The Next Phase of IoT:
Information & Visualization With Digital Twins

Tadeh Hakopian

Conf42 IoT 2023

INTRODUCTION

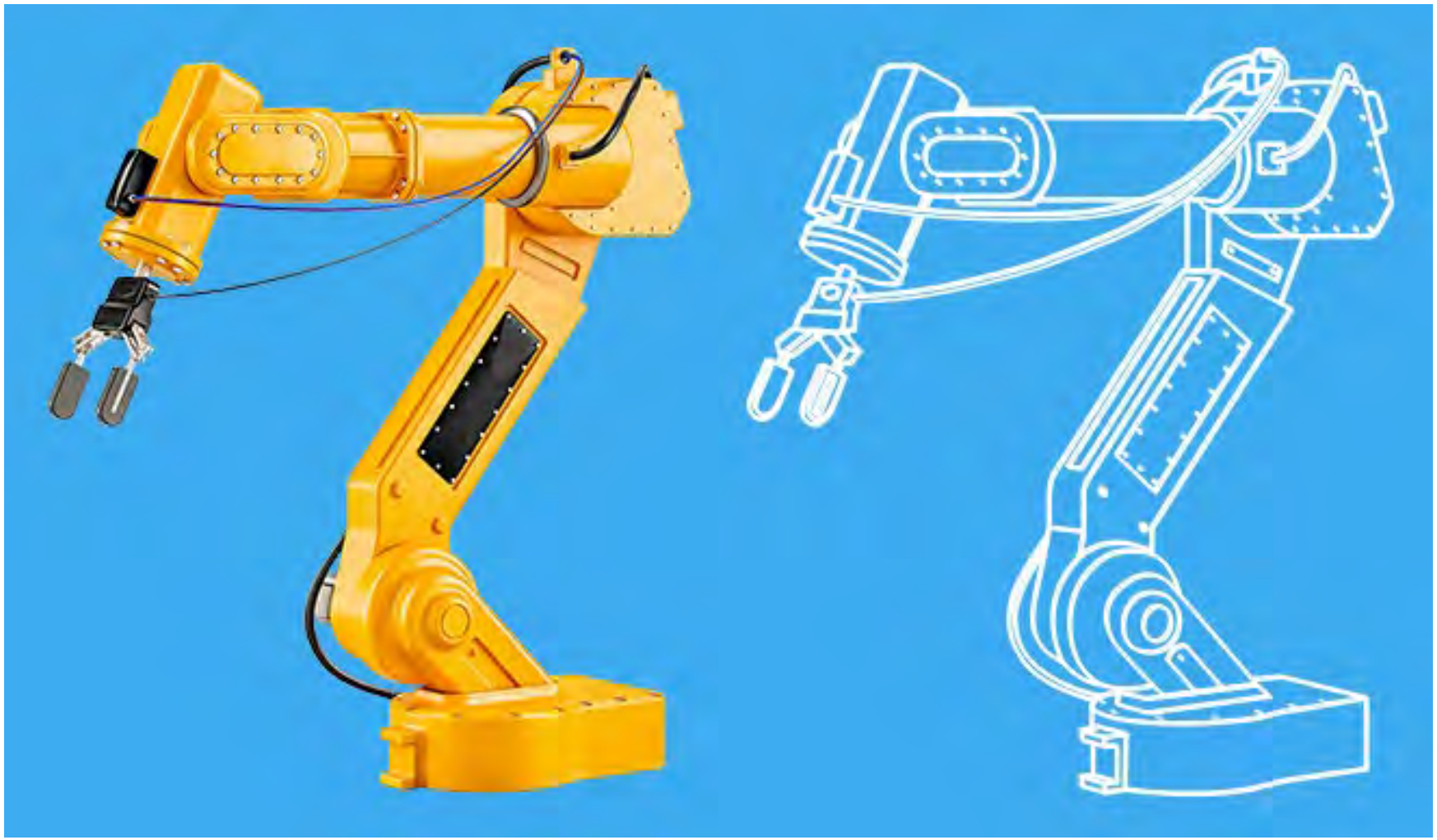
ABOUT ME

- Tadeh Hakopian
- (Todd-A) (Ha-co-pea-on)
- Program Manager
- Background in Digital Integration and the Built Environment
- Course Author and Speaker for Building Information Modeling (BIM) and Coding content

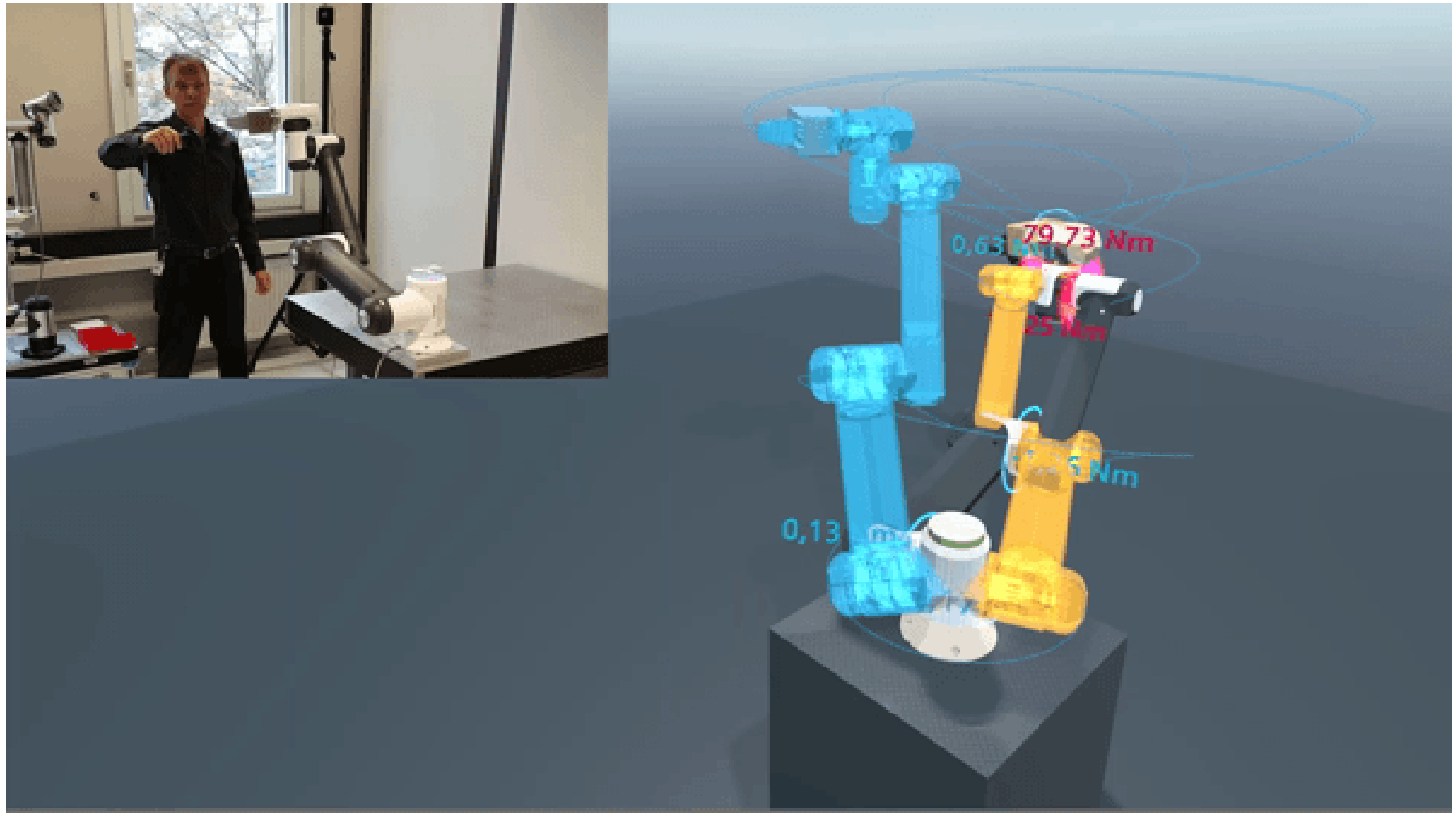
WHAT ARE DIGITAL TWINS?

A digital twin is a digital representation of a physical object or system

TWO FOR ONE

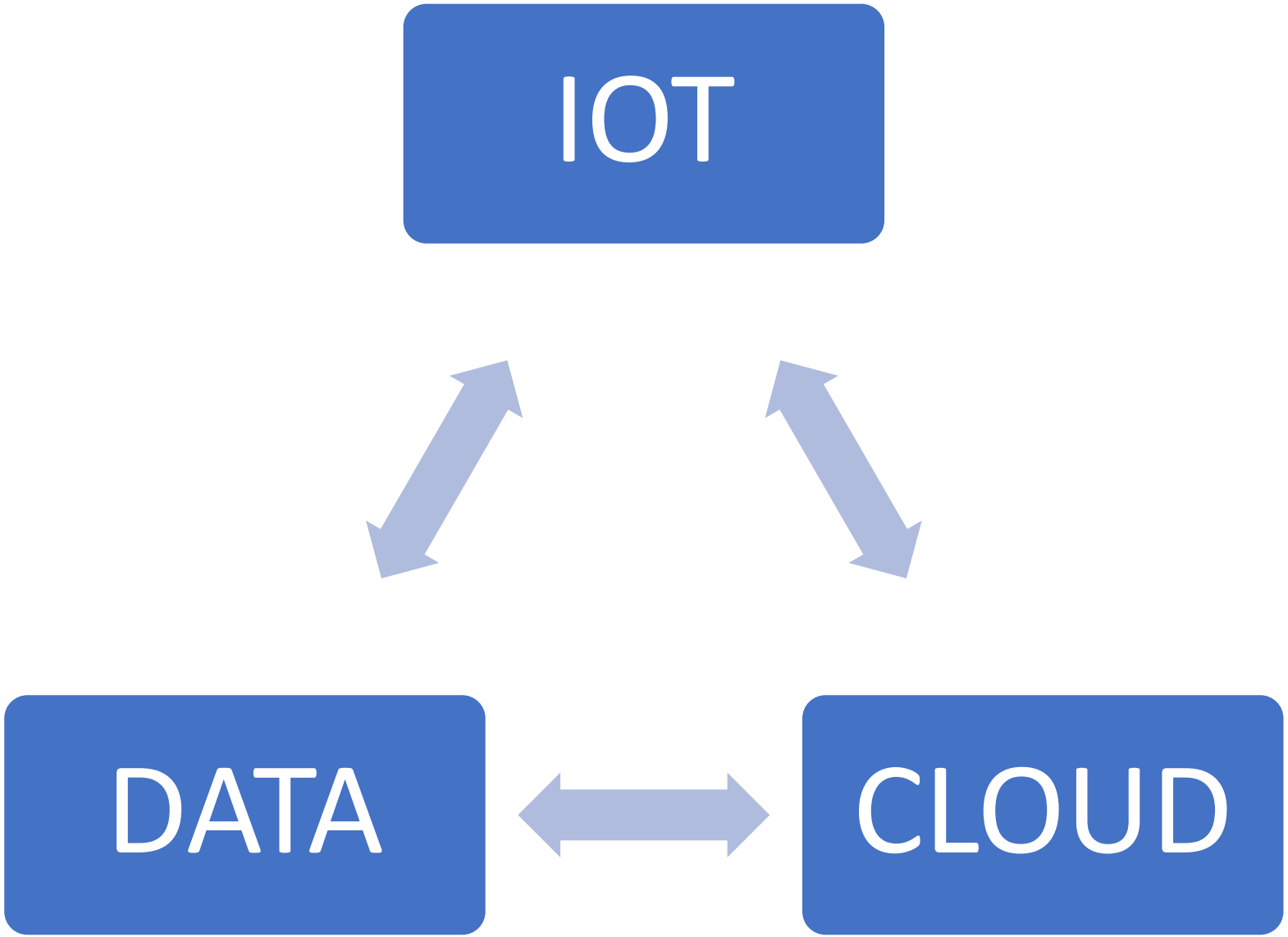


TWO FOR ONE



https://new.siemens.com/global/en/company/stories/research-technologies/digitaltwin/robotics-simulation.html

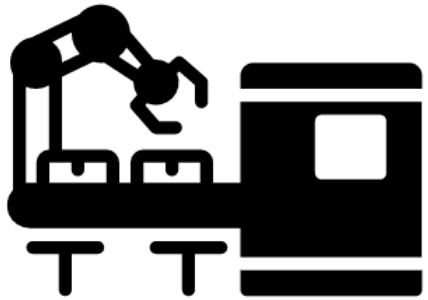
INGREDIENTS



https://www.digitalconnectmag.com/how-to-manage-your-iot-adoption-before-it-makes-a-mess/

USE CASES

Manufacturing



Factory automation simulation

Vehicles

Autonomous vehicles and Telemetry Sensors

Healthcare

Devices for monitoring the human body

Structures & Buildings

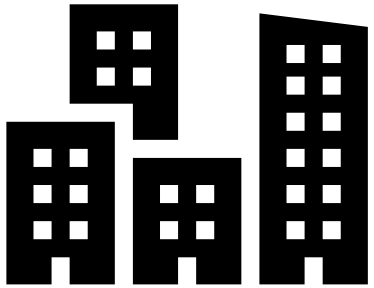
Monitor energy use and equipment in buildings

BENEFITS OF DIGITAL TWINS & IOT DEVICES

1. Real time look at what's happening to physical assets
2. All maintenance history and operations metrics in one place
3. No more binders and paper logs to sort through
4. Scalable operations from small to large projects
5. Predict outcomes based on historical data from device data

SHARED BENEFITS

Owners



Access data of your assets and explore ways to improve operations for long term ROI

Facility Managers

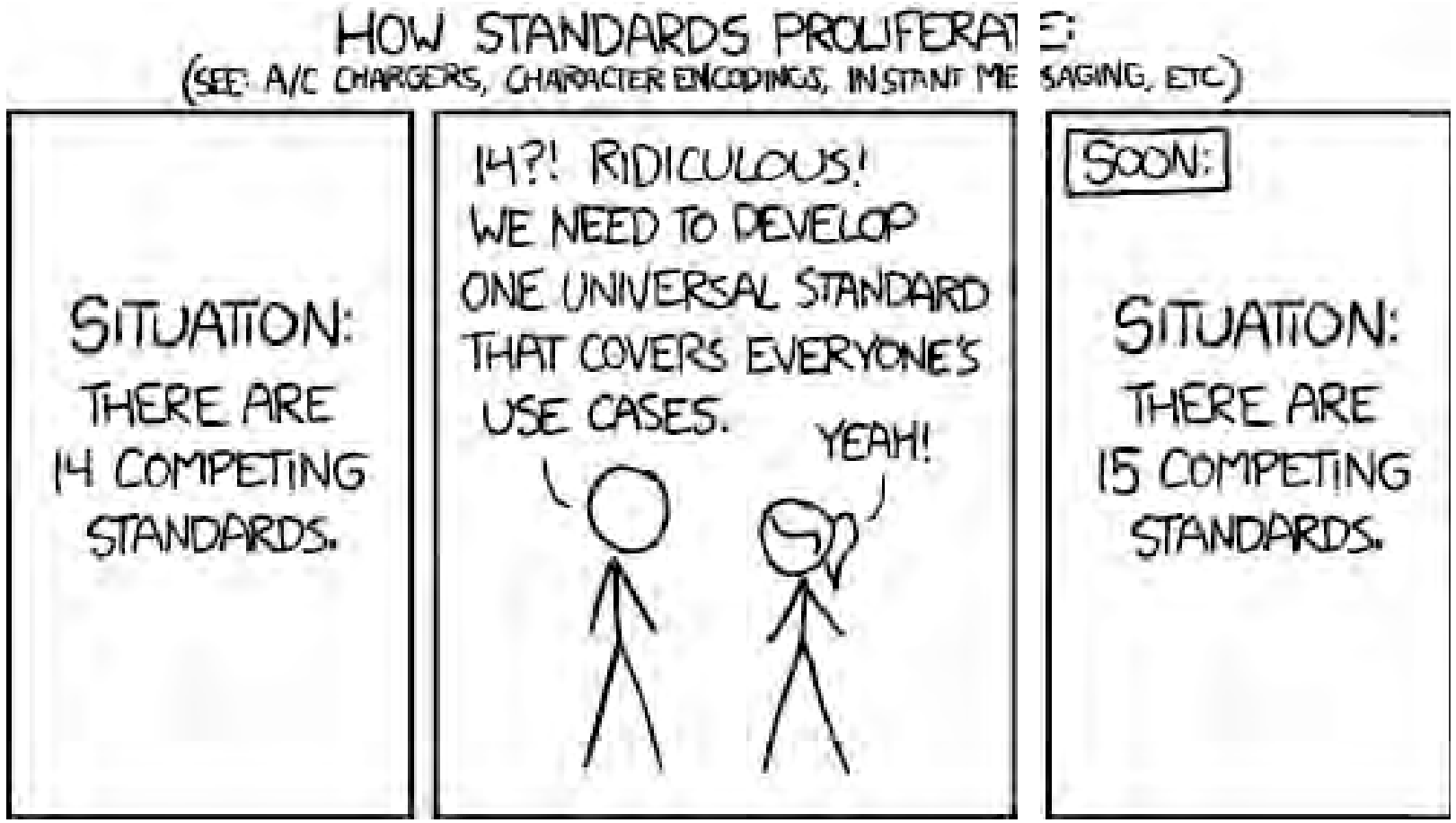
Easier access to aggregated information of the facility with real time data over the cloud

Equipment Manufacturers

Connected lifecycle of IoT devices to help support and inform the operations of the Building

DATA STANDARDS

STANDARDS


HOW STANDARDS PROLIFERATE:
(SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC)
SITUATION: THERE ARE 14 COMPETING STANDARDS.
14?! RIDICULOUS! WE NEED TO DEVELOP ONE UNIVERSAL STANDARD THAT COVERS EVERYONE'S USE CASES.
YEAH!
SOON:
SITUATION: THERE ARE 15 COMPETING STANDARDS.

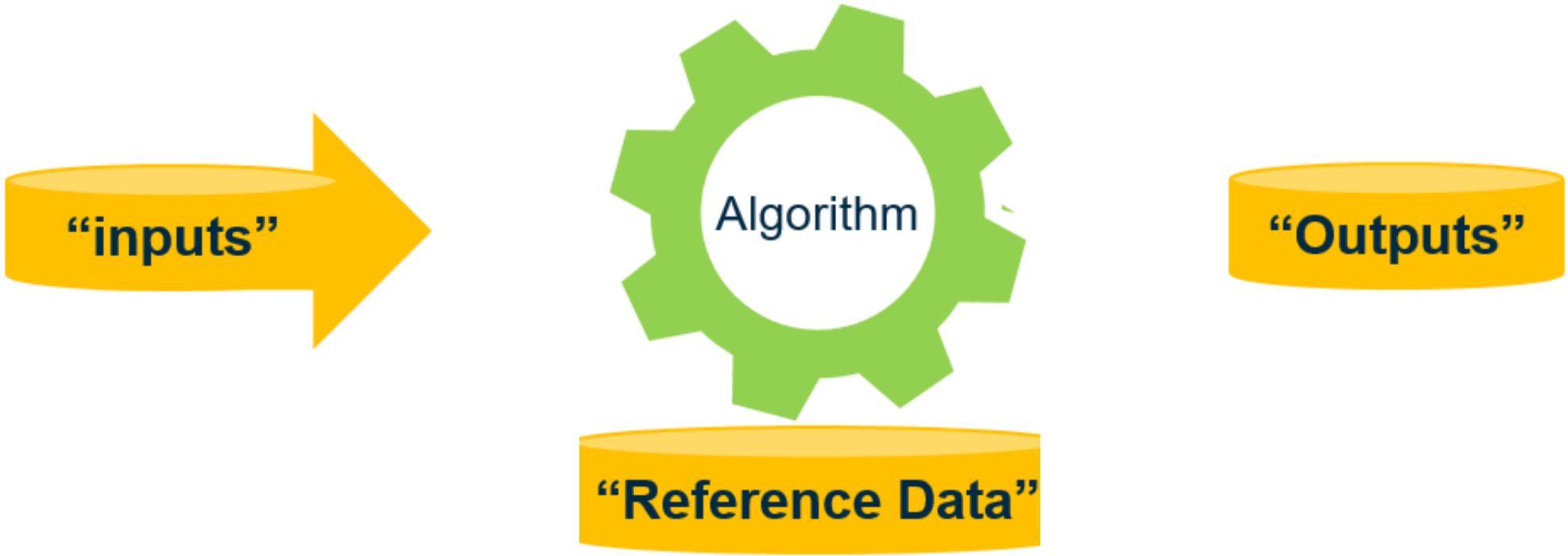
STANDARDIZING BODIES

https://venturebeat.com/2021/06/11/digital-twin-consortium-pursues-open-source-collaboration/

STANDARDIZING BODIES

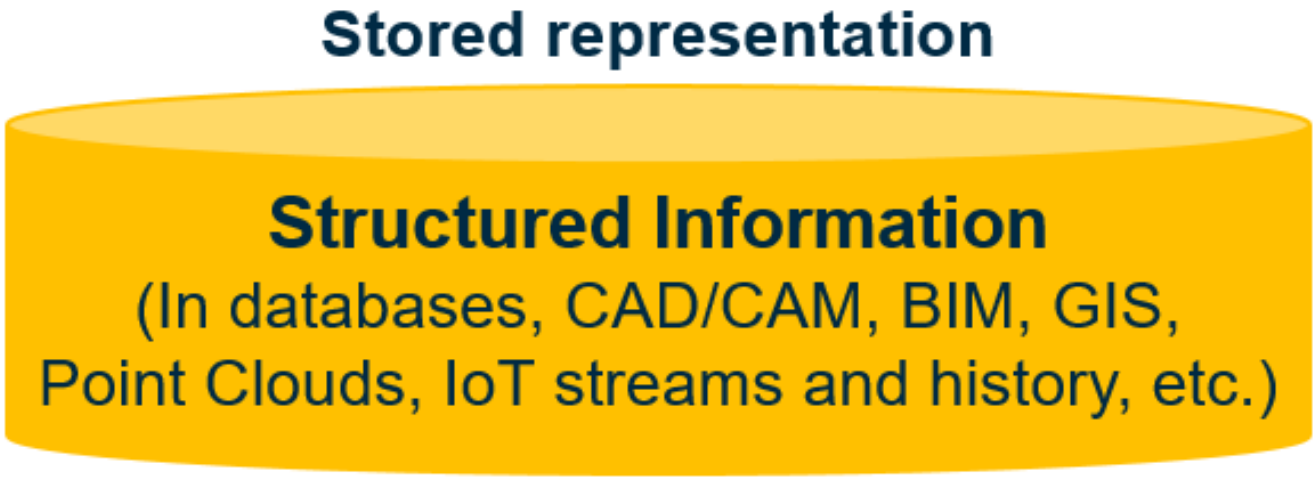
https://www.digitaltwinconsortium.org/glossary/index.htm

DIGITAL REPRESENTATION



digital twin™ CONSORTIUM

https://www.digitaltwinconsortium.org/glossary/index.htm



digital twin™
CONSORTIUM

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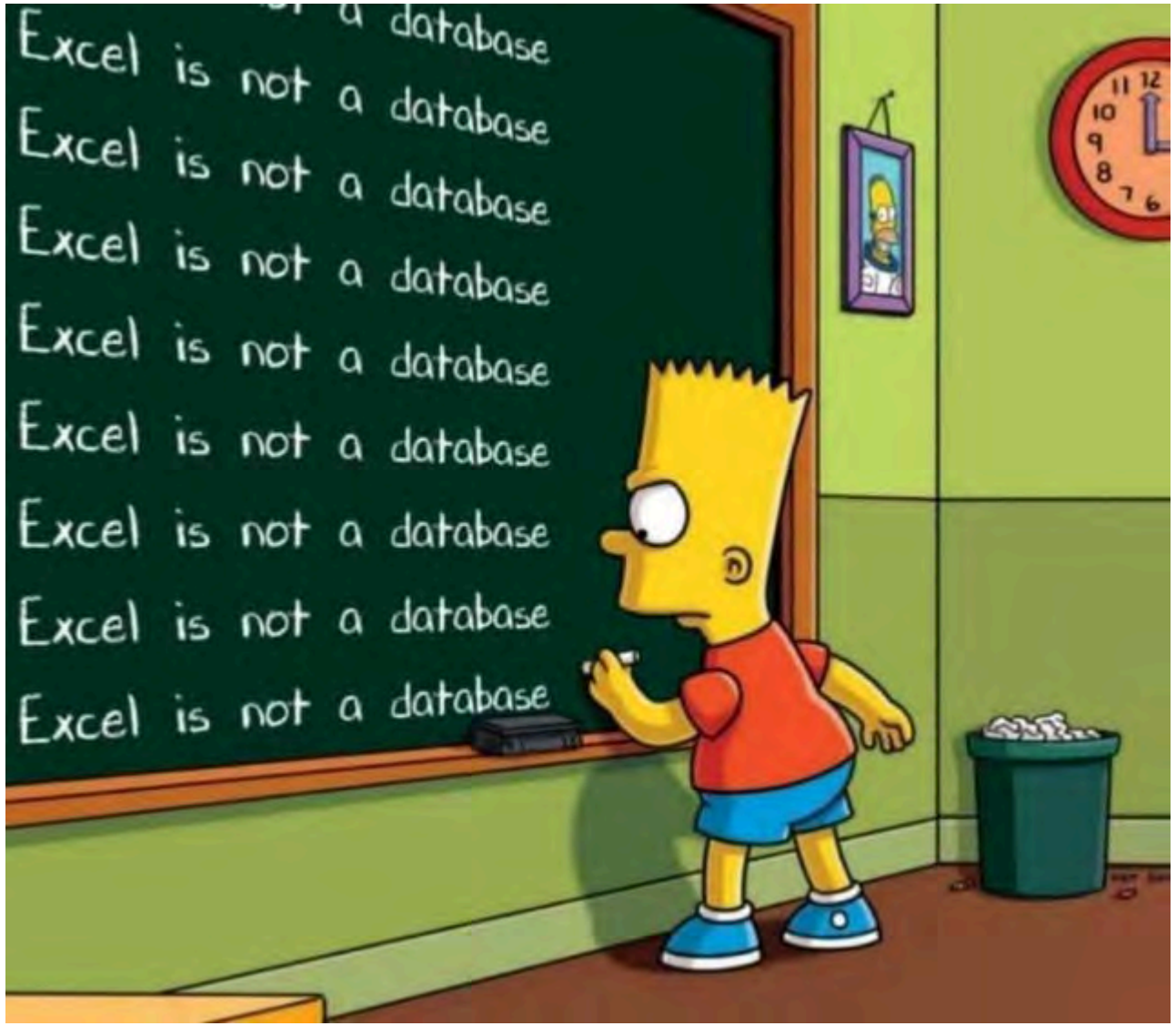
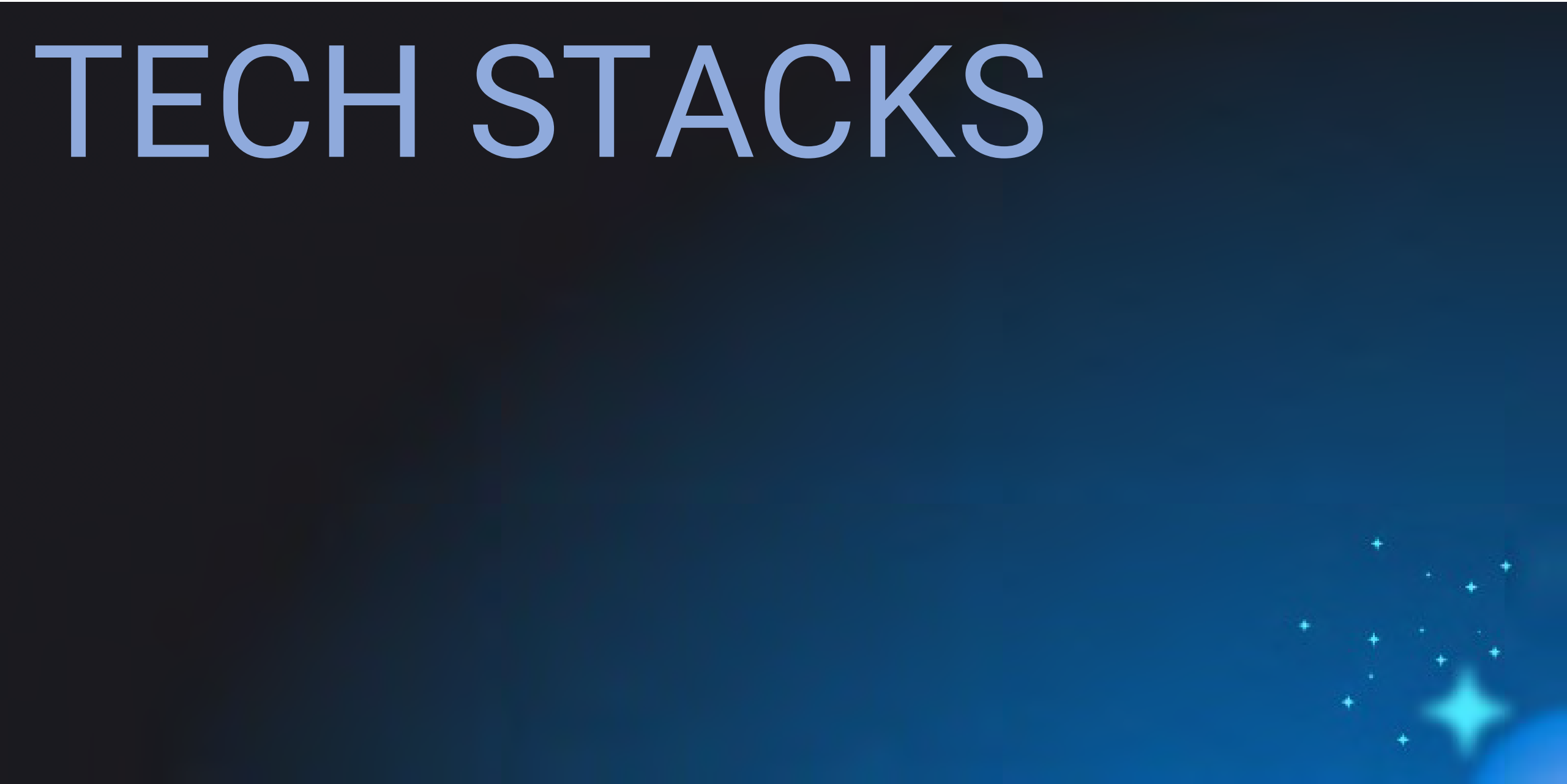
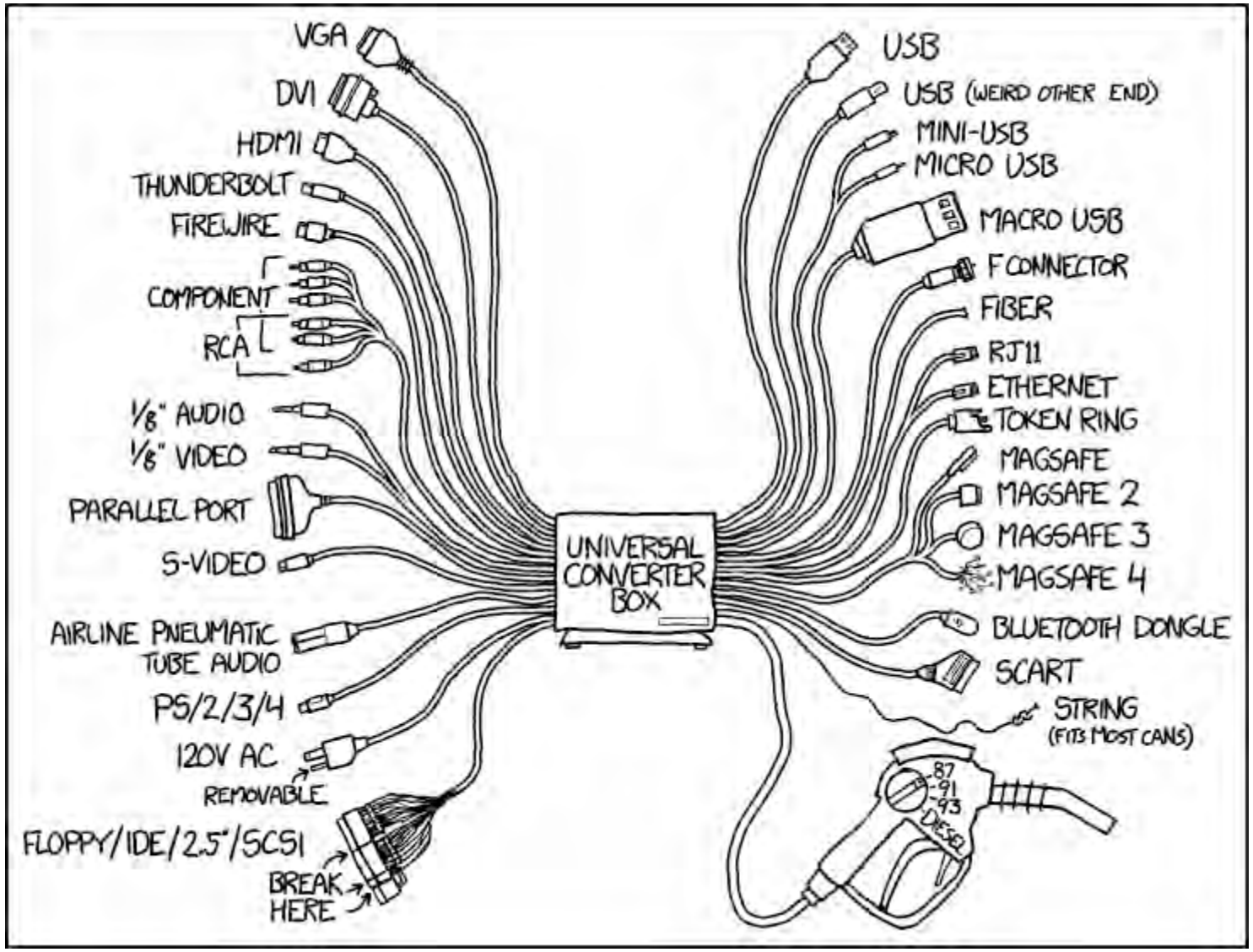
DATA STANDARDS



TECH STACKS

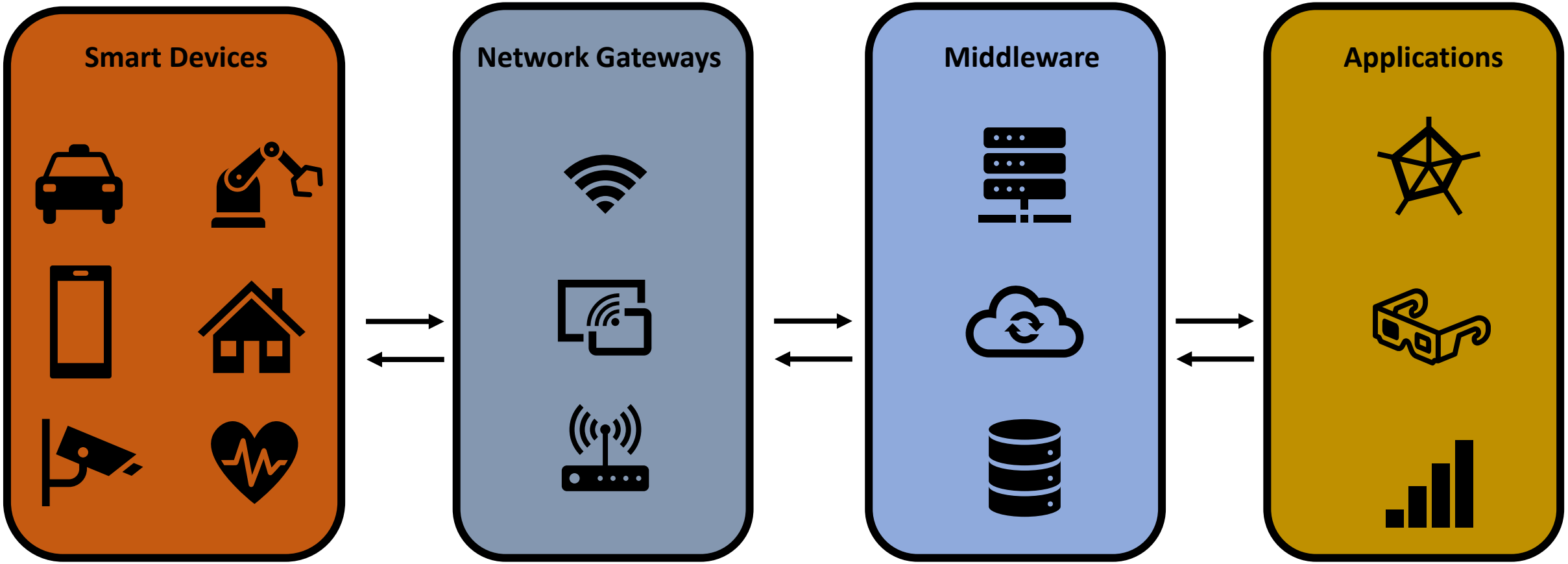


COMMON SOFTWARE SOLUTIONS



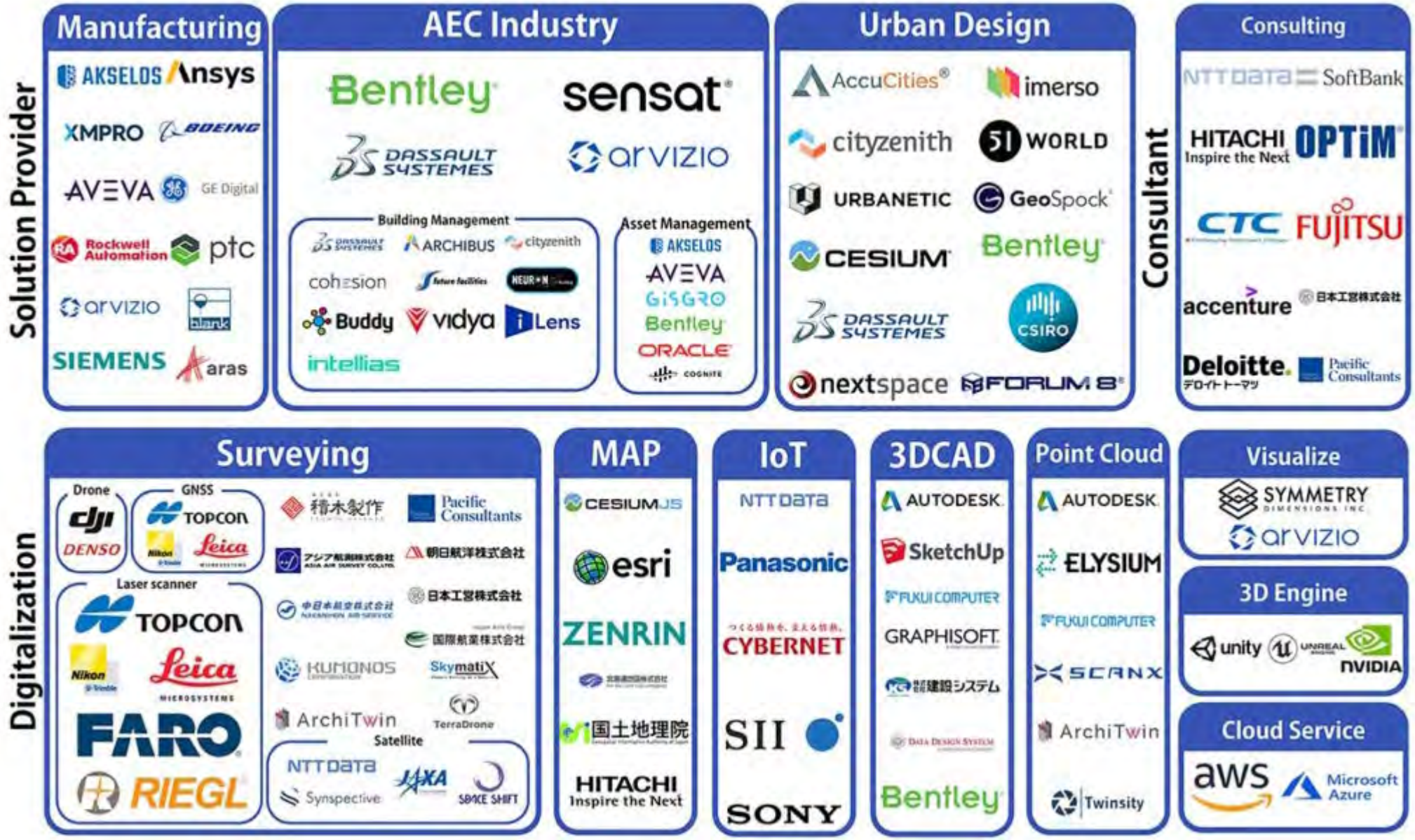
The universal solution to interoperability

IOT COMPONENTS AND CONNECTIONS



https://www.altexsoft.com/blog/iot-architecture-layers-components/

DIGITAL TWIN INDUSTRY SOLUTIONS

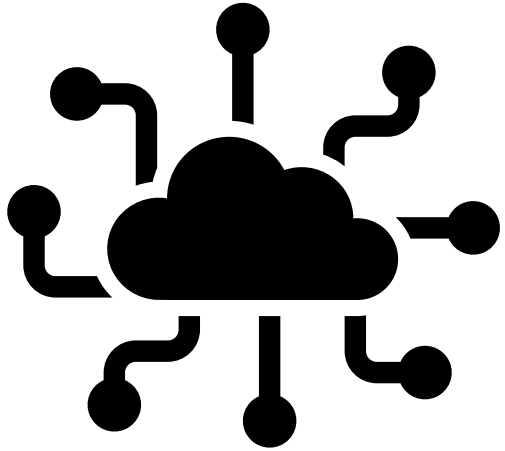


https://www.accucities.com/digital-twin-industry-map-by-symmetry-dimensions/

EXPANDING YOUR TECH STACK – DATA SCIENCE TOOLS

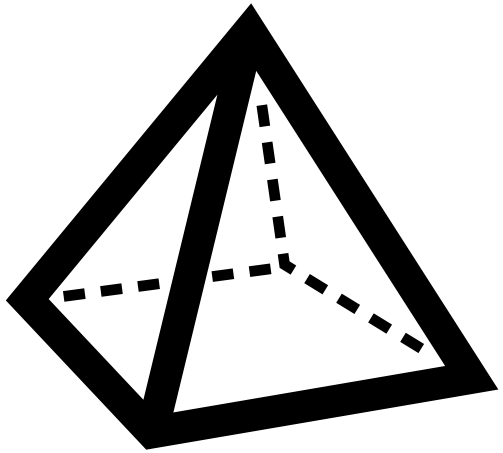
KEEP IT SIMPLE

Sensors



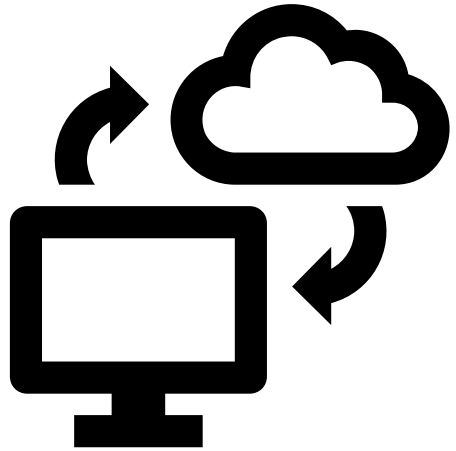
Physical devices that report on real world activity

Models



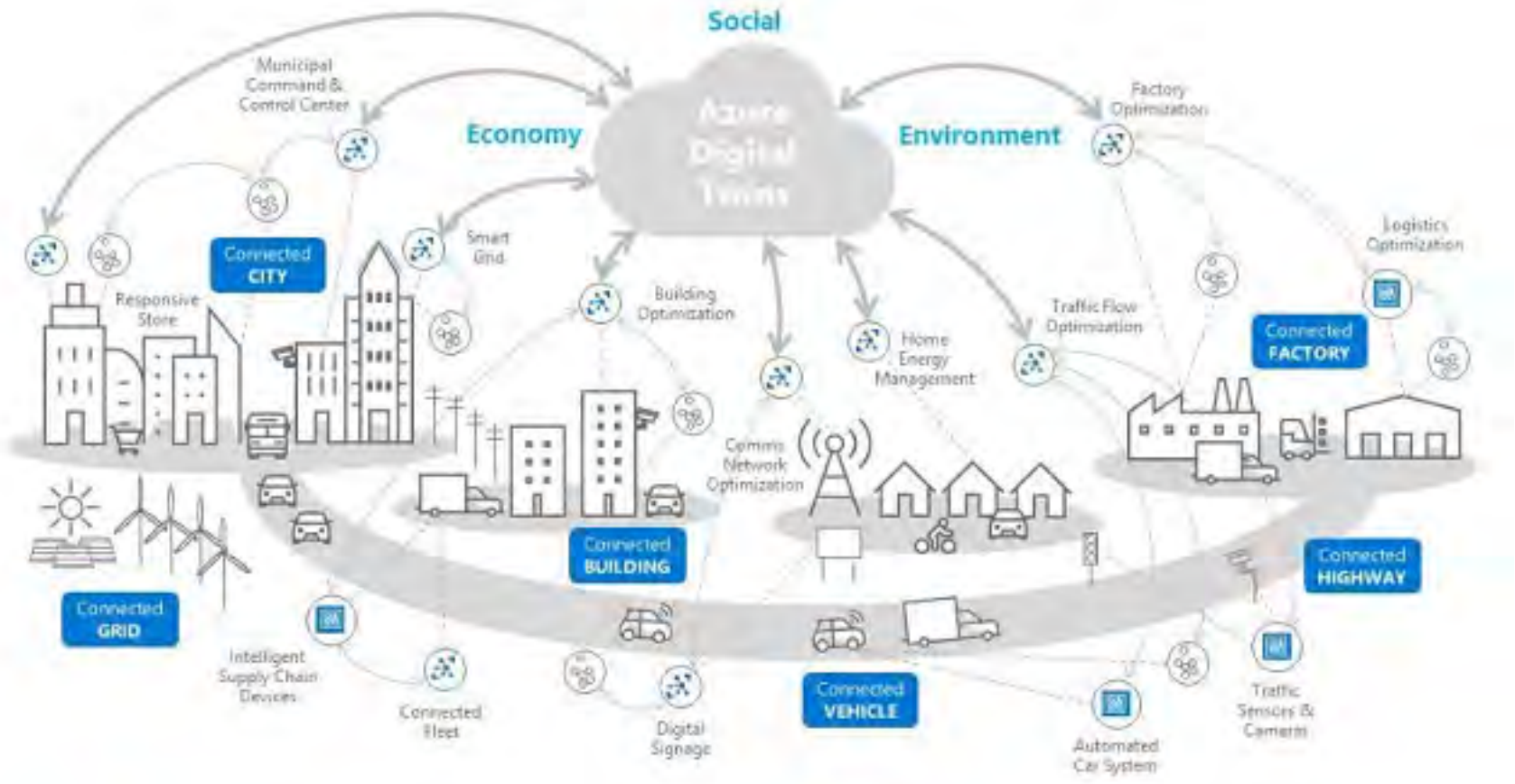
Digital Versions of the physical environment

Hosting



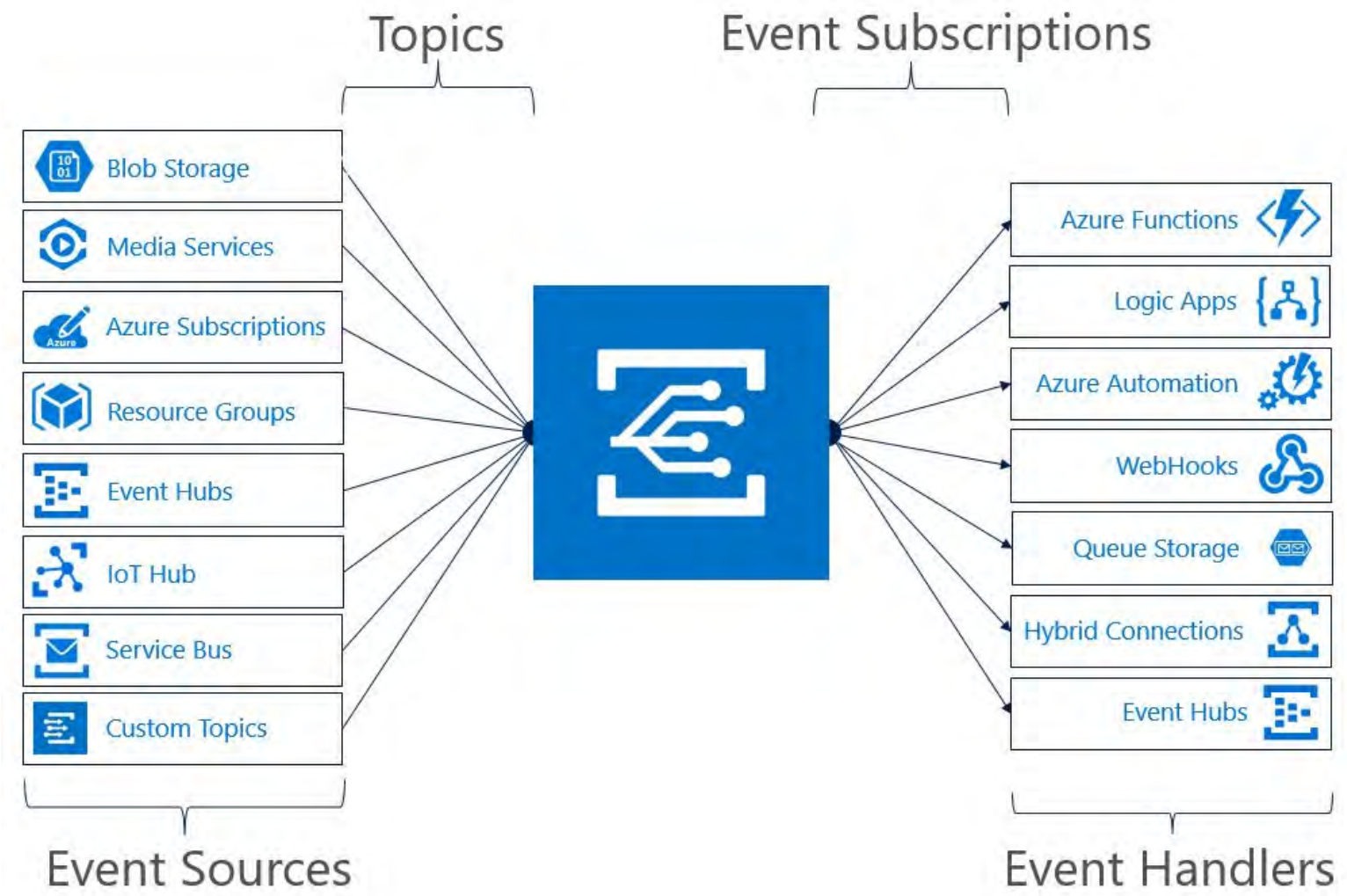
Services that connect sensors to models and other endpoints

PROJECTS



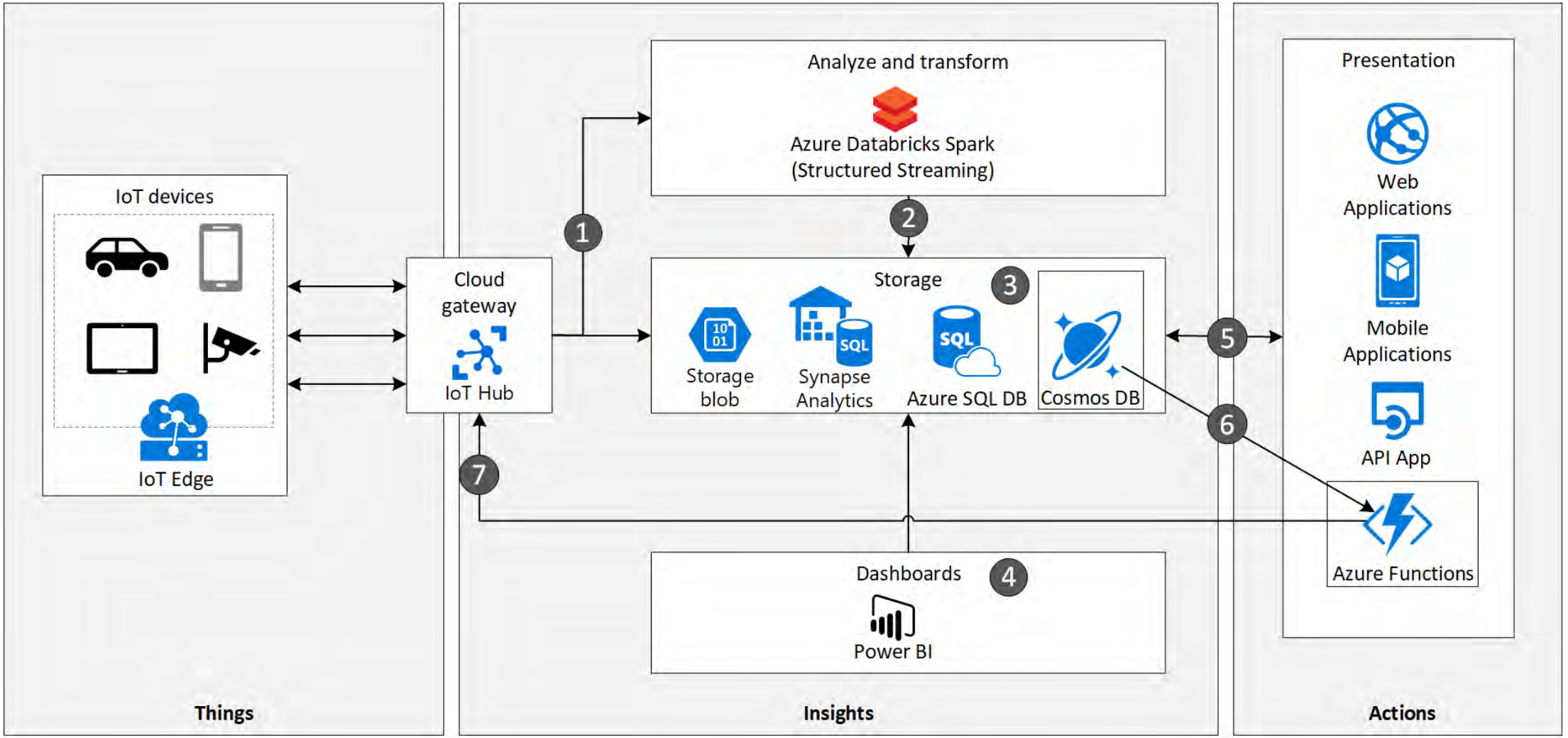
Azure Digital Twins

COMMON SOFTWARE SOLUTIONS



Azure Digital IoT

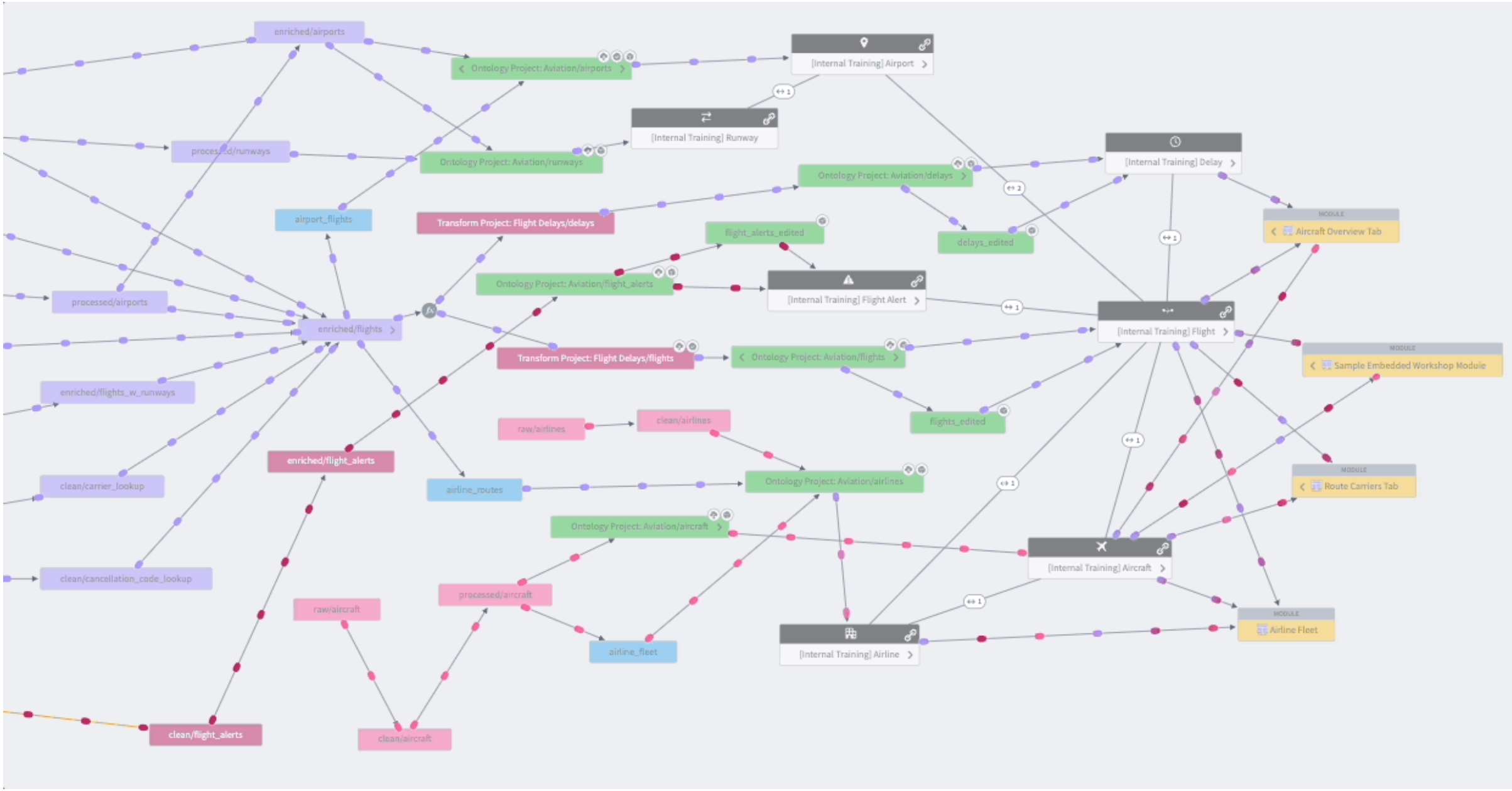
COMMON SOFTWARE SOLUTIONS



Azure Cosmos and IoT

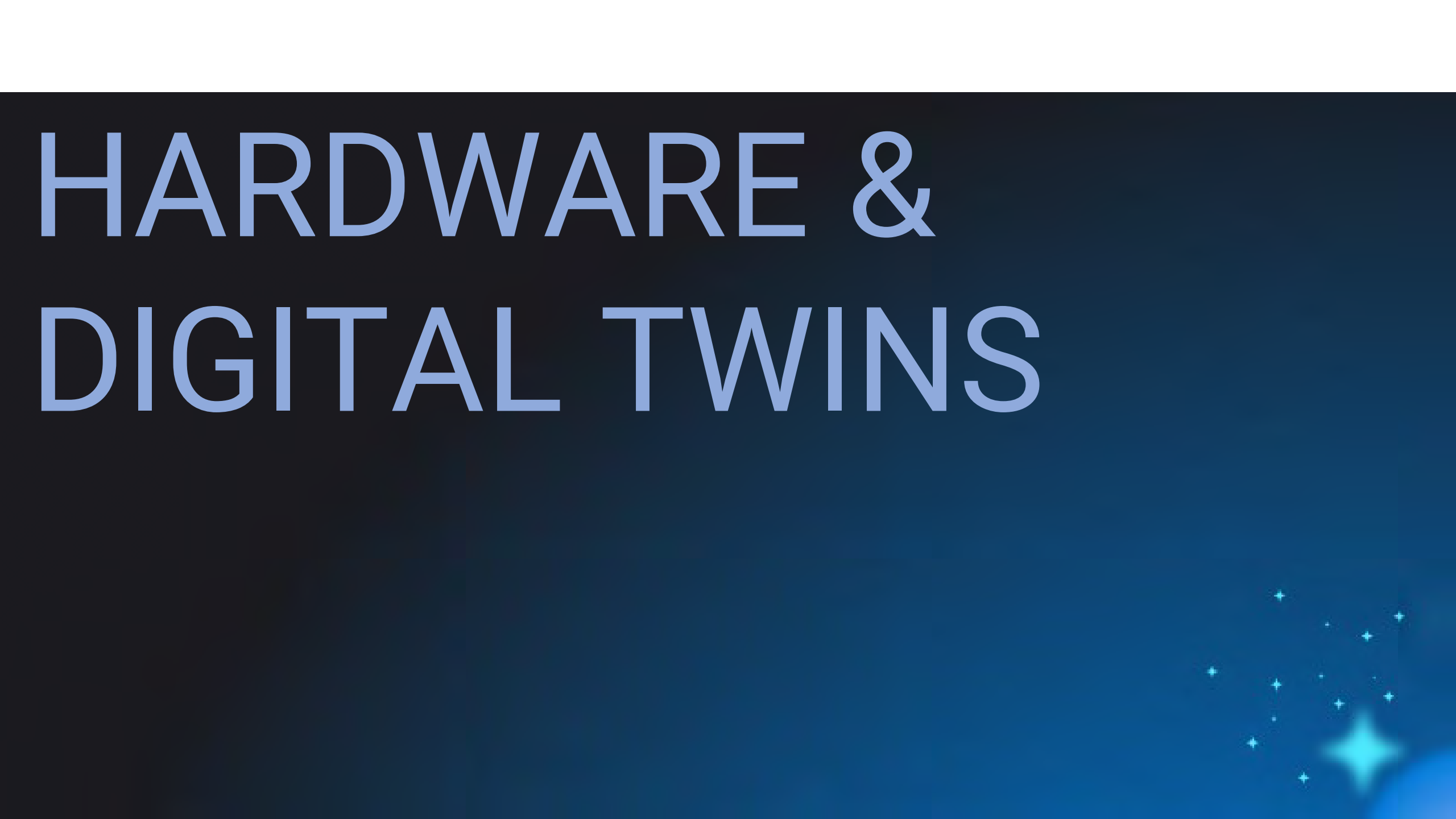
https://docs.microsoft.com/en-us/azure/architecture/solution-ideas/articles/iot-using-cosmos-db

COMMON SOFTWARE SOLUTIONS

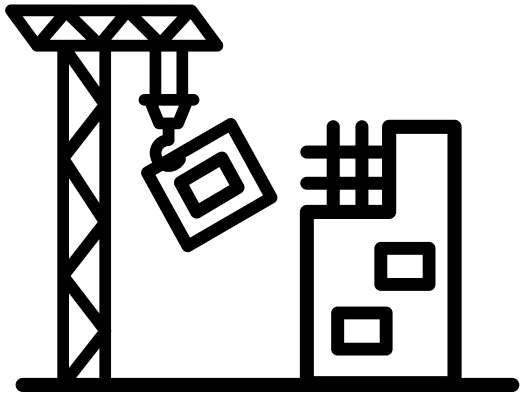


Ontology Model – Data Lineage and Connections

HARDWARE & DIGITAL TWINS



DIGITAL TWINS AND MODULAR CONSTRUCTION



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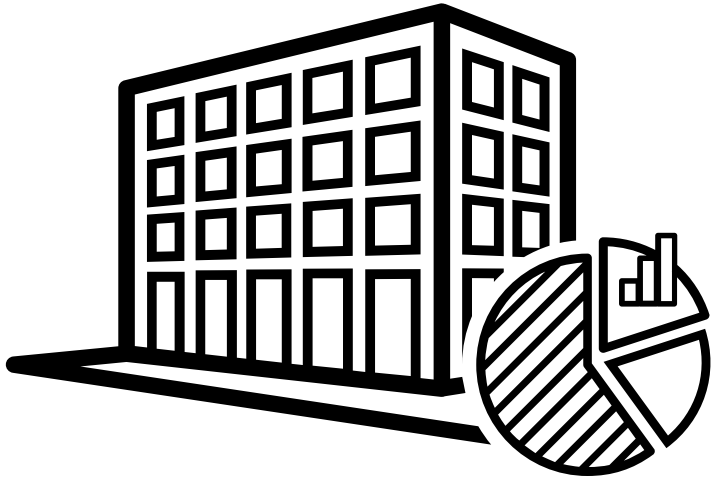

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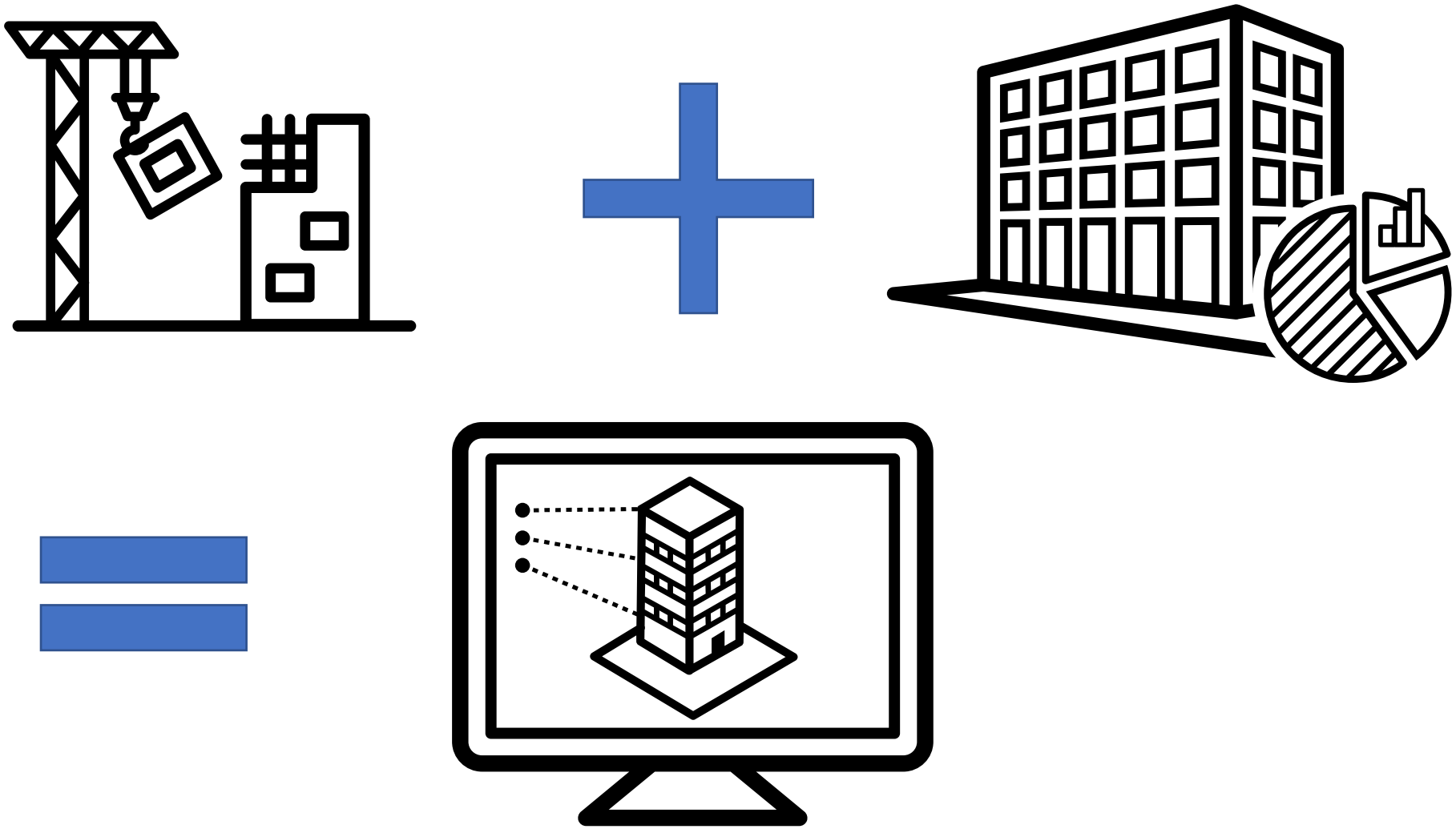
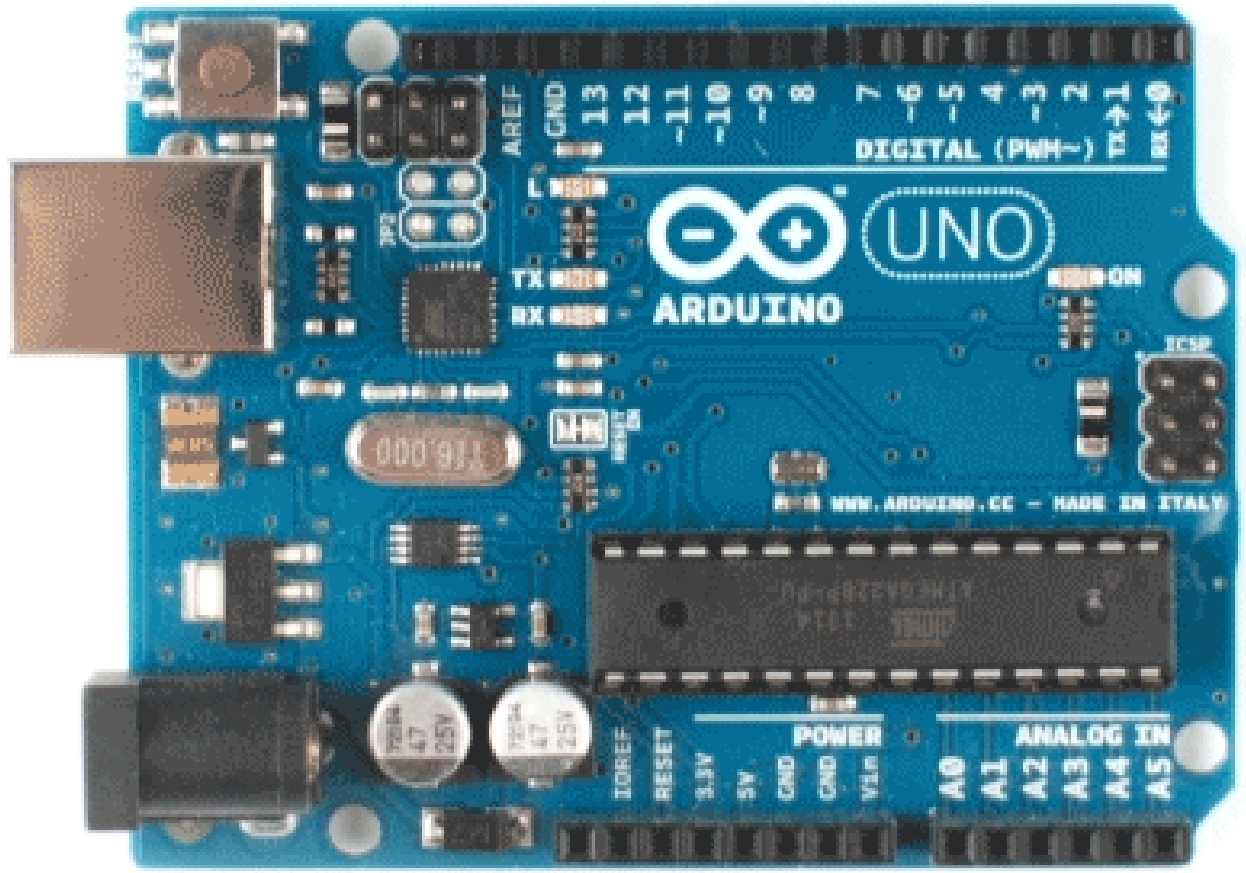


IOT APARTMENTS

https://www.inputmag.com/design/modular-construction-might-be-the-solution-to-las-homelessness-crisis

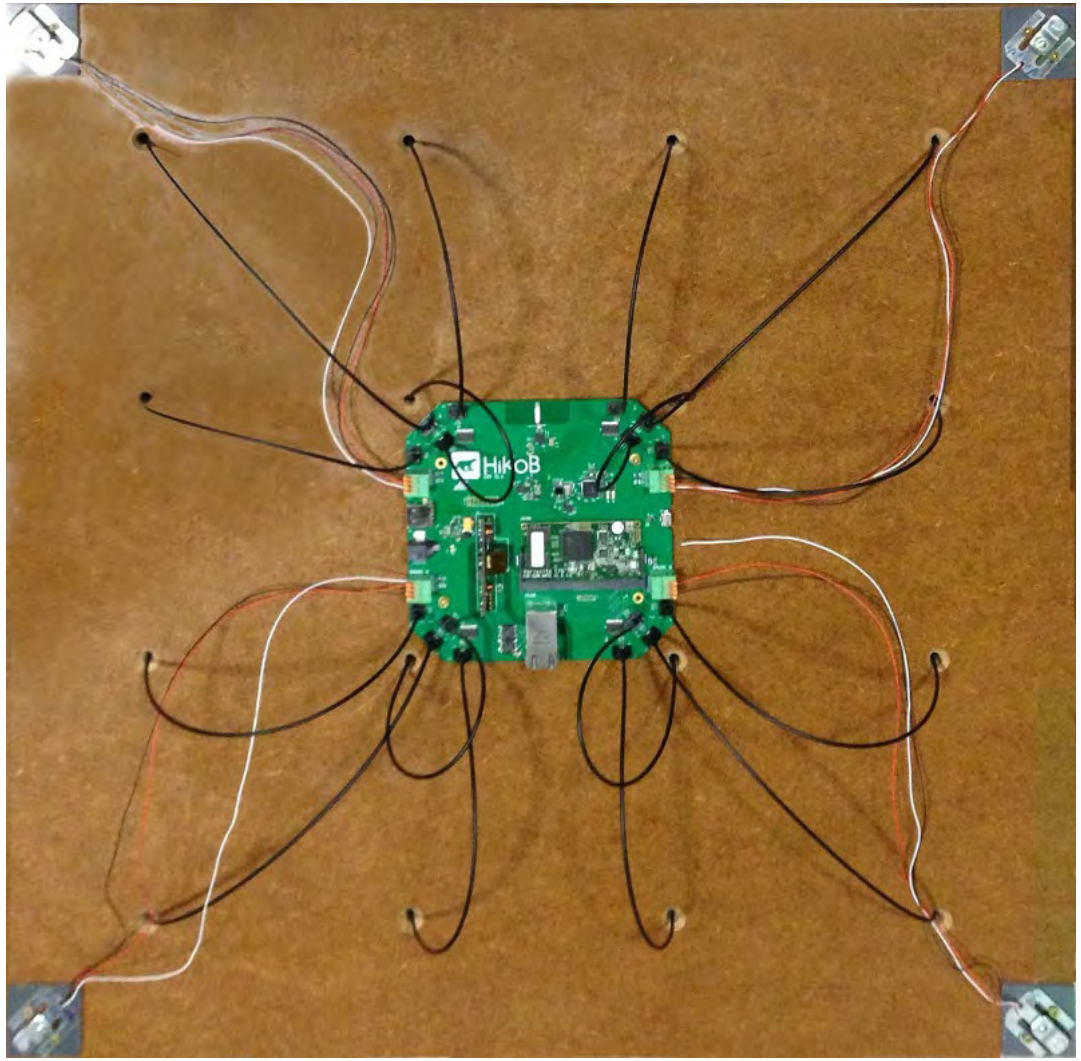
OPEN SOURCE SOLUTIONS



ARDUINO

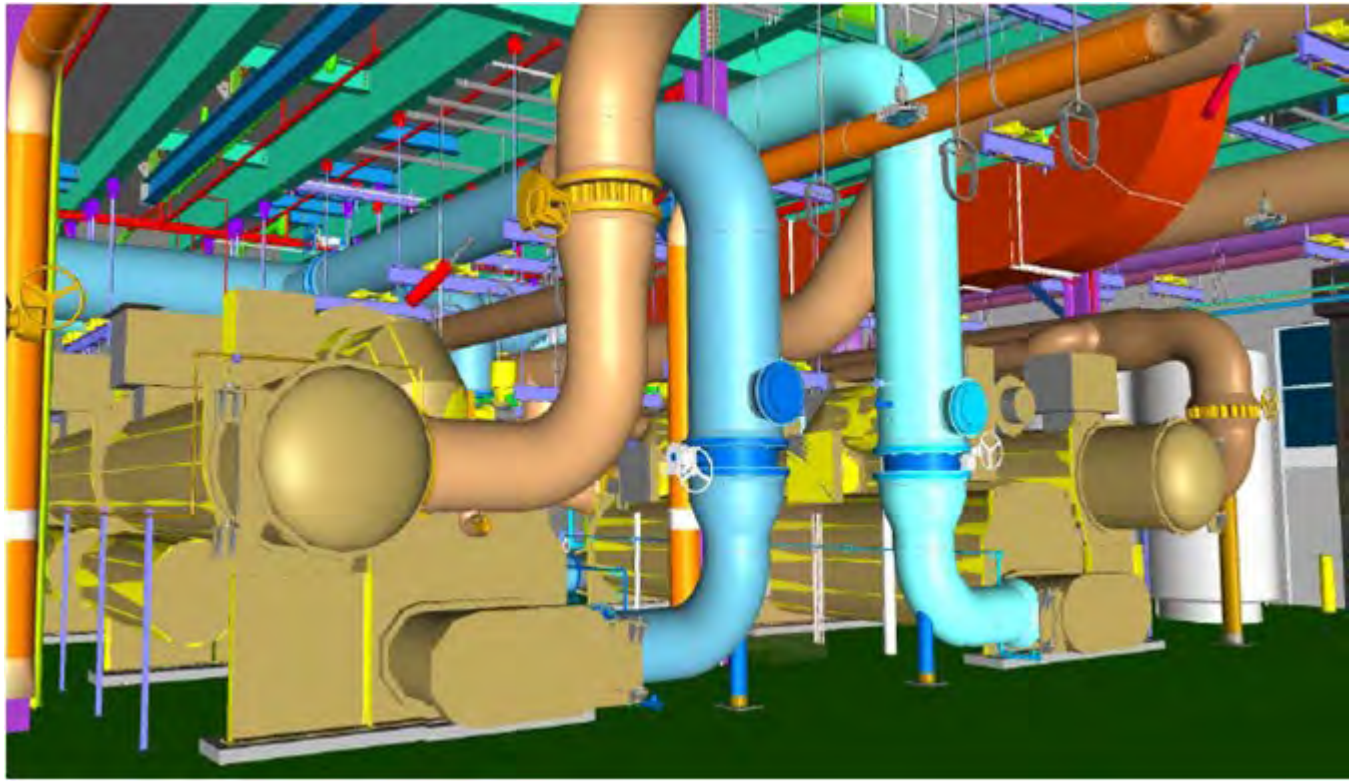
openremote

IOT SENSORS BUILT INTO YOUR ASSEMBLIES



https://www.inputmag.com/design/modular-construction-might-be-the-solution-to-las-homelessness-crisis

MODULAR IOT EQUIPMENT



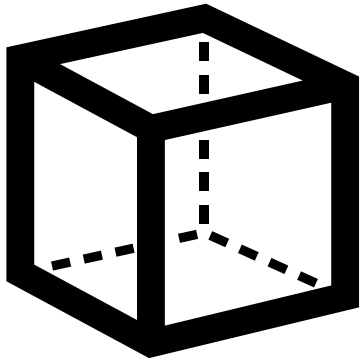
https://betterbuildingssolutioncenter.energy.gov/implementation-models/ford-motor-company-dearborn-campus-uses-a-digital-twin-tool-energy-plant

VISUALIZATIONS

WHAT DOES IT LOOK LIKE? VISUALIZATIONS

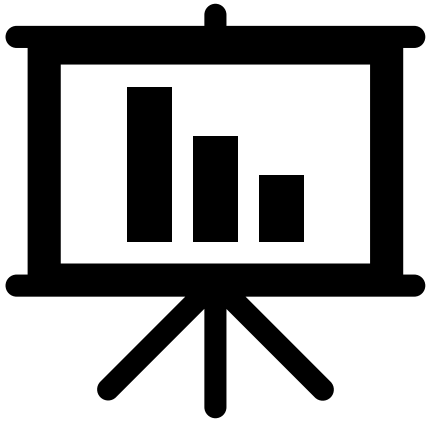
WHAT DOES IT LOOK LIKE? VISUALIZATIONS

3D Models



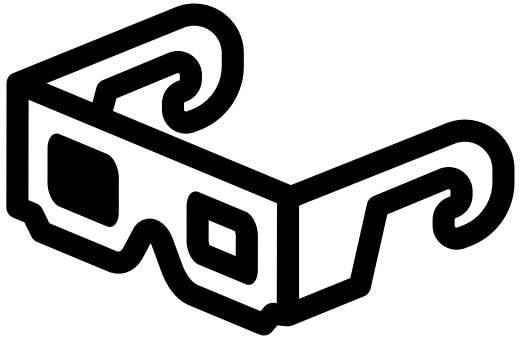
Geometric representation of design or asset

Charts



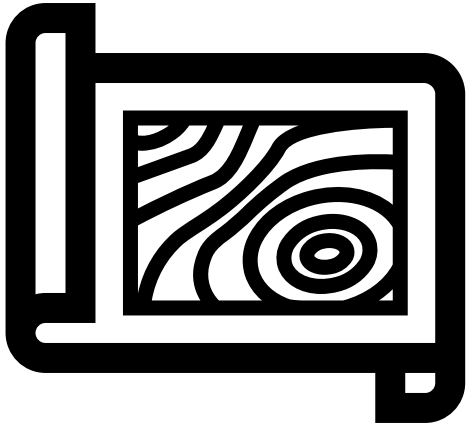
Information displayed in a structured format

VR/AR



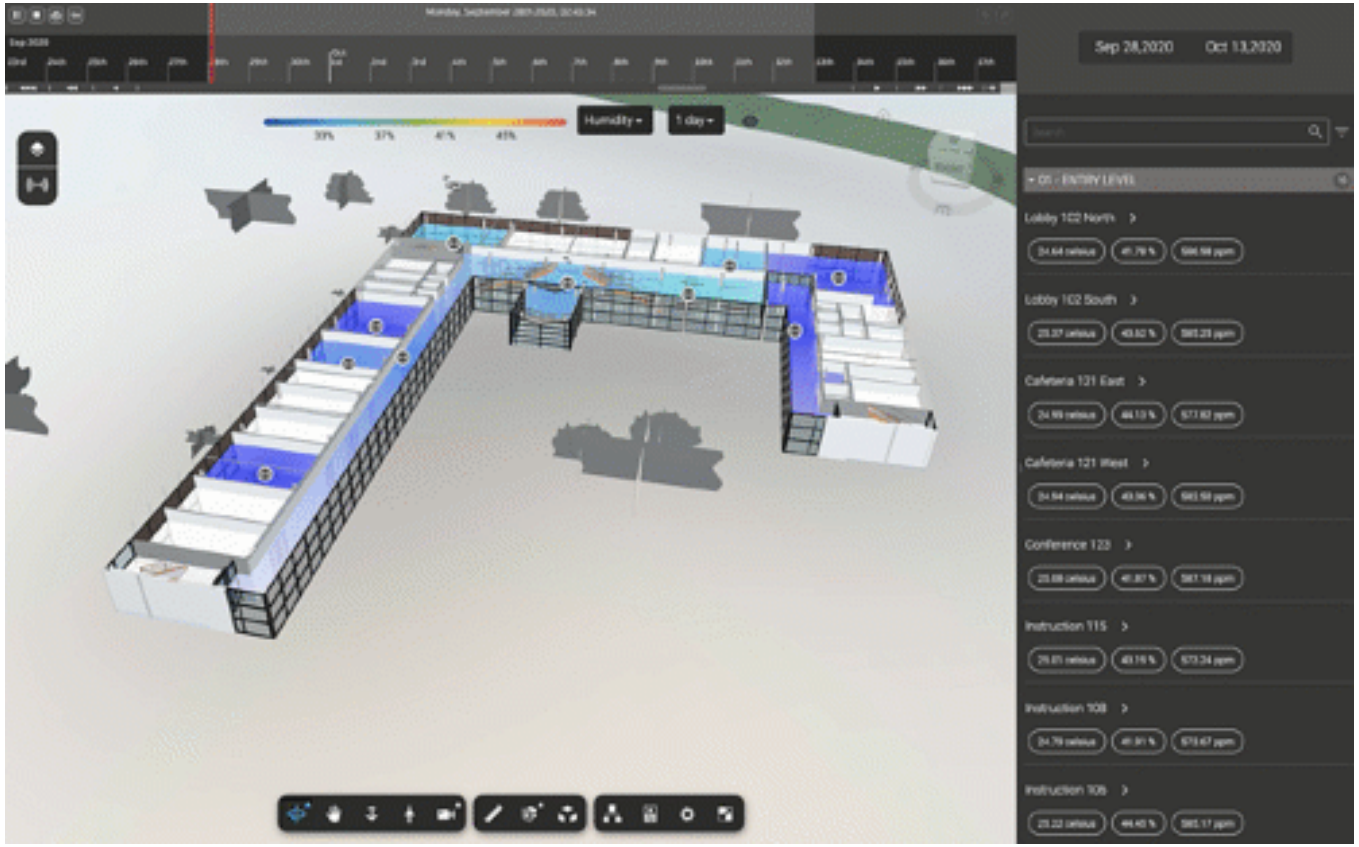
Equipment that immerses someone into a simulated experience

Maps



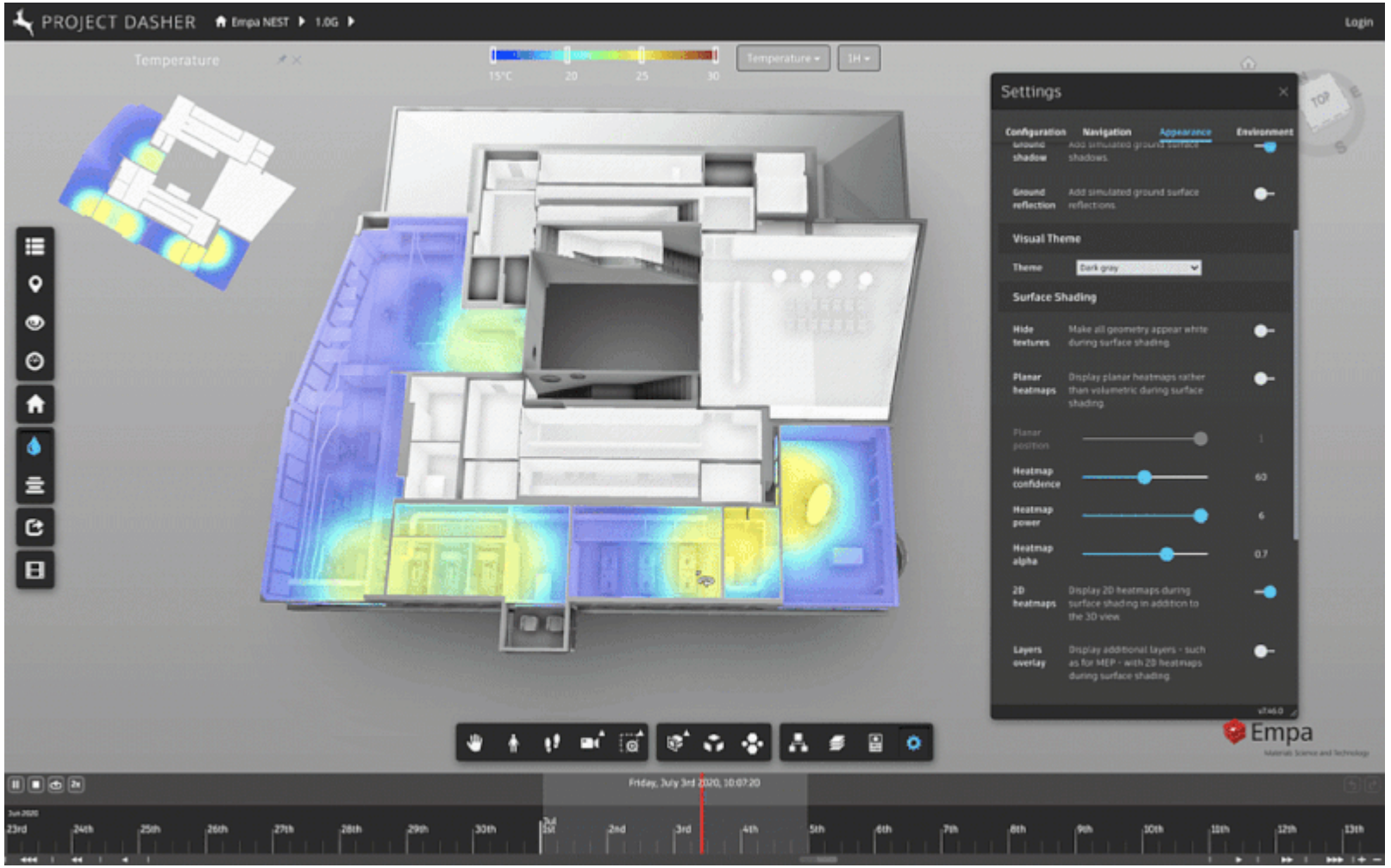
Description of an area through 2D or 3D projection

3D MODELS



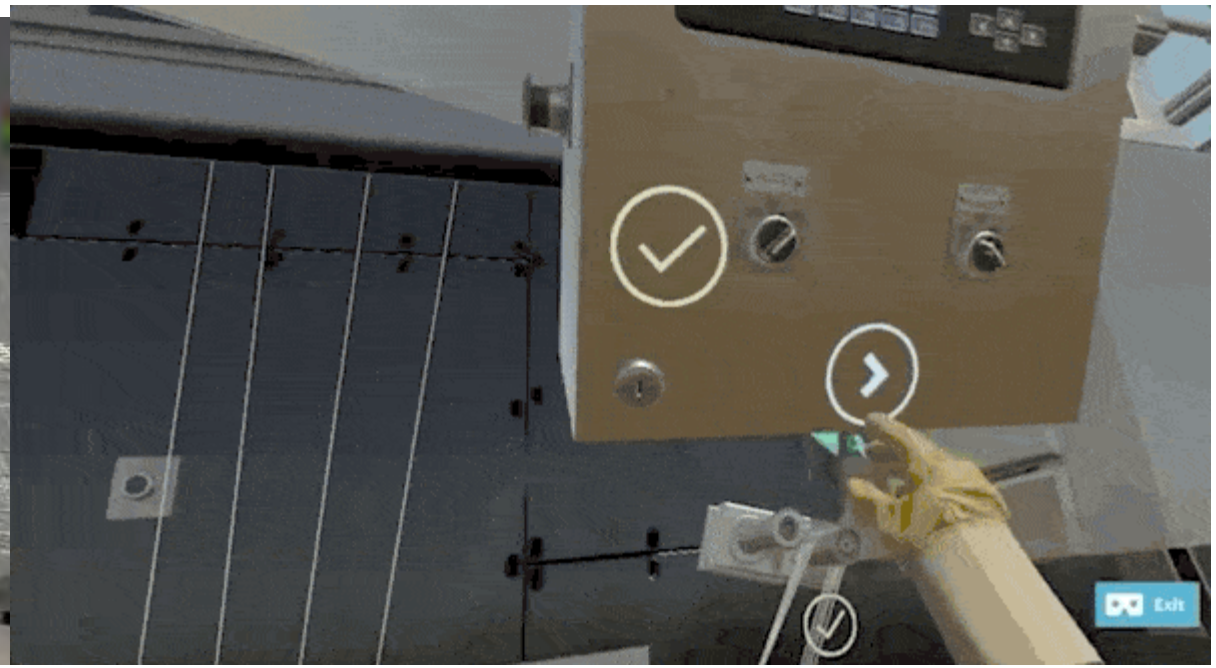
https://www.keanw.com/2020/11/autodesk-tandem-and-the-forge-viewer-data-visualization-extension.html

3D MODELS



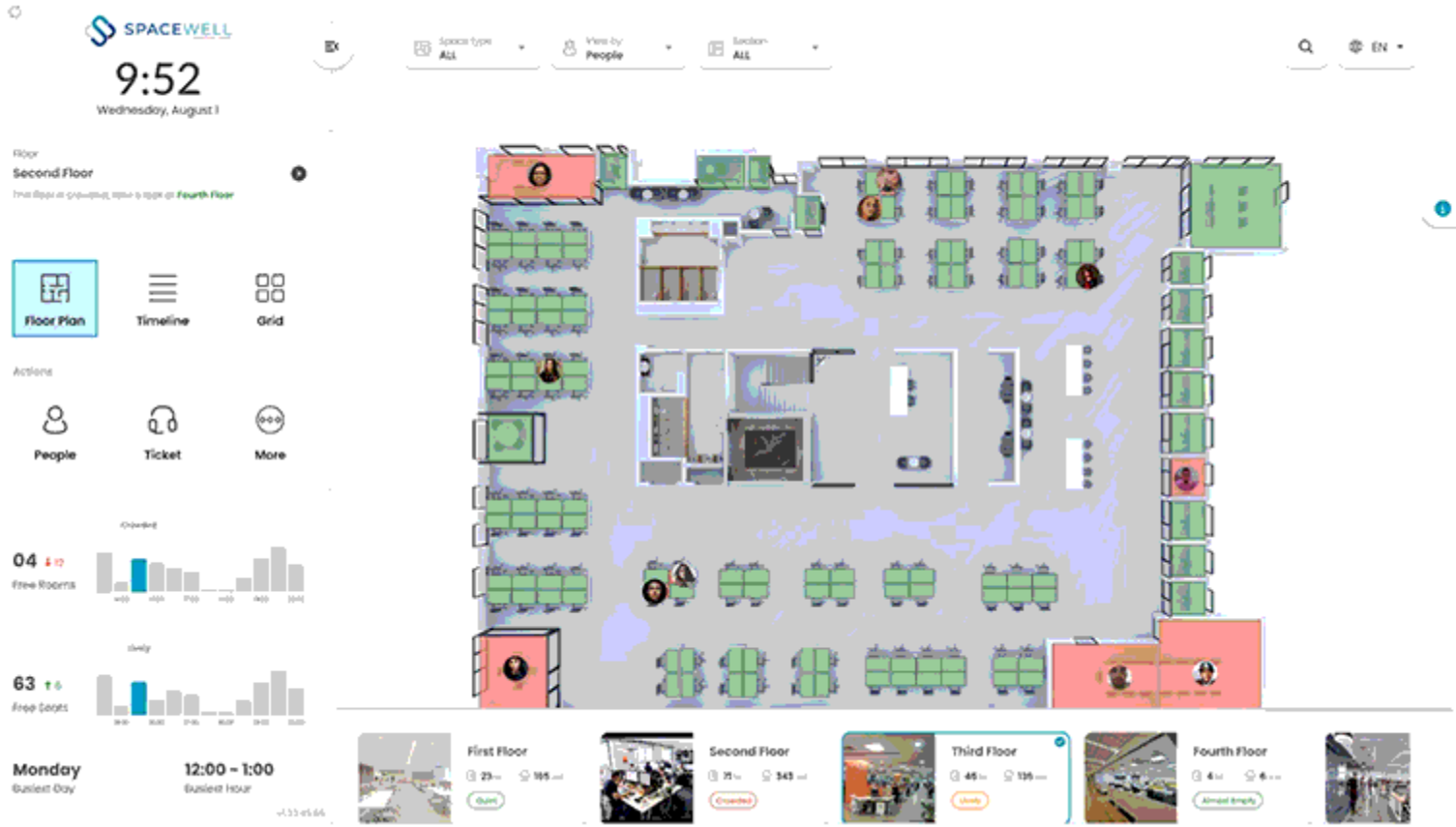
https://www.keanw.com/2020/11/autodesk-tandem-and-the-forge-viewer-data-visualization-extension.html

VIRTUAL REALITY



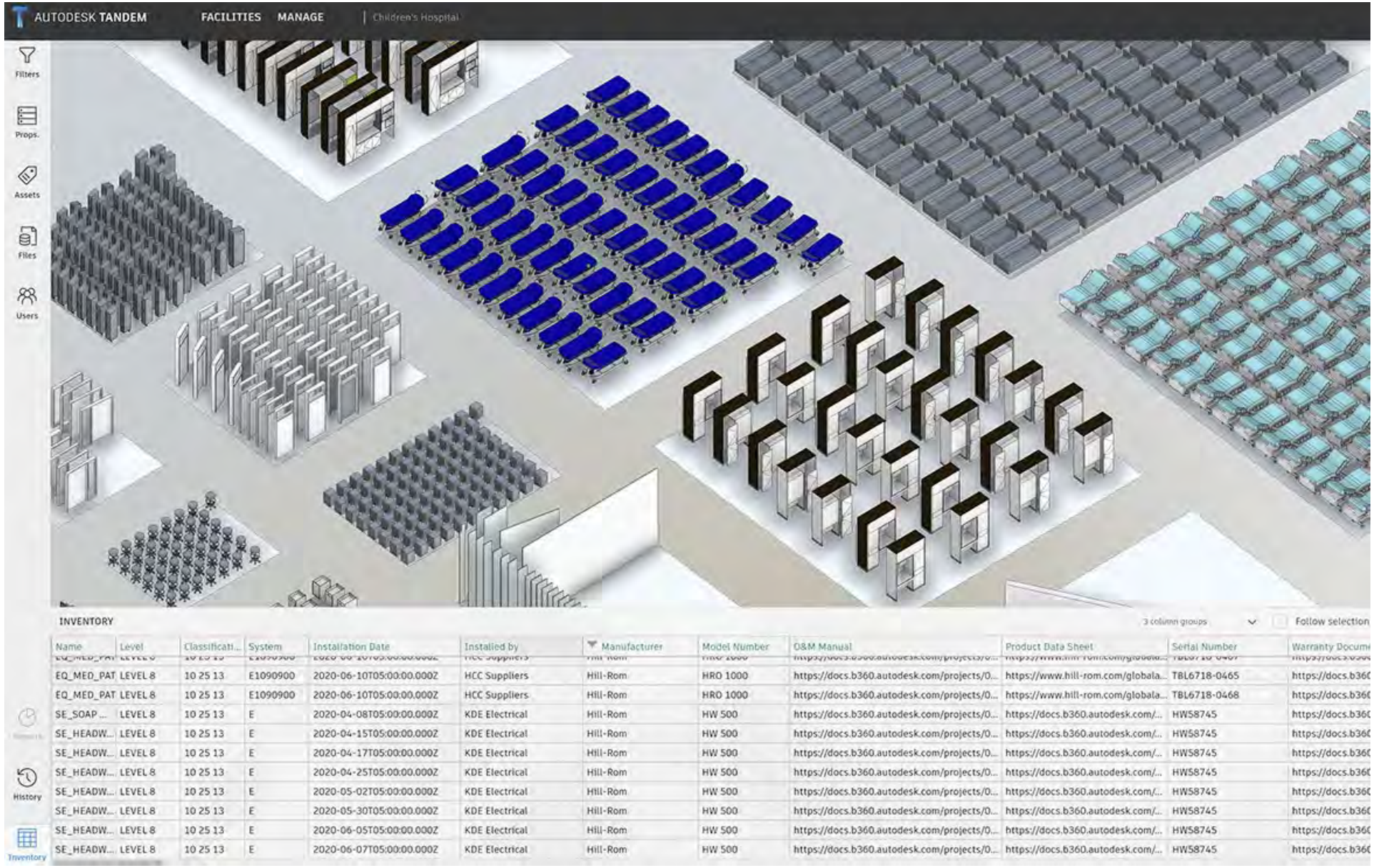
https://circuitstream.com/blog/digital-twin/

MAPS / GIS



https://spacewell.com/solutions/workplace-solutions/indoor-air-quality-monitor/

CLOUD PLATFORMS

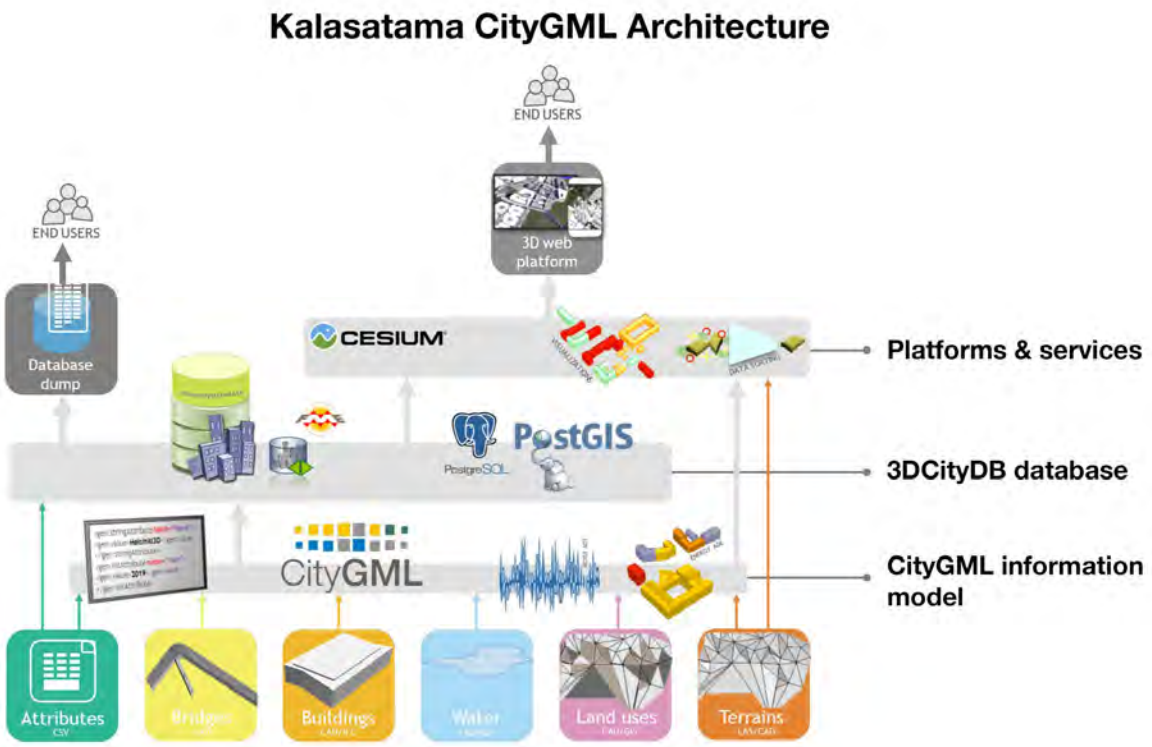


[Digital Twin Drives AEC and Digital Transformation | Autodesk News]

GAME ENGINES

https://www.autodesk.com/autodesk-university/class/My-First-Digital-Twin-Real-Time-Rendering-Story-2020#presentation

URBAN SCALE TWINS



[Helsinki is Building a Digital Twin of the City - AEC Business (aec-business.com)]

Figure 48. Presenting Smart Kalasatama projects

PLANNING FOR TWINS

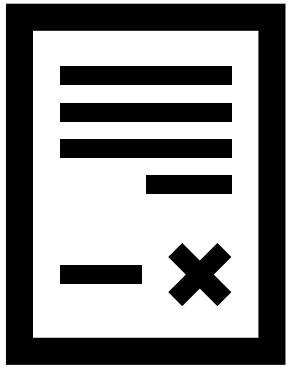
WHO PAYS FOR ALL THIS

WHO PAYS FOR ALL THIS

The Owner pays for this

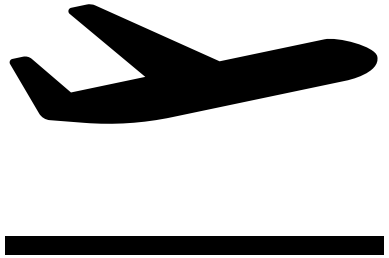
BUSINESS CASE

RFP



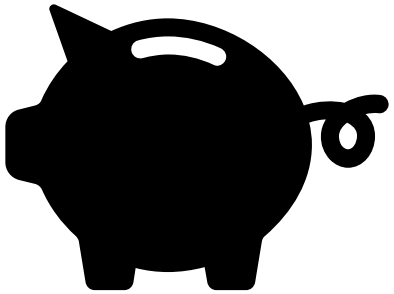
Include in your proposals as part of the service

Pilot Program



State it as a pilot project with your client

ROI

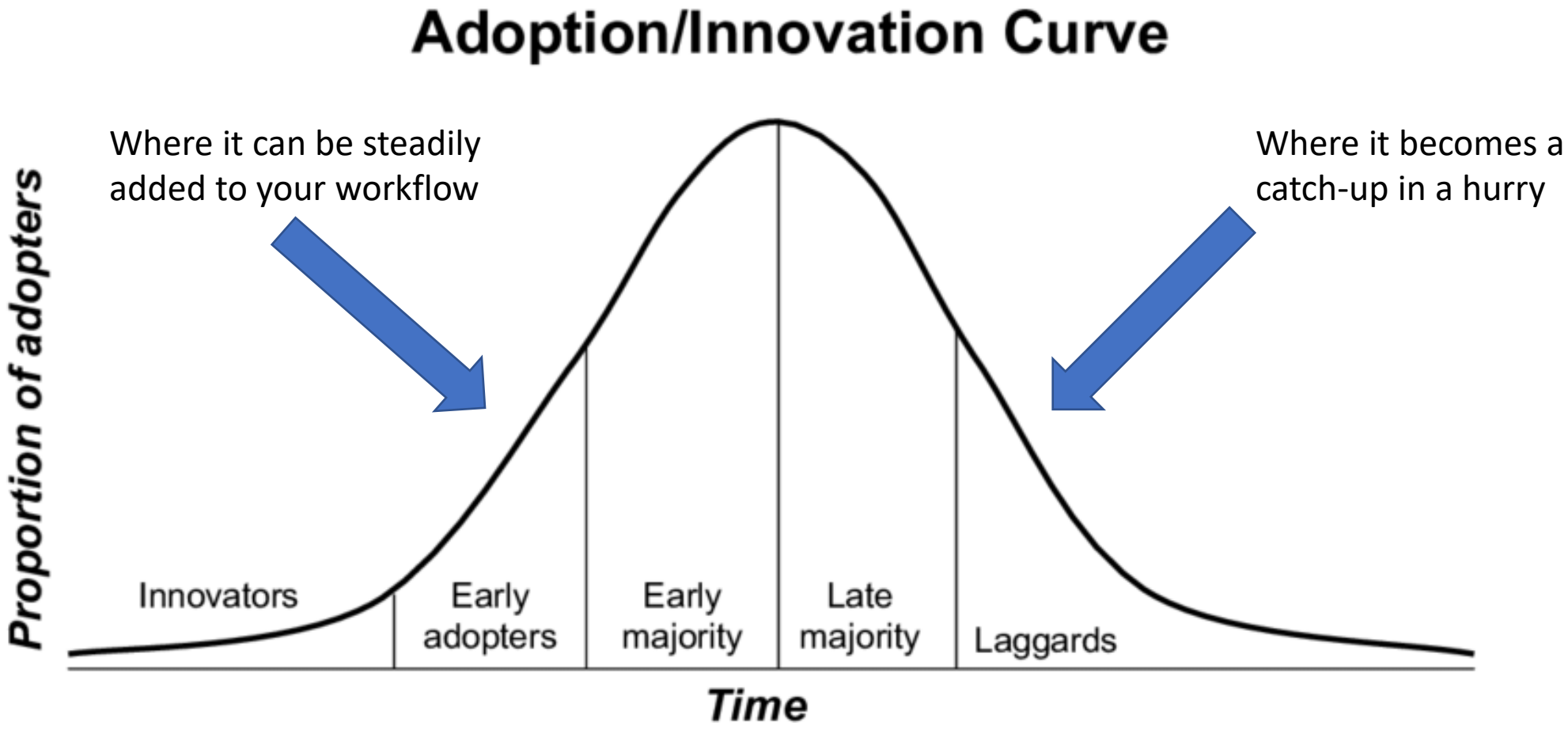


Describe the potential Return on Investment

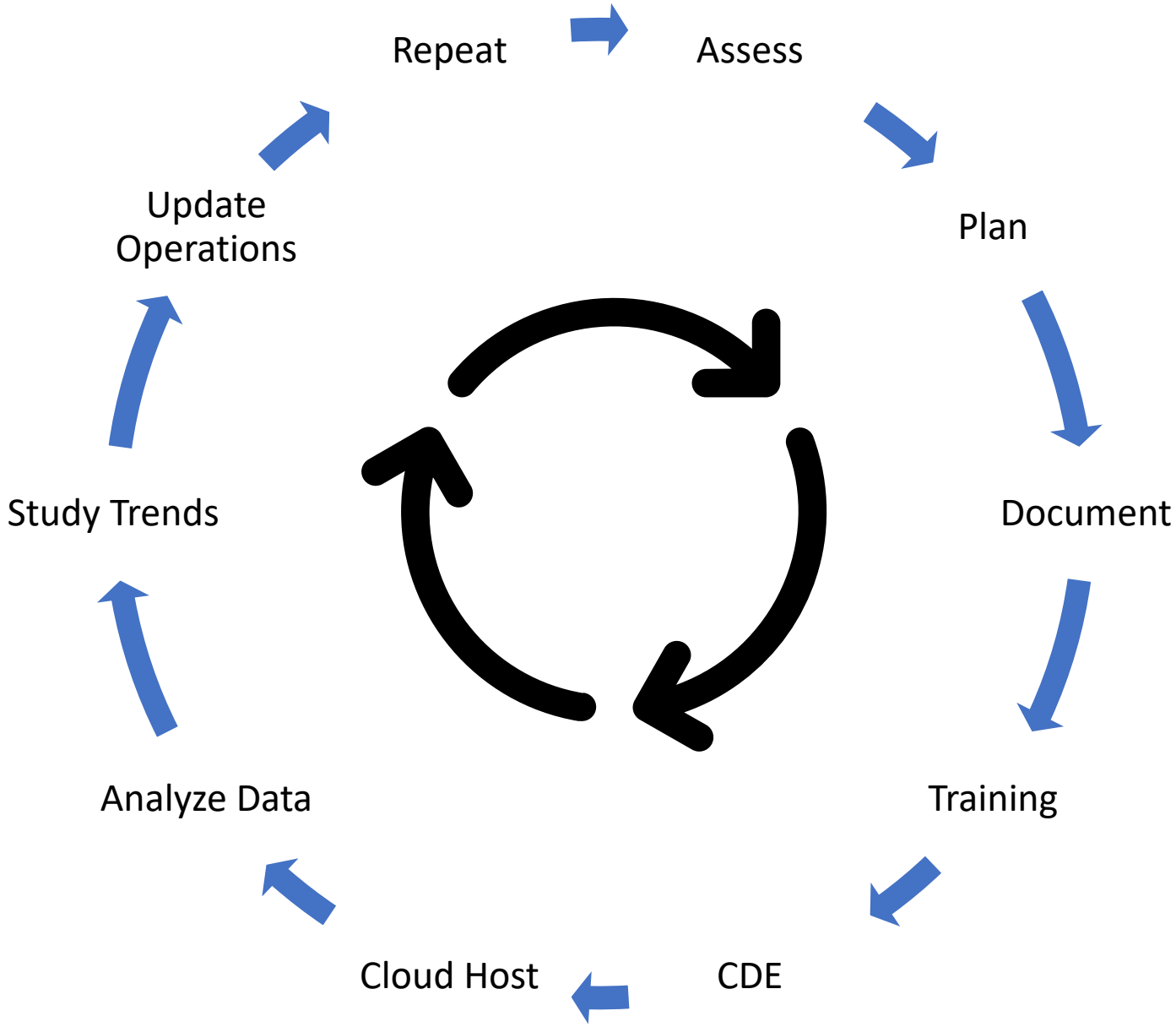
Opportunity

Explore and provide results of the process

COORDINATING OVER TIME FOR DELIVERY

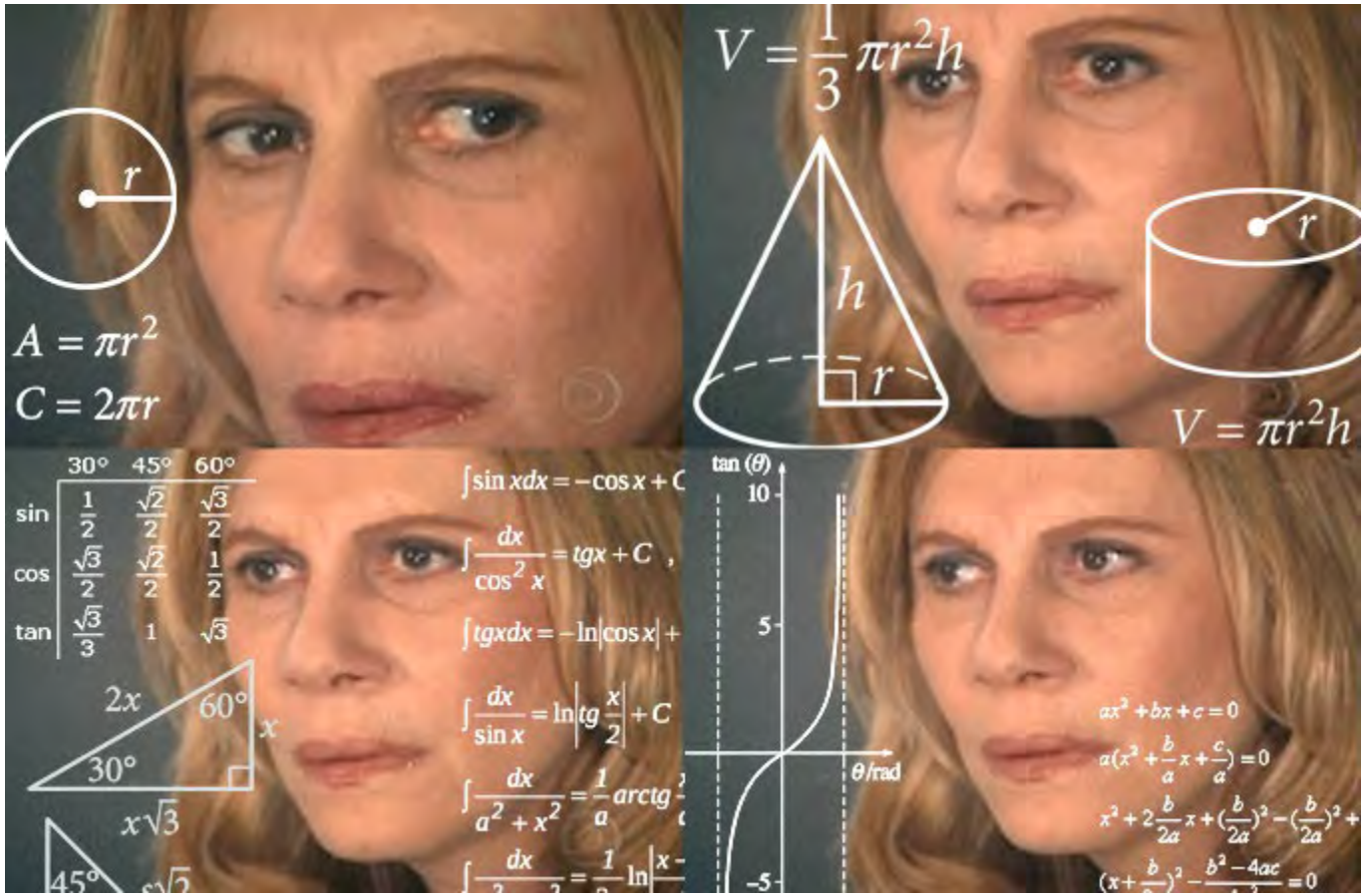


YOUR PROJECT TEAM SETUP



GETTING STARTED

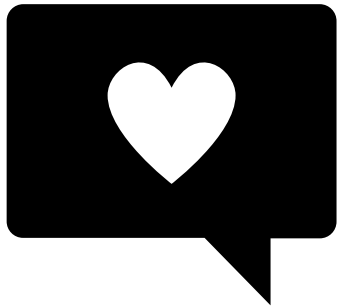
WHERE TO BEGIN?



Planning your Digital Twins operations in 4 easy steps

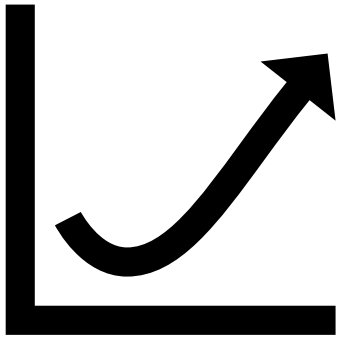
WHERE TO BEGIN

Know what you want



What are the kinds of things you care about?

Where are the Opportunities



What kind of targets do you want to achieve?

Plan it out

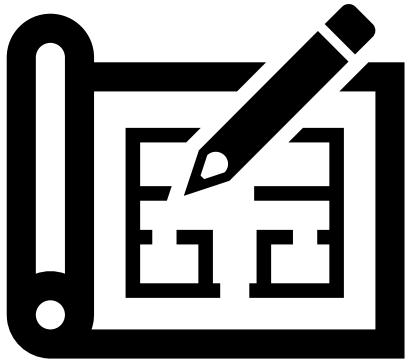


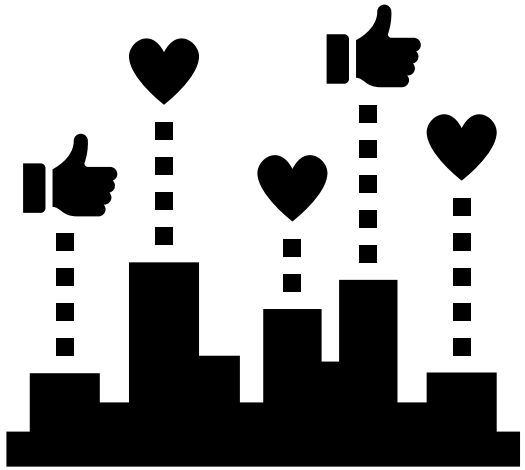
Chart a path and figure out what you need to connect together

Adjust your operations

If you go off course the correct your trajectory

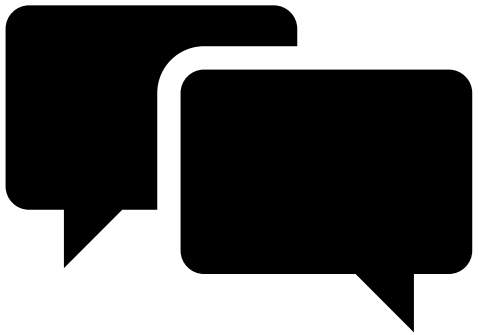
WHAT DO YOU WANT TO ACHIEVE?

Building Performance Information



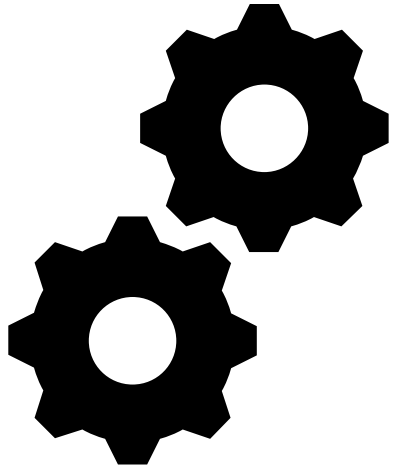
you need sensors and analytics

User Feedback



you need human facing services to complement the data

Automation



you need integrated services and planning across operations

BRINGING IT ALTOGHER

1. Create connections to the physical environment
2. Get live updates from physical equipment
3. Have a place to store the data
4. Analyze the data for breakdowns, trends, notifications, usage etc,
5. Update your equipment and Digital Twin assets
6. Repeat
7. Forever
8. Just like the real building the work is ongoing

YOUR PROJECT TEAM SETUP

TAKE-AWAYS

REVIEW KEY POINTS

1. Digital Twins are **virtual representations** of physical assets
2. All Digital Twins exist in a **Schema of connected devices** and services
3. Standardizing bodies can provide **common ground for planning** a Digital Twin Strategy
4. There are many **modes of visualization** for Digital Twins available
5. Create a **business plan and roadmap** for your organization to try Digital Twins
6. Find opportunities to use Digital Twins in **your projects as proof of concept**

RESOURCES

- Network world - https://www.networkworld.com/article/3280225/what-is-digital-twin-technology-and-why-it-matters.html
- Oracle Digital Twin Framework - https://docs.oracle.com/en/cloud/paas/iot-cloud/iotgs/iot-digital-twin-framework.html
- DTC Assessment Criteria - https://www.digitaltwinconsortium.org/initiatives/DTC-Open-Collaboration-Project-Assessment-Criteria.pdf
- DTC open source assessment - https://www.digitaltwinconsortium.org/initiatives/DTC-Open-Collaboration-Projects-Overview-and-Guidelines.pdf
- Industrial Enterprise for Digital Twins - https://www.ptc.com/-/media/Files/PDFs/IoT/digital_twin_industrial-enterprises-6-11-19.pdf
- McKinsey Construction Productivity - https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Operations/Our%20Insights/Reinventing%20construction%20through%20a%20productivity%20revolution/MGI-Reinventing-Construction-Executive-summary.pdf

THANKS!

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