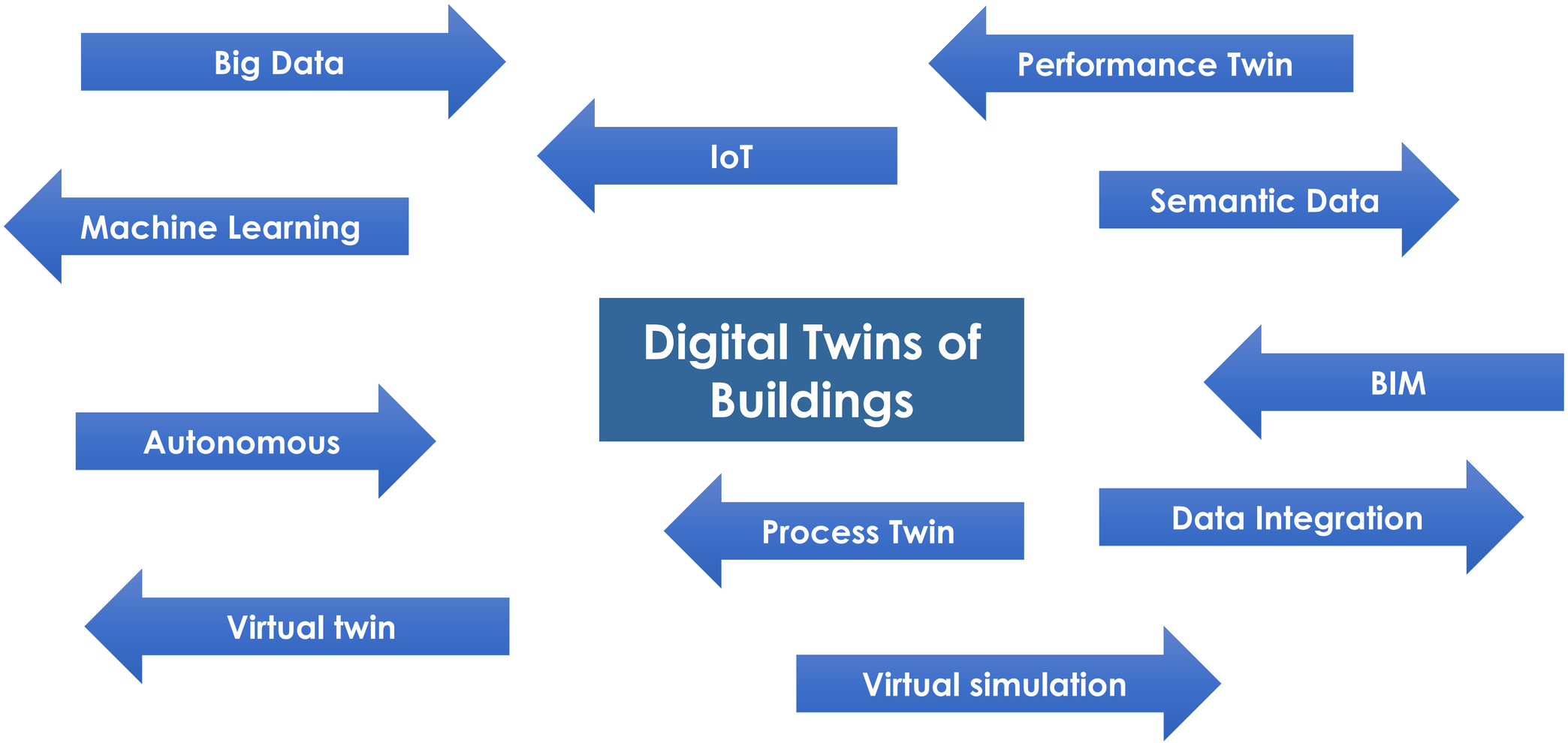
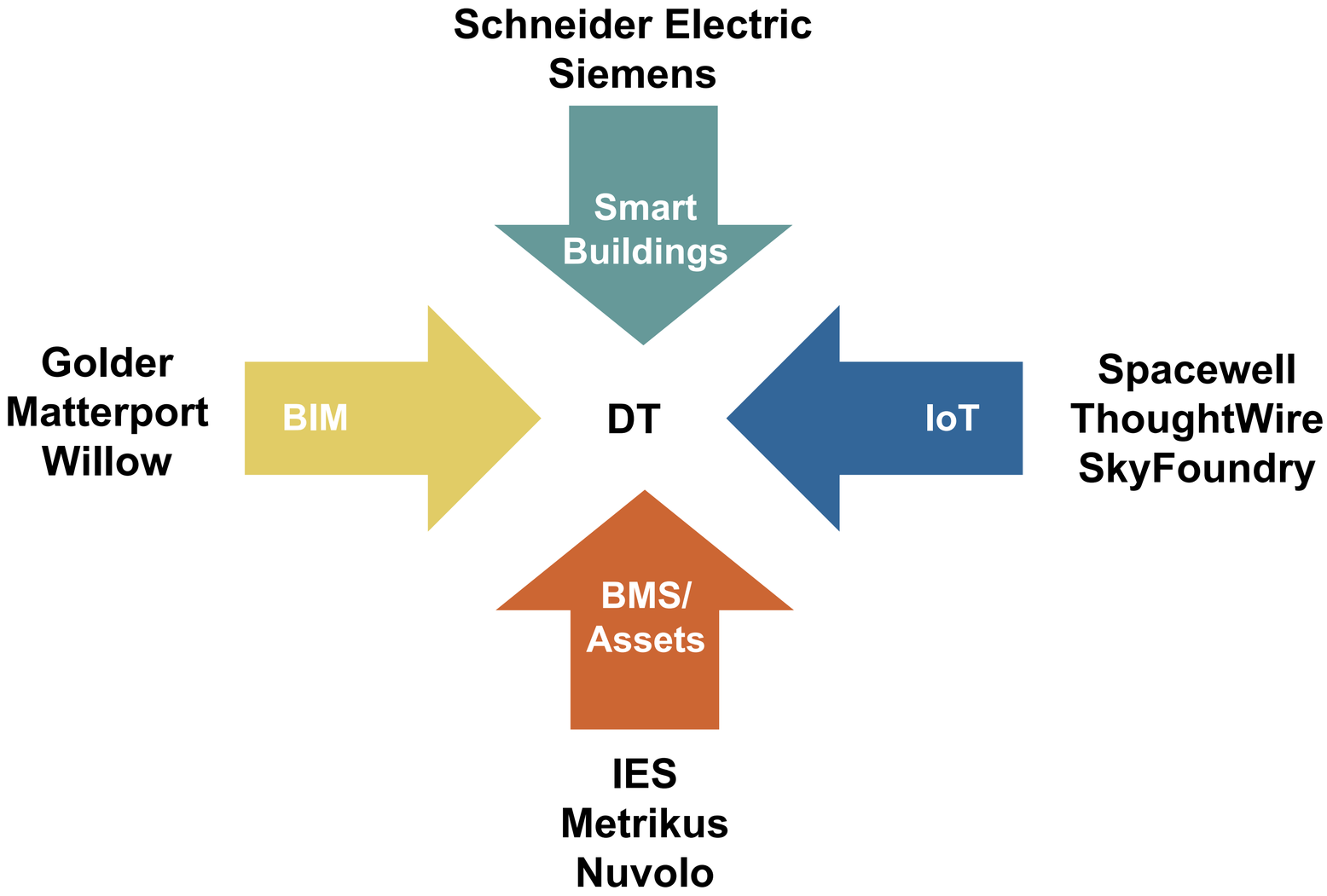
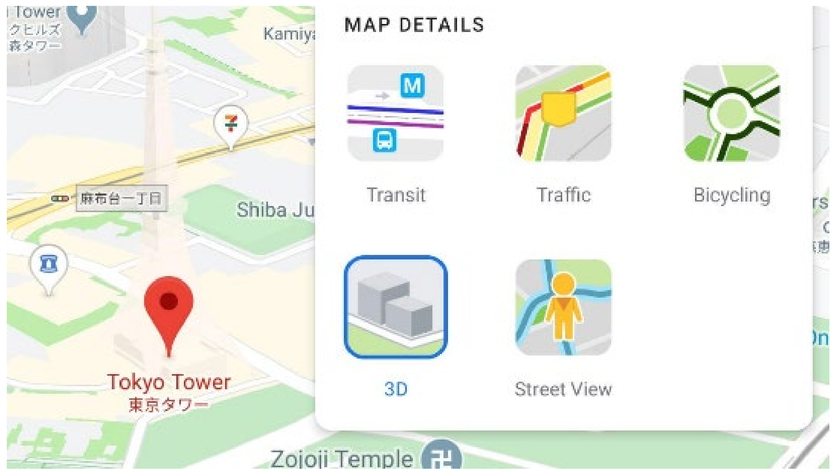
Digital twins for buildings – it has become a world of confusion!

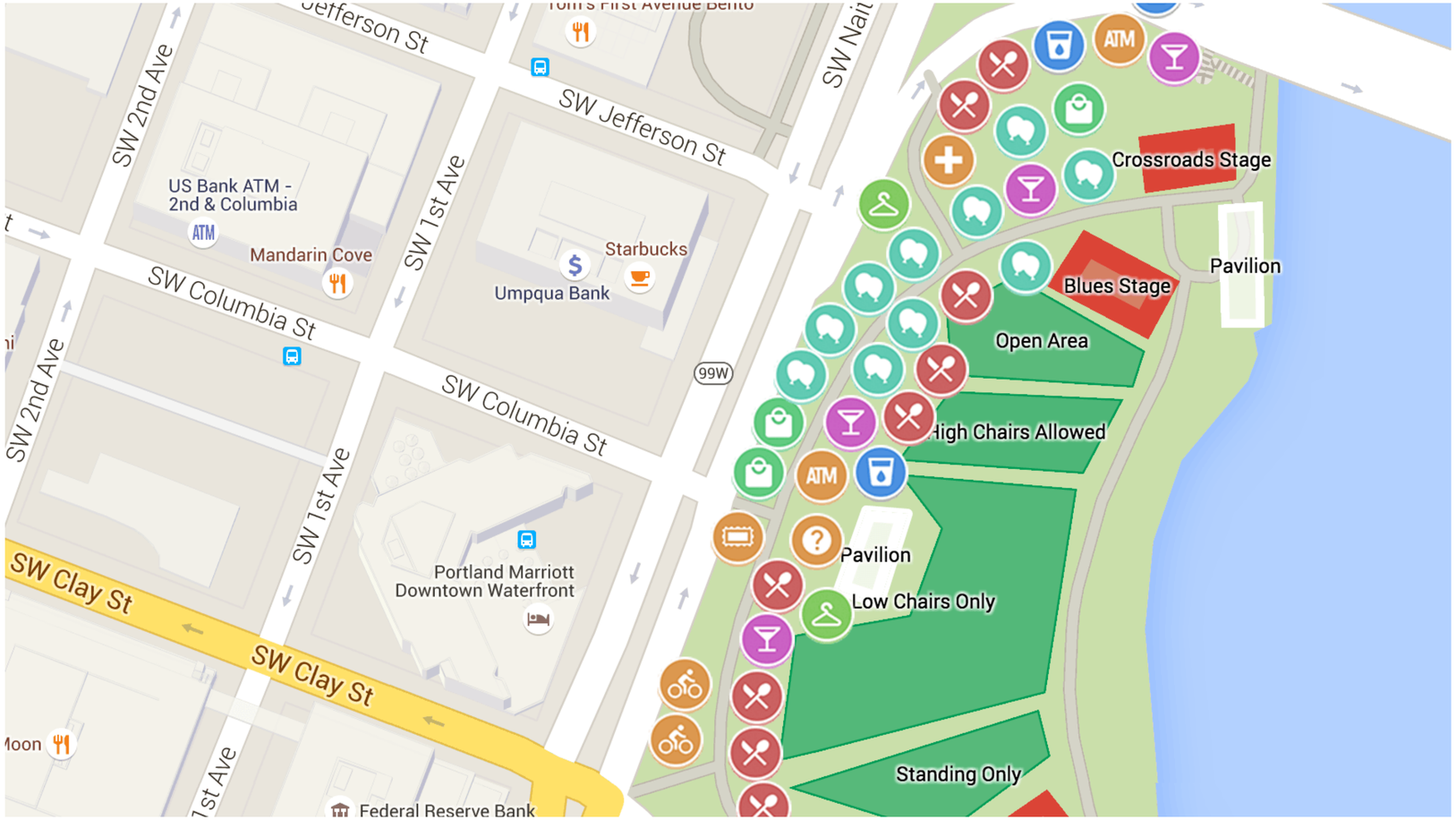


Digital twin offerings come in different shapes and sizes



Many of us are already using digital twins in our daily lives





Agenda

1. Digital Twins: Why The Confusion?

2. **Defining Digital Twins & Replicas**

3. How to get started?

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Digital Twins & Data Replicas

- The term Digital Twin is often associated with a 3D model of a facility
- Typically based on a BIM data model of the physical asset
  (BIM – Building Information Model)

- But there are other representations of digital twins (or digital data replicas)

Image courtesy of J2 Innovations

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Digital Twins – IIC Definition

Industrial Internet Consortium (IIC)

A digital twin is a formal digital representation of some asset, process or system that captures attributes and behaviors of that entity suitable for communication, storage, interpretation or processing within a certain context.

The digital twin information includes, but is not limited to, combinations of the following categories:

- physics-based model and data,
- analytical models and data,
- time-series data and historians,
- transactional data,
- master data,
- visual models
- computations

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Combining Physical Data Replicas and Operational Data Replicas

- Combining digital data that represents the physical model of a building with…
- A normalized digital representation of all operational data associated with equipment systems, sensors, meters, and devices that support the occupant environment…
- Provides the basis for a range of “digital twin” applications

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Getting There: Integrating Physical Data Replicas and Operational Data Replicas

- Even in modern buildings with “smart” communicating devices, equipment systems are often siloed – e.g.,
  - building automation system data not combined with utility usage and cost data,
  - different systems use different protocols and data formats, some data comes from external webservices
  - proprietary databases in software applications, and on and on
- Even the newest IoT devices are often islands – on their own separate networks, with separate user interfaces, data repositories, communication protocols and API’s for data access – “open does not mean standard”
- Facility managers can not have effective situational awareness and the ability to ensure optimal operation of their facilities without a solution that unifies operational data
- Unifying digital information is an essential step in achieving truly intelligent buildings and is a key element in the ”stack” of technology to accomplish a digital twin

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Key Requirements of a Comprehensive Digital Data Replica of Operational Data

- The ability to **connect** to highly diverse data sources. More than just sensors, HVAC equipment, and BAS.
  - Ex: Utility feeds of consumption and pricing data, asset data, facility characteristics, production metrics - all need to be brought together for effective management.
- **Normalization** of the diverse data, using a methodology that provides high fidelity semantic information (metadata) that describes the meaning of the data.
- The data platform must be more than simply aggregated data storage**, i.e., a "data lake"**. The data needs semantic "metadata" to represent its meaning to make it easily used across diverse applications
- Applying metadata is an essential element of implementing an effective digital twin data replica
  - For modeling of the physical attributes of a building BIM is the industry standard
  - For modeling of the data associated with building equipment systems Haystack (http://project-haystack.org) is most often used

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Key Requirements of a Comprehensive Digital Data Replica of Operational Data

- The ability to provide **live data** for users that need it, while providing others with a complete working **"digital twin"** of their data even when **offline from the building systems**.

  This is a key distinction – there is a need for more than Apps that view live data. We need to be able to create a complete replica of all data up to the last moment the data was available.

  This is especially **important in the case of interruptible/unreliable network connections**, and in applications such as energy and performance analysis, modeling, benchmarking and M&V that is better performed offline and requires extensive historical data

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Providing Operators with Relevant Information

- Users – service technicians, financial managers, energy engineers or customer experience professionals – need the ability to access and view the data **they care about** via a variety of applications, analysis tools and reporting applications
- Having all operational data brought together in a unified and normalized platform provides a foundation for a range of “digital twin” applications
- Let’s look at some use cases…

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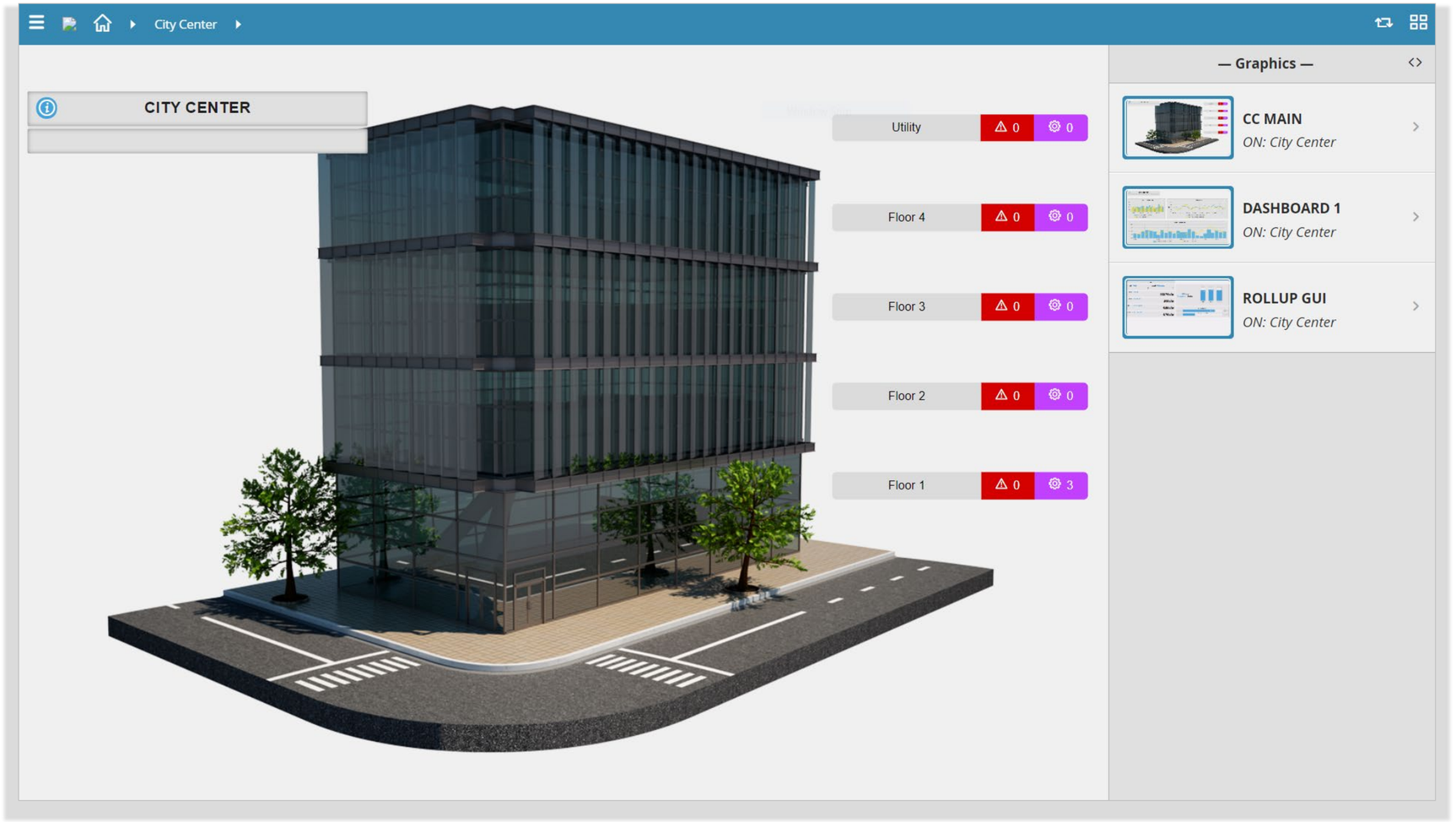
Digital Twin Applications – Providing Operators with Information and Context



- Example: Overlaying operational data on 3D model of a facility
- Combines operational data with physical model

Image courtesy of J2 Innovations

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Use Cases for Digital Twins & Data Replicas

- **Visualization** of data in an array of tools that provide functionality beyond that of any single product or system
  - Ex: Showing occupancy status and space temperatures on a floor plan
  - Ex: Enable playback of these and other conditions over time (the operational data DVR)

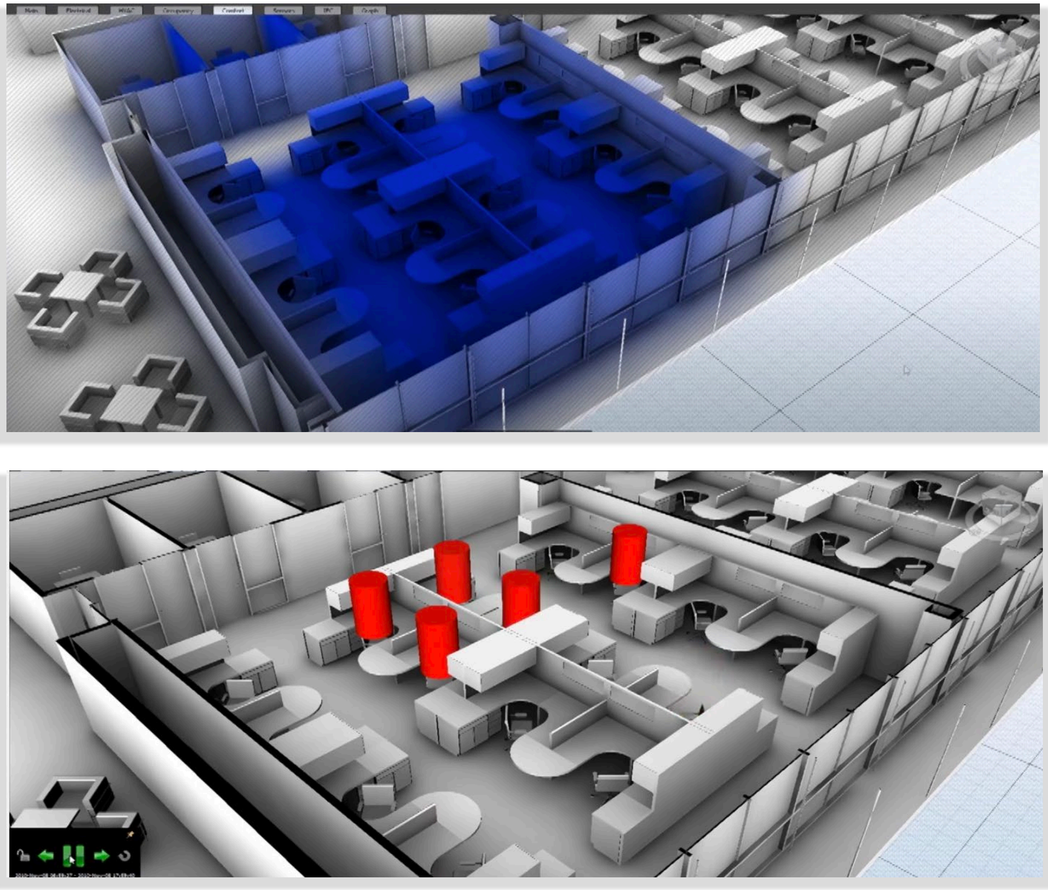

Image Autodesk Project Dasher

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Many Applications Are Independent of Physical Models

- Many uses of operational data are independent of physical models
- Ex: Combining Energy consumption and tariff rate data to show impact of usage on actual costs →

Lines = consumption and demand

Bars = tariff-based cost

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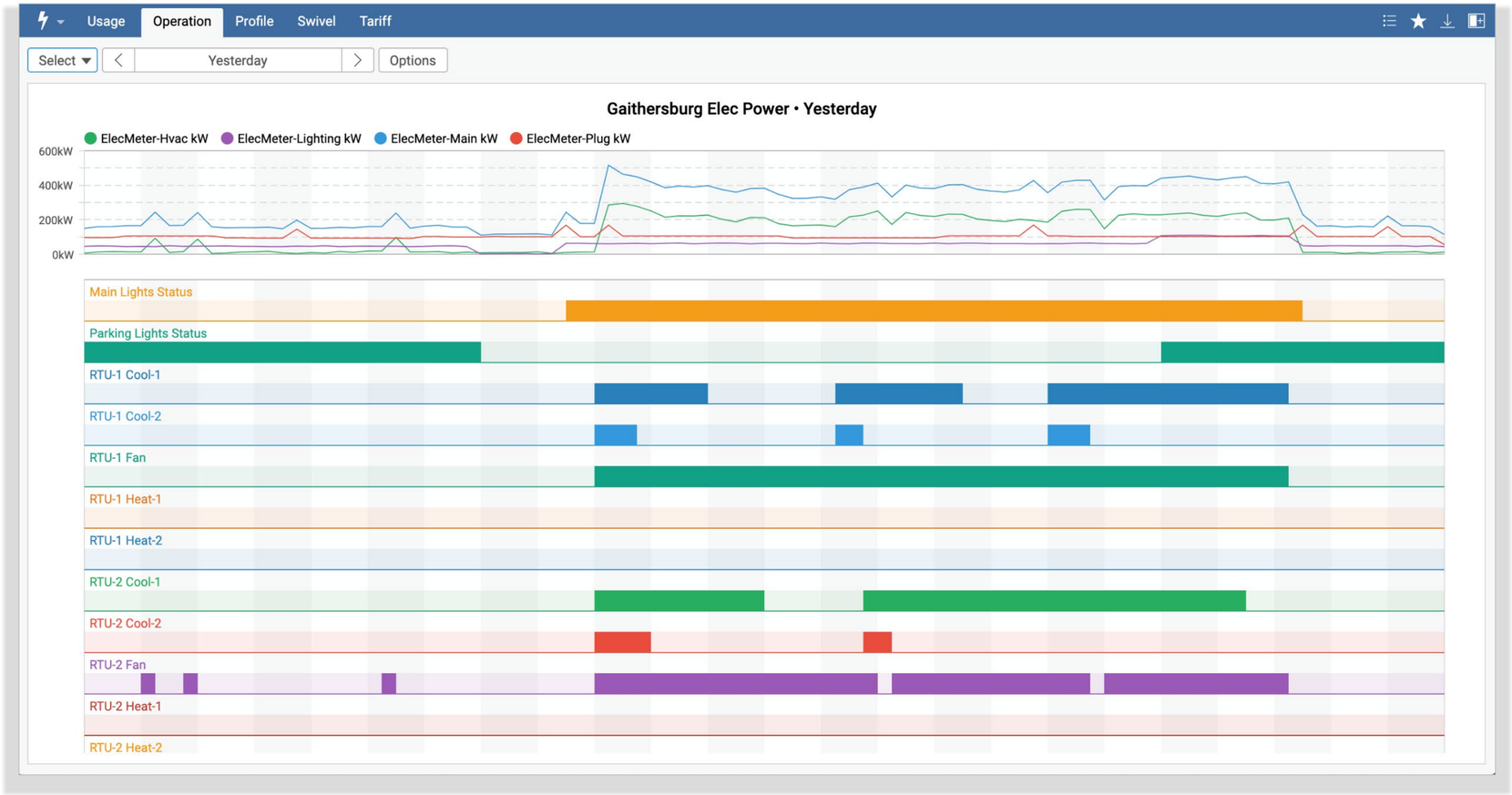
Digital Twins – Applications Independent of Physical Models

- Example: Correlating energy meter data (top) and equipment operation status (bottom)
- Result: know what is causing energy use patterns



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Core Functions of Digital Twin Technology

- **Data Integration** – Combining data from diverse equipment to support applications that utilize it in a variety of ways – 3D models, energy analysis, forecasting, benchmarking, design validation, etc. Impacts:
  - Communications
  - Data modeling
  - Data storage
  - Application integration (API's)
- **Data Visualization** in an array of tools that provide functionality beyond the that of any single product or system. Impacts:
  - Understanding user types and needs

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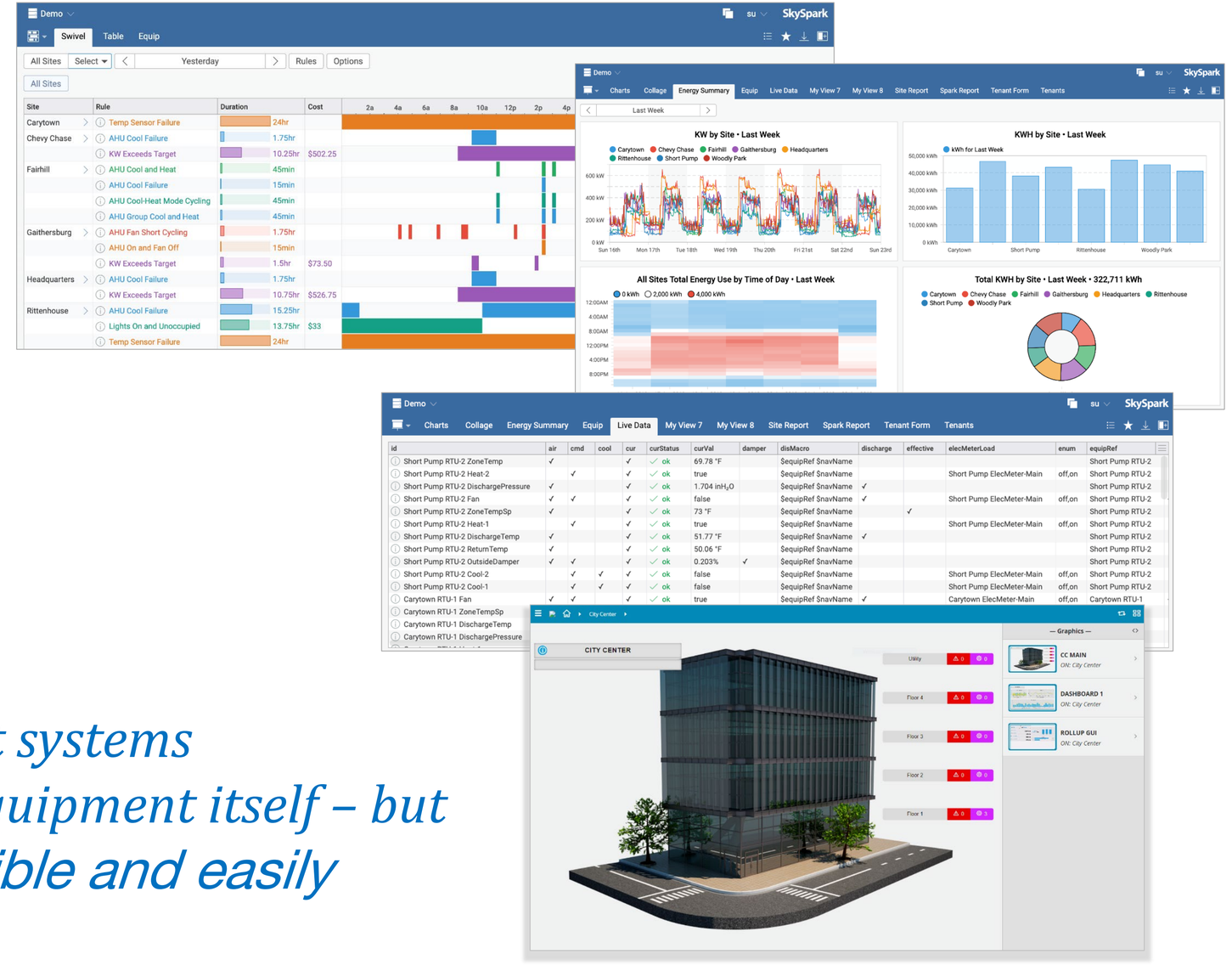
The Result

- A normalized, data replica that enables diverse users to address their individual needs for operational management, analysis and reporting

- *The data produced by equipment systems is now more valuable than the equipment itself – but only if it is normalized, accessible and easily utilized*



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Digital twins are part of a digitization journey for buildings

Digitization of Control System	Digitization of Building Management	Digitization of Building Plans and Schemas	Digitization of Building Systems	Collection of Additional Digital Information	Bringing It All Together
BMS	Portfolio Management	BIM	Smart Lighting	IoT Sensors	Building Digital Twin
	Asset Management	CAD	Smart HVAC	External Information	
	Space and Workplace Management		Digitized Energy System		
	Building Occupant Tools		Asset Digital Twins		

Full Scope of Building Digital Twin

You will already have some of the components in place

Construction Data
Materials, asset warranty, service contracts, floor and building plans,

Geospatial Data
Precise asset and building location

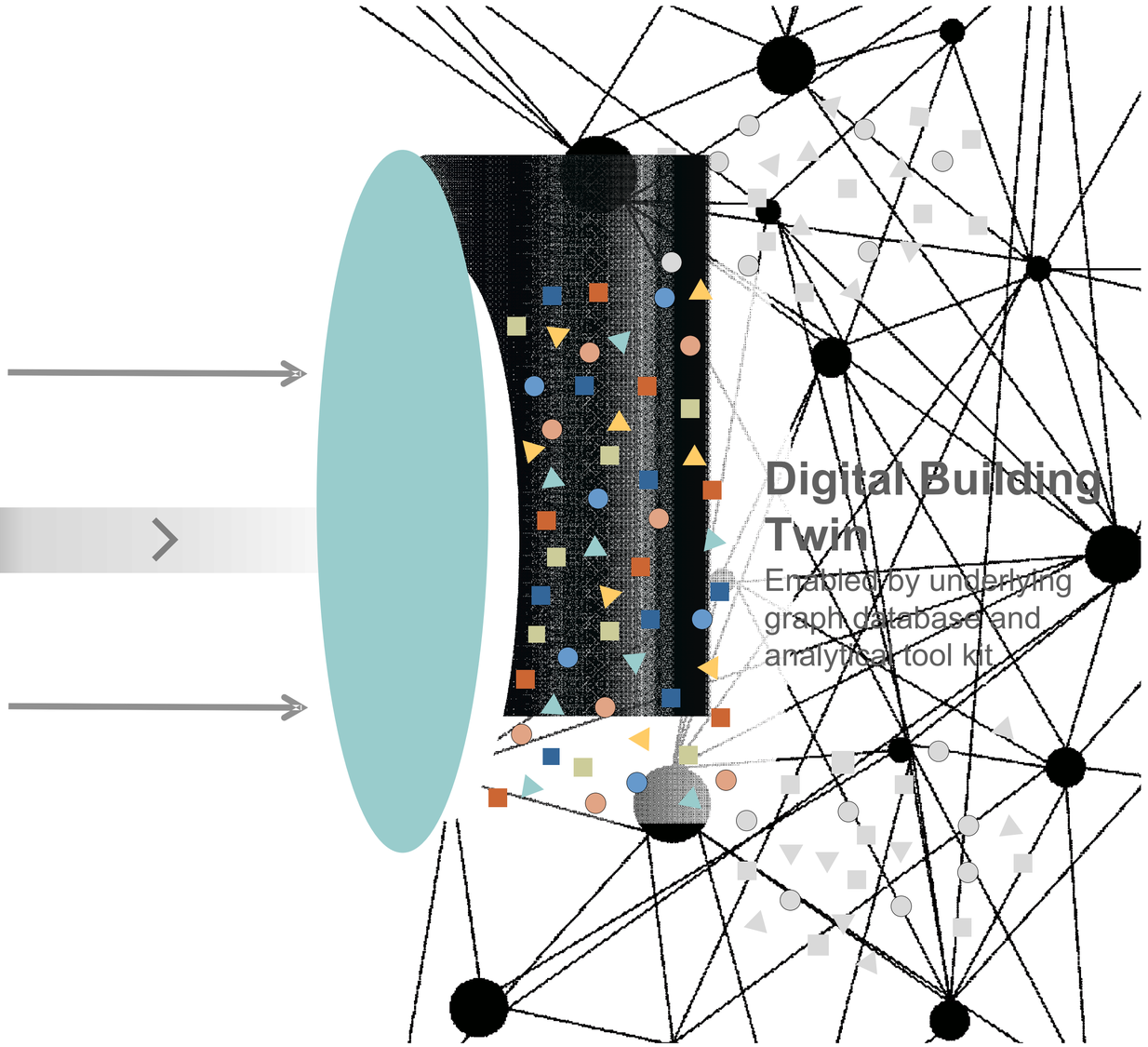
Building Assets & Systems
HVAC, fire systems, elevators, access control system, BMS/BAM, CAFM, IWMS

Processes Data
Workflow execution, asset set point, schedules

IoT Data
Sensors and meters for live asset data, occupancy data, indoor environment data

Business Data
Current leases, tenant information, free floors, building/floor revenue

External Data
From third party sources



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Think about your end vision

Autonomous Twin

A model with the ability to learn efficiently from various sources of data, and to use that learning to autonomously reason and to act on behalf of users. Takes responsibility for the tasks one would expect a human operator to manage, as well as to react to previously unseen scenarios.
Additional use of AI, AR, VR

Comprehensive Twin

A model able to apply prescriptive analytics based on industry best practices recommending actions to be taken. Real-time simulations for present-based or future-based what-if scenarios.
Additional use of prescriptive analytics

Predictive Twin

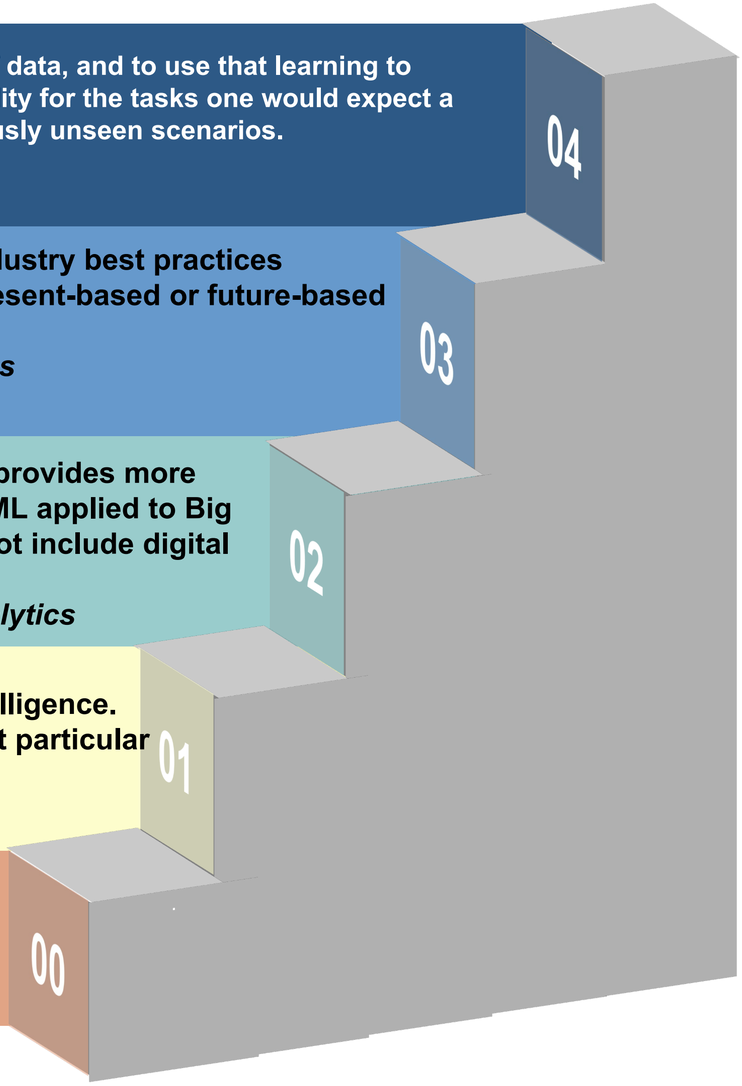
Model has some capacity for feedback and control. Integration provides more granular data in real-time/near real-time. Advanced analytics and ML applied to Big Data to identify pattens and provide early warnings. May or may not include digital replica.
Additional use of machine learning (ML), advanced analytics

Informative Twin

A model linked to the building systems & sensors but lacking intelligence. Provides insight into basic parameters or performance of an asset at particular points in time. May or may not include digital replica.
Additional use of BMS/BAS, IoT sensors, basic analytics

Description Twin

A digital replica of assets, facilities and buildings which is not linked to building systems and sensors.
Uses 3D Modelling, BIM, GIS



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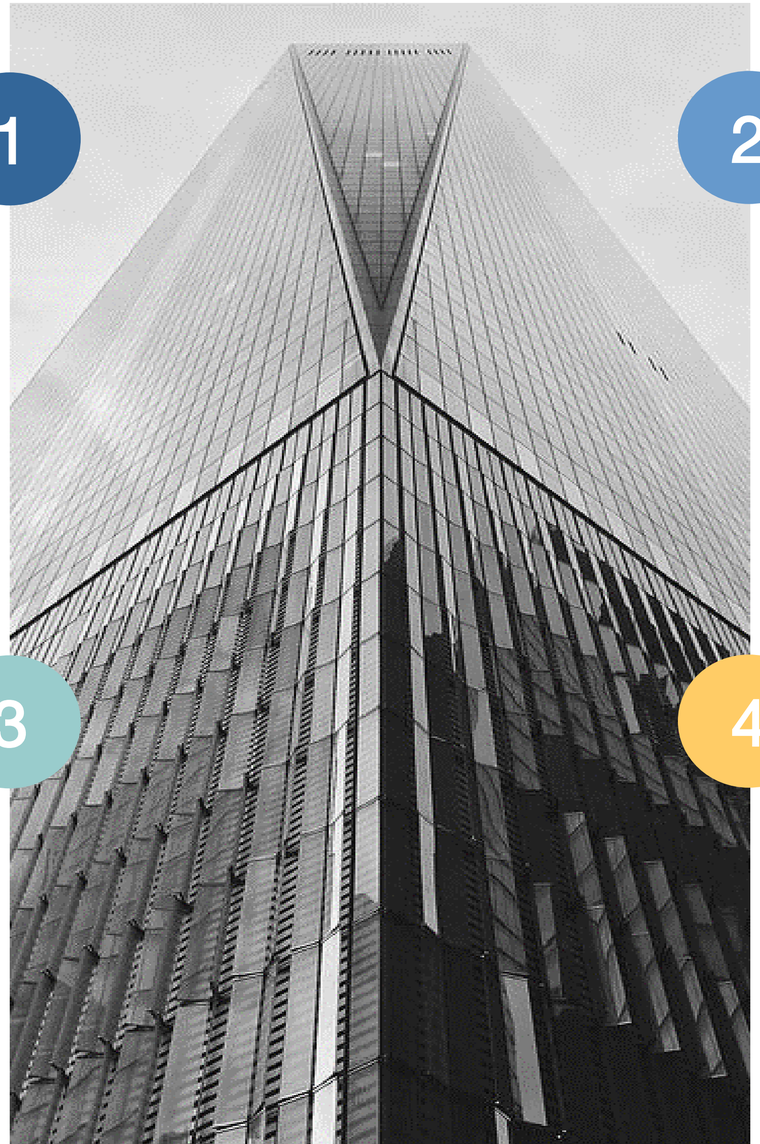
Four strategies to get value from digital twins now

1 Get the basics in place

Data cleaning, insist on open protocols and easily accessible data for all future building technology investments



2 Prioritize operational twins

Prioritize IoT platforms with a database optimized for efficiently managing huge volumes of “machine data”

3 Insist on access to a construction twin

Engage early with architectural and engineering teams to ensure access the final BIM models

4 Use your HQ to stake out a leadership role

Get involved in pilot projects at your flagship buildings

Thank you!

John Petze

Susan Clarke

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QUESTIONS?

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