Starting from Square 1

Building Your Facilities Data

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DLRGROUP
ARCHITECTURE ENGINEERING PLANNING INTERIORS

CONTINUING EDUCATION AIA

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Course Description

This presentation will provide an overview of the value of harnessing cutting-edge technology to build and maintain an accurate and detailed database of existing and new facilities. Attendees will explore the benefits of tools such as Lidar scanning and digital twins, which can streamline data collection, support space and operational planning, and drive efficiencies across a range of workflows, from small maintenance tasks to complex renovations. The presentation will explore real-life applications and benefits through various case studies.

Learning Objectives

At the end of this course, participants will be able to:

- Attendees will learn how Lidar and digital twin technologies can help identify physical hazards, structural weaknesses, and access/egress issues in their existing facilities; thus supporting risk mitigation and emergency planning.
- Attendees will learn how to monitor and manage various health and wellness factors within a building by utilizing various technologies. For example- exploring devices that can monitor and improve indoor air quality, daylighting, thermal comfort, safe levels of acoustics, and general occupant well-being. These strategies can also be used for on-going facility tracking or to better inform decision-making during renovations or building improvements.
- Attendees will learn how to utilize building infrastructure technologies to improve the safety and security of the occupants through data monitoring, device control, and scenario simulation.
- Attendees will explore how to utilize building space data to support equitable space access and long-term sustainability in their facilities, and ensure that educational environments are optimized for accessibility, and long-term usability.
- Attendees will learn how to incorporate technologies into their existing and new facilities to predict maintenance and operational needs which can lead to more intentional and streamlined maintenance and cleaning as well as reduce unnecessary maintenance labor and materials.

MEET YOUR PRESENTERS

DATA CONSTRUCTORS

DLRG

Brenna Milne, IIDA, WELL AP

Senior Interior Designer

DLRG

William Carney

Design Technology Leader

DLRG

Dez Cubero, Assoc. AIA

Architectural Designer

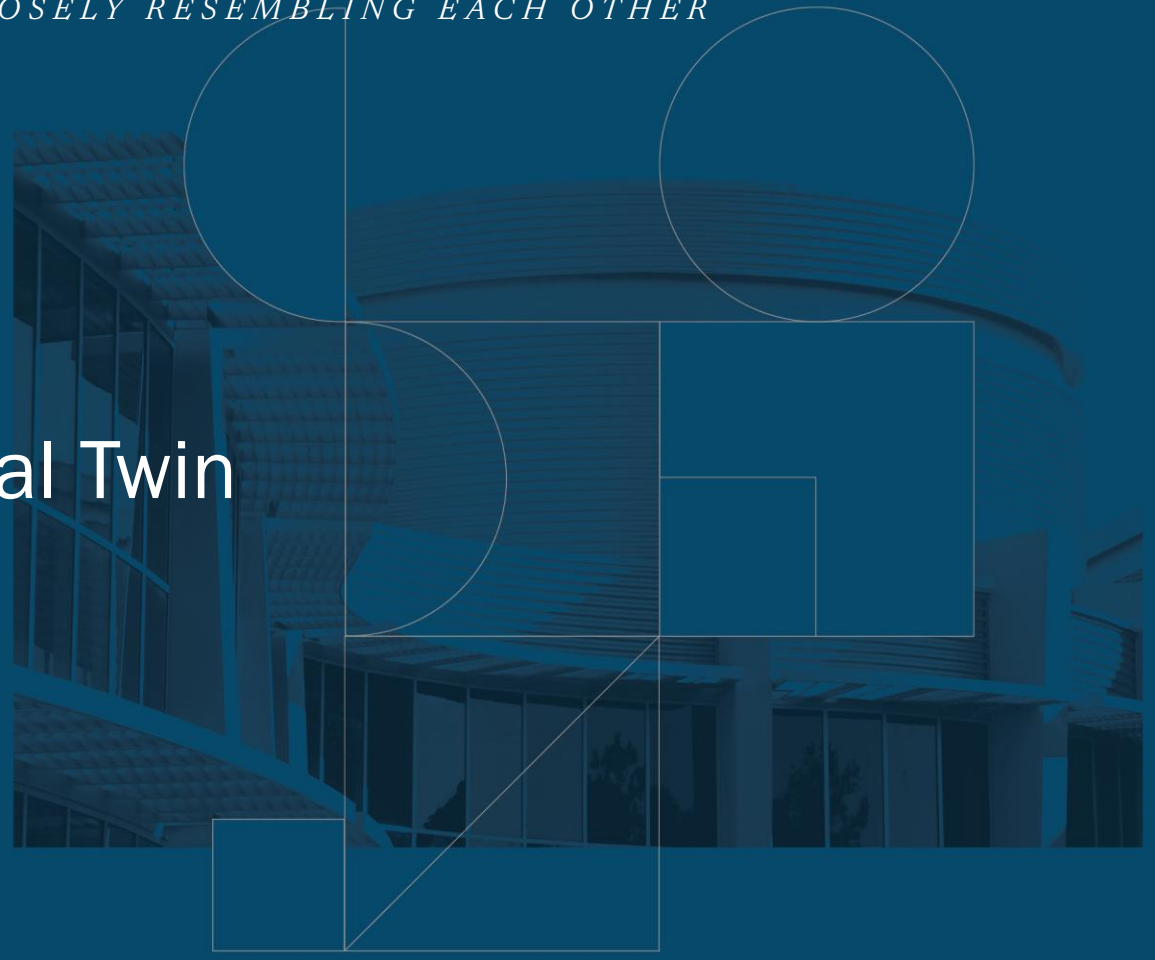
LHPS

JR Armstrong

Facilities Manager

ONE OR TWO THINGS CLOSELY RESEMBLING EACH OTHER

What is a Digital Twin

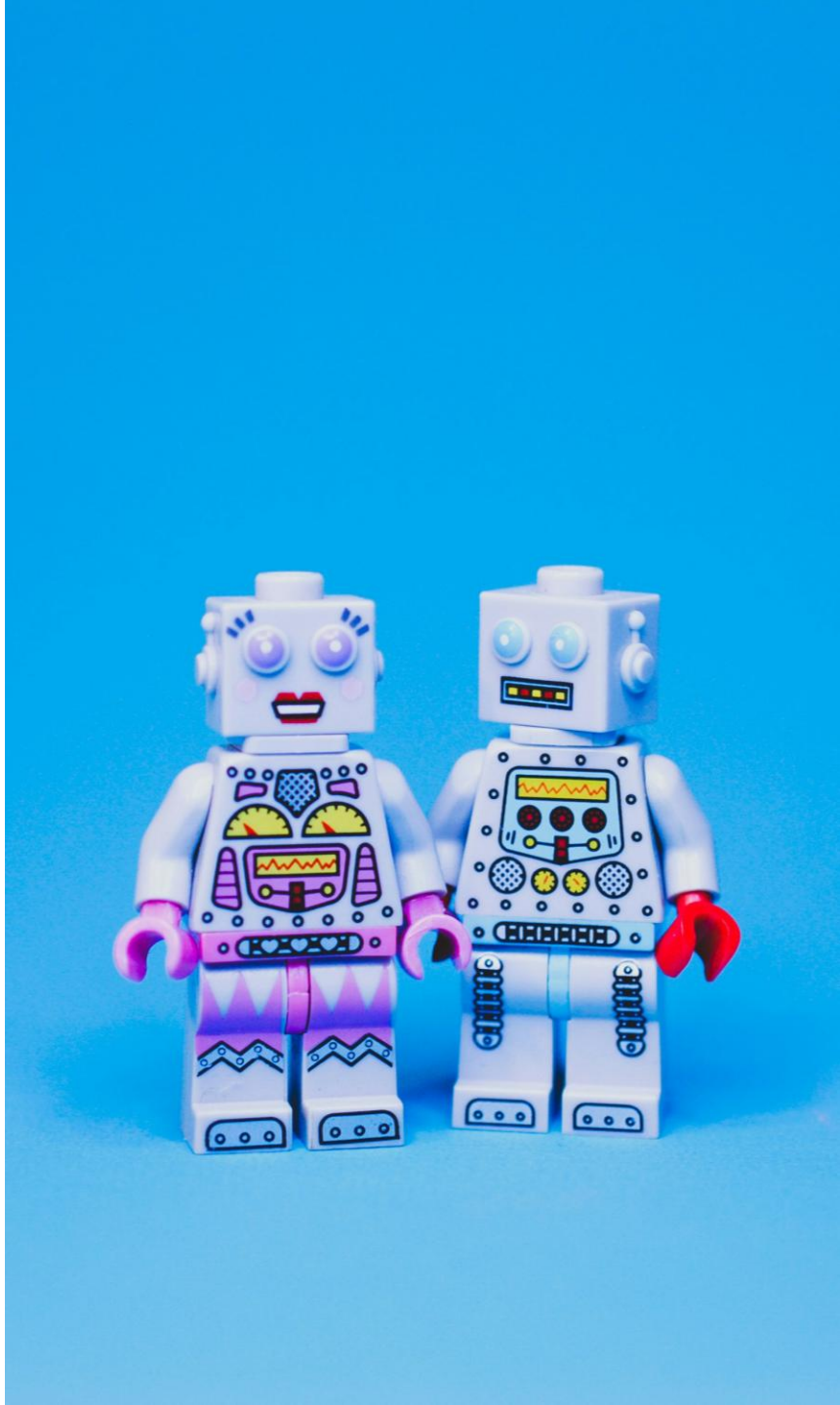


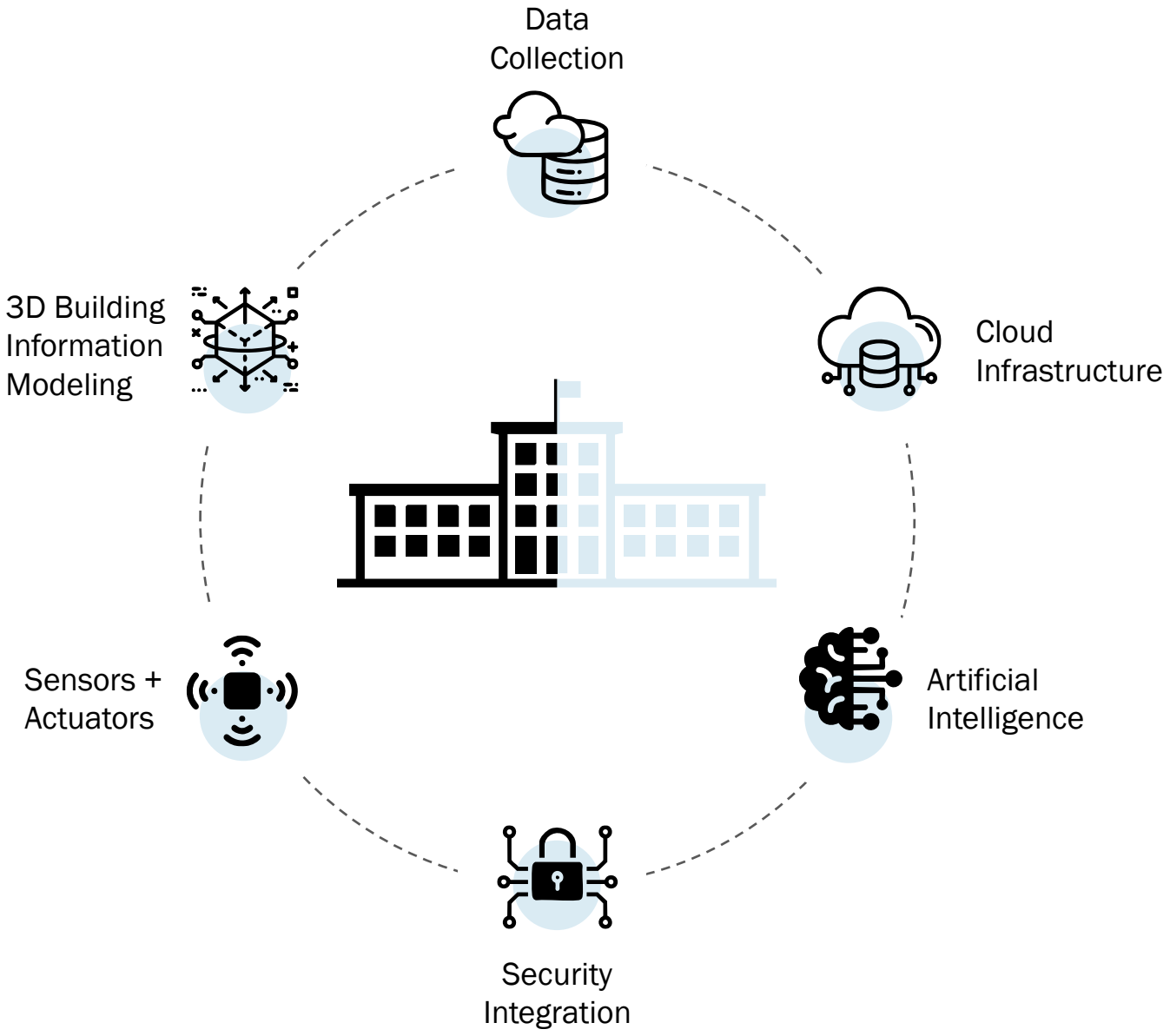
WHAT IS IT?

Create, then optimize scenario isn't a one size fits all

Digital twin development offers an ***alternative solution*** to building and facilities management

Imagine a digital clone, that reflects its real-world counterpart, with incredible attention to detail





Digital Twin Toolkit

Essentials For Optimization and Decision Making

Each element plays a role in data collection *or* analysis. All play an integral role in:

- **Tracking performance**
- **Predicting maintenance needs**
- **Testing layouts & simulating scenarios**
- **Informed decision making**

AUTODESK Tandem

BIMVision

AUTODESK Viewer

SIMULATION OF WHAT ***WILL*** AND ***UNDERSTANDING*** OF WHAT ***DID*** HAPPEN

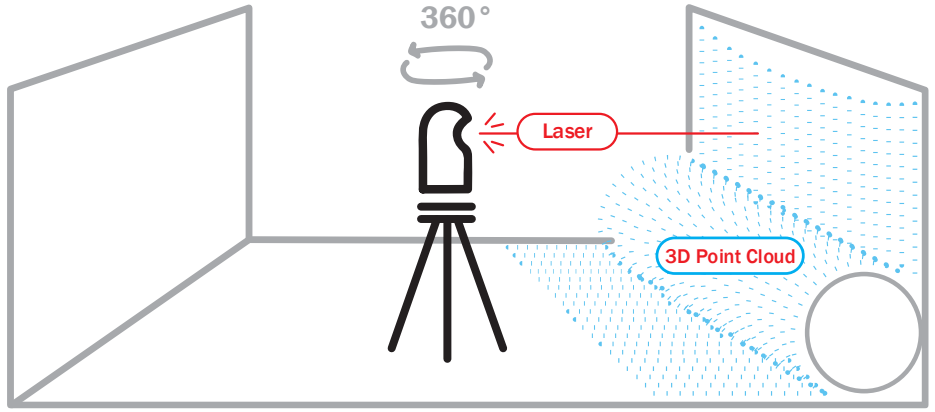
How is a digital Twin Used


An idea posed by NASA in the late 1960s to mimic spacecrafts at earthbound space centers. A few decades later, LiDAR scanning began being used to collect data for
virtual digital twins.

THE **TWINNING**

Pro-Tip: Use real-time and historical data in conjunction with 3d modeling to simulate future scenarios.

LiDAR scanning technology measures distances by emitting pulsing light waves to detect and track objects. By simulating environments or scenarios that closely replicate real-world conditions, users can observe, study, and interact with them in a more controlled and informed way.

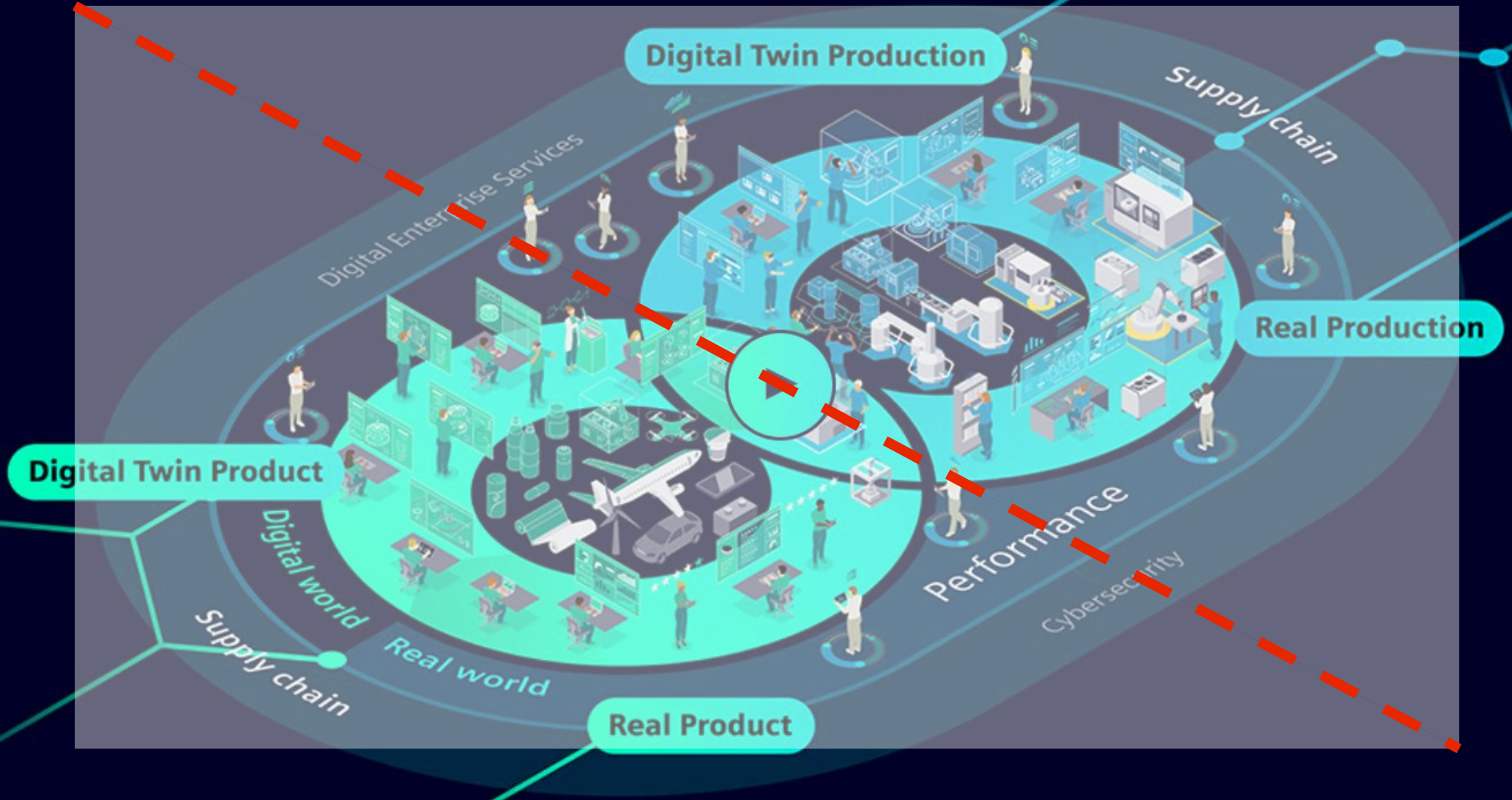


*SIMULATION OF WHAT **WILL** AND **UNDERSTANDING** OF WHAT **DID** HAPPEN*

TWINNING **IN ACTION**

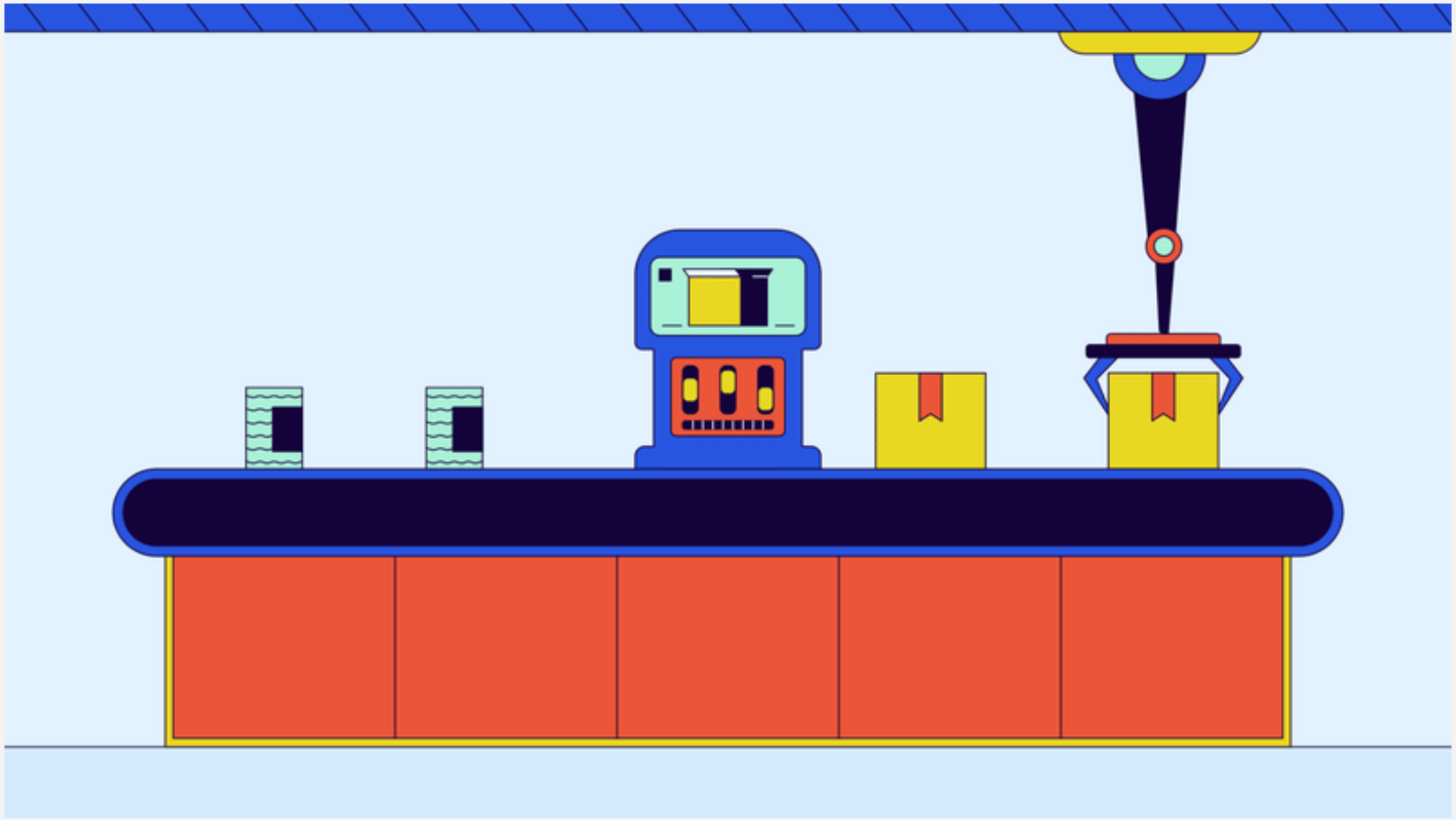
A foundation for smarter, safer, and more sustainable building management

MONITORING



PREDICTION

THE **WHAT WILL**



The part that helps **predict what might happen** in the future.

Because the system is controlled and has only a few variables, it’s easy to simulate what the outcome will be.

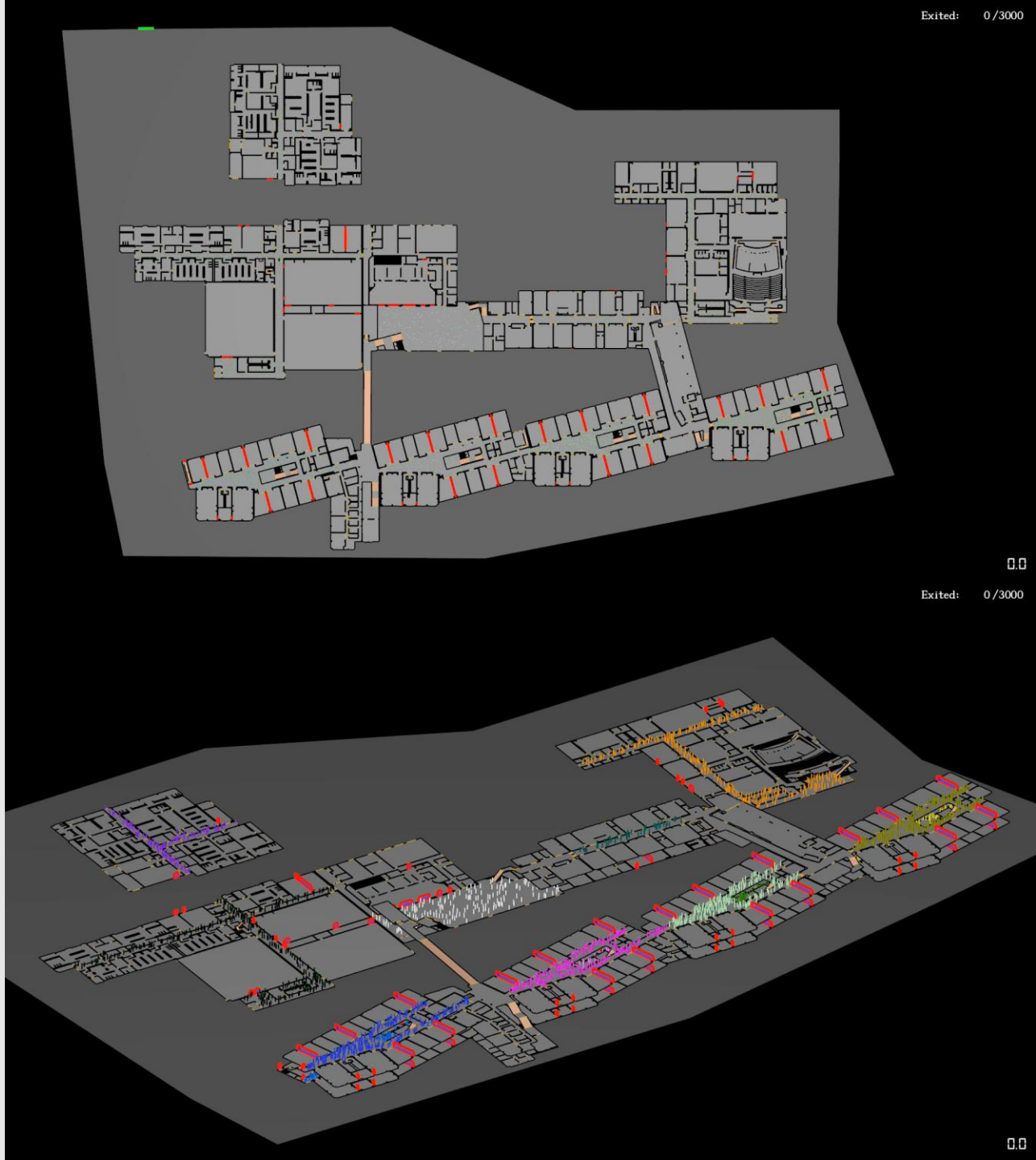
PREDICTIVE ANALYTICS

Bridge the physical and digital worlds – consistently gather detailed reports using IoT sensors that detect environmental activity through data collection

Types of IoT Sensors: Humidity, Motion, Heat, Smoke, Proximity, Infrared sensors

Precedent

Simulate travel time and how students will navigate through hallways of a large sprawling Texas high school.



THE **WHAT DID**

Scenario: Occupancy rate of office building

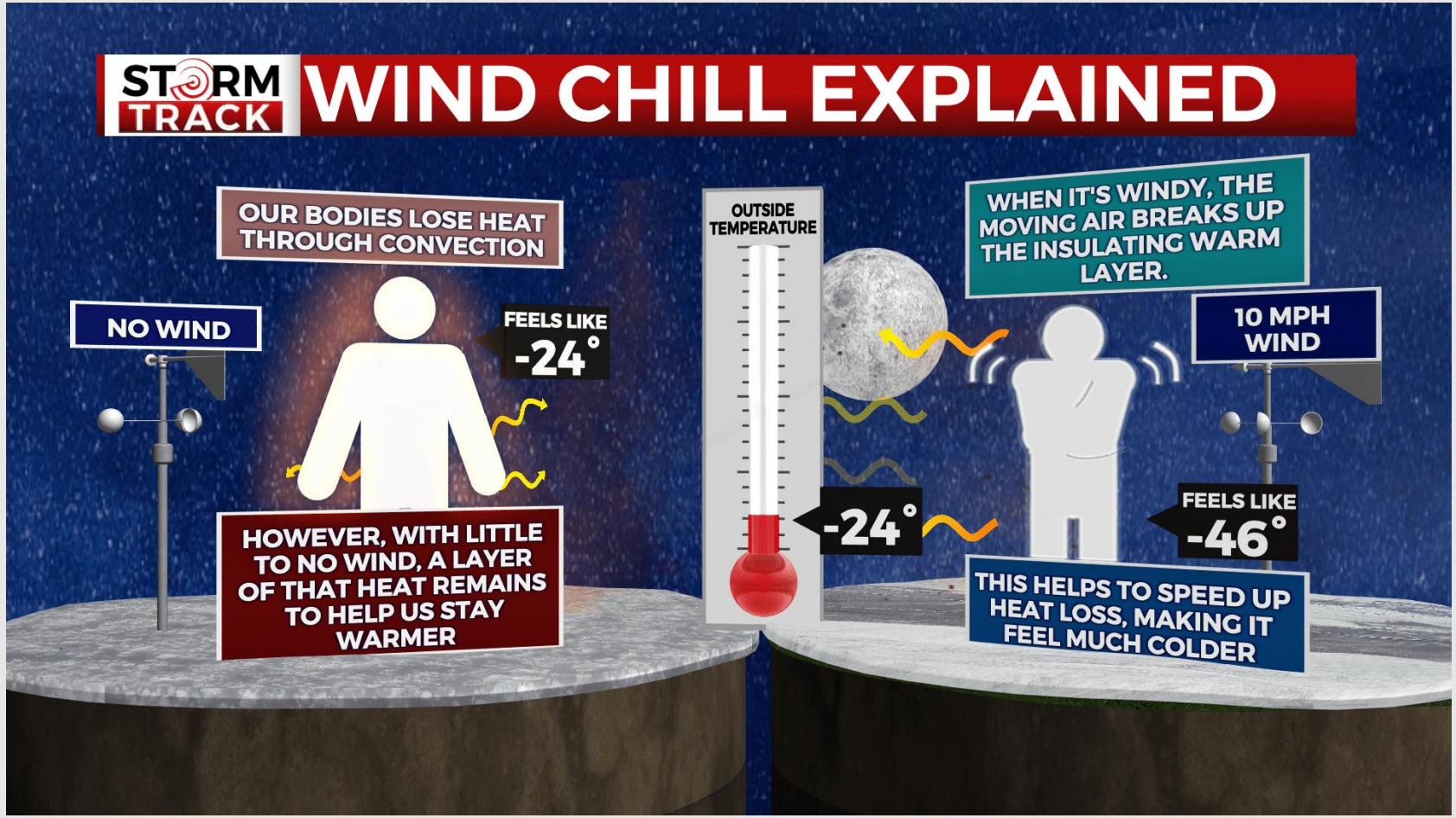
Pro-Tip: Capture + track real-time environmental data

Use infrared or thermal data (IoT sensors) to monitor space even in low visibility. The digital twin can **record and analyze past movement or activity patterns**

*ENRICHING YOUR **TWINFORMATION** MAKES THE DATA MORE VALUABLE*

Combined Technologies makes better twins

DATA **ENRICHMENT**



THE **WHAT IS vs WHAT DID**

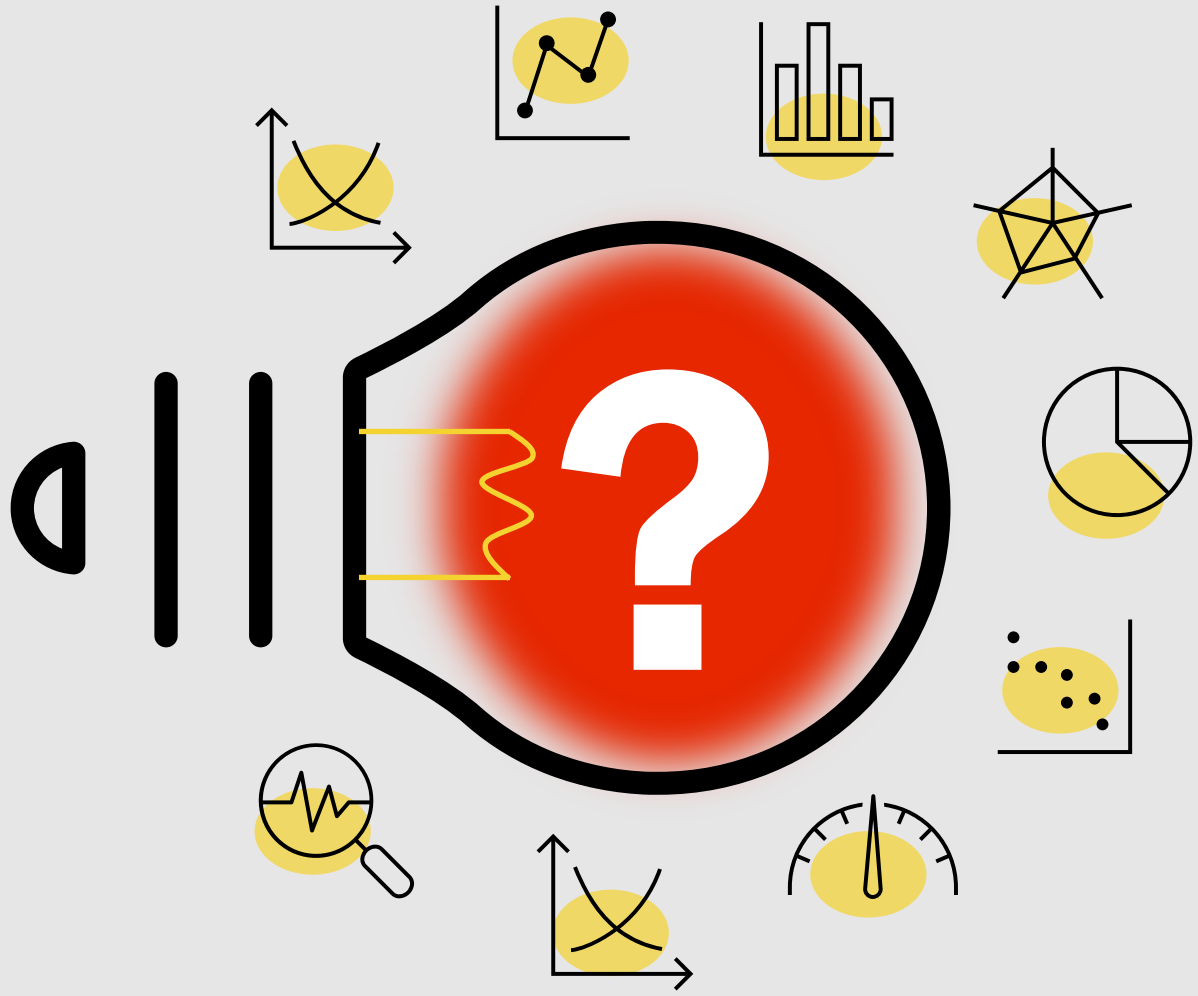
Data Source: Where I can get data

DEZ

Data Field: What data from the source

Purpose: What am I trying to understand

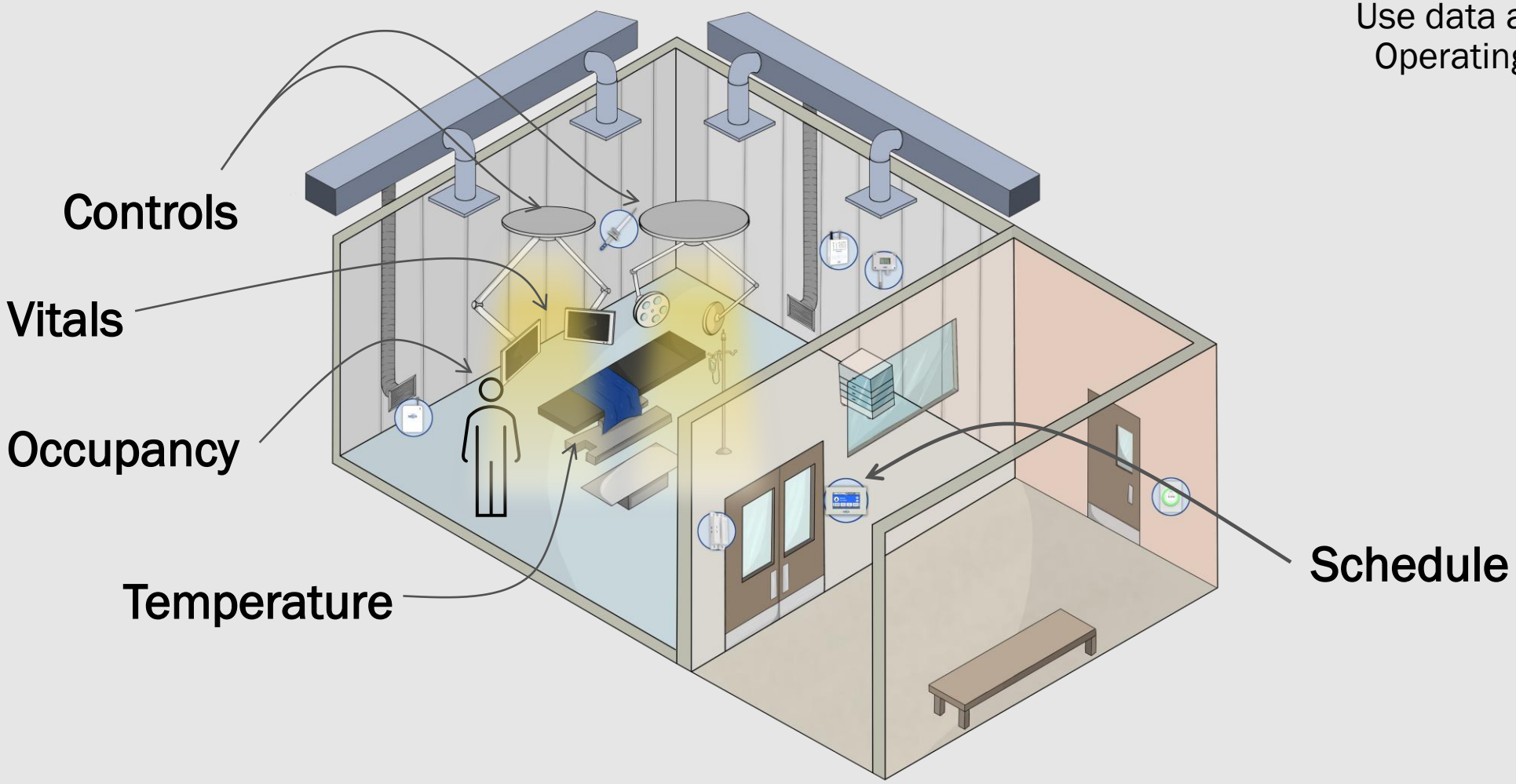
Insight: What I should know



DATA **ENRICHMENT**

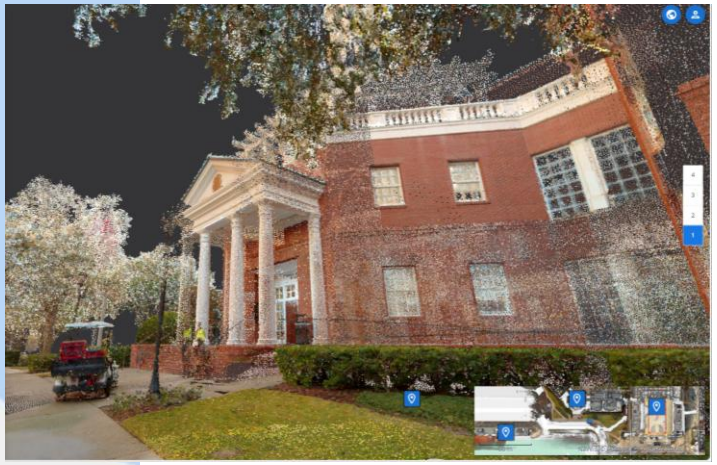
Precedent

Use data analytics to inform Operating Room functions.



SPACE UTILIZATION STUDY

Project A
Lake Highland Preparatory School



Campus Map Image (left) was generated using the LiDar Scanning point cloud data, which also includes web-based digital walkthrough capability with additional data points for each interior space of the buildings included.

3D Exterior Image (above) is an additional example of the exterior LiDar scanning captured.

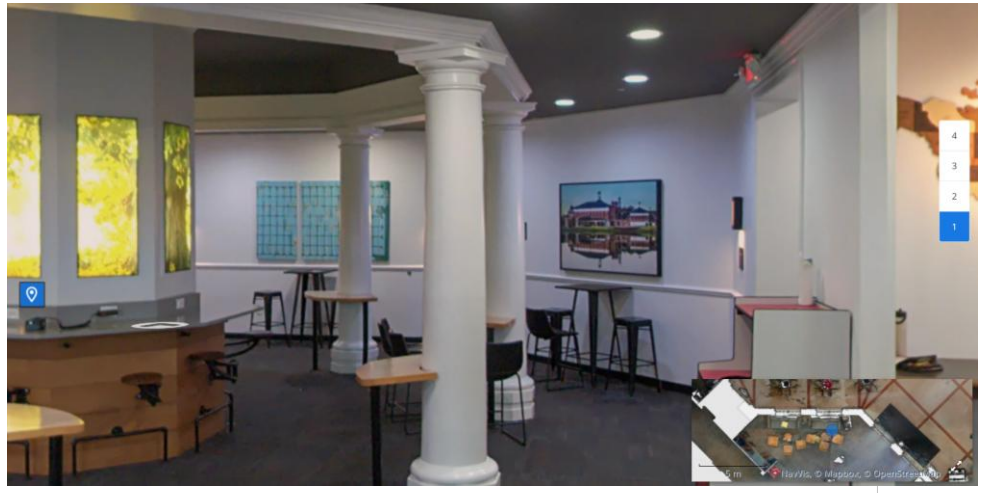
364k+
Interior Square Feet

19 Buildings
spanning 2 campuses

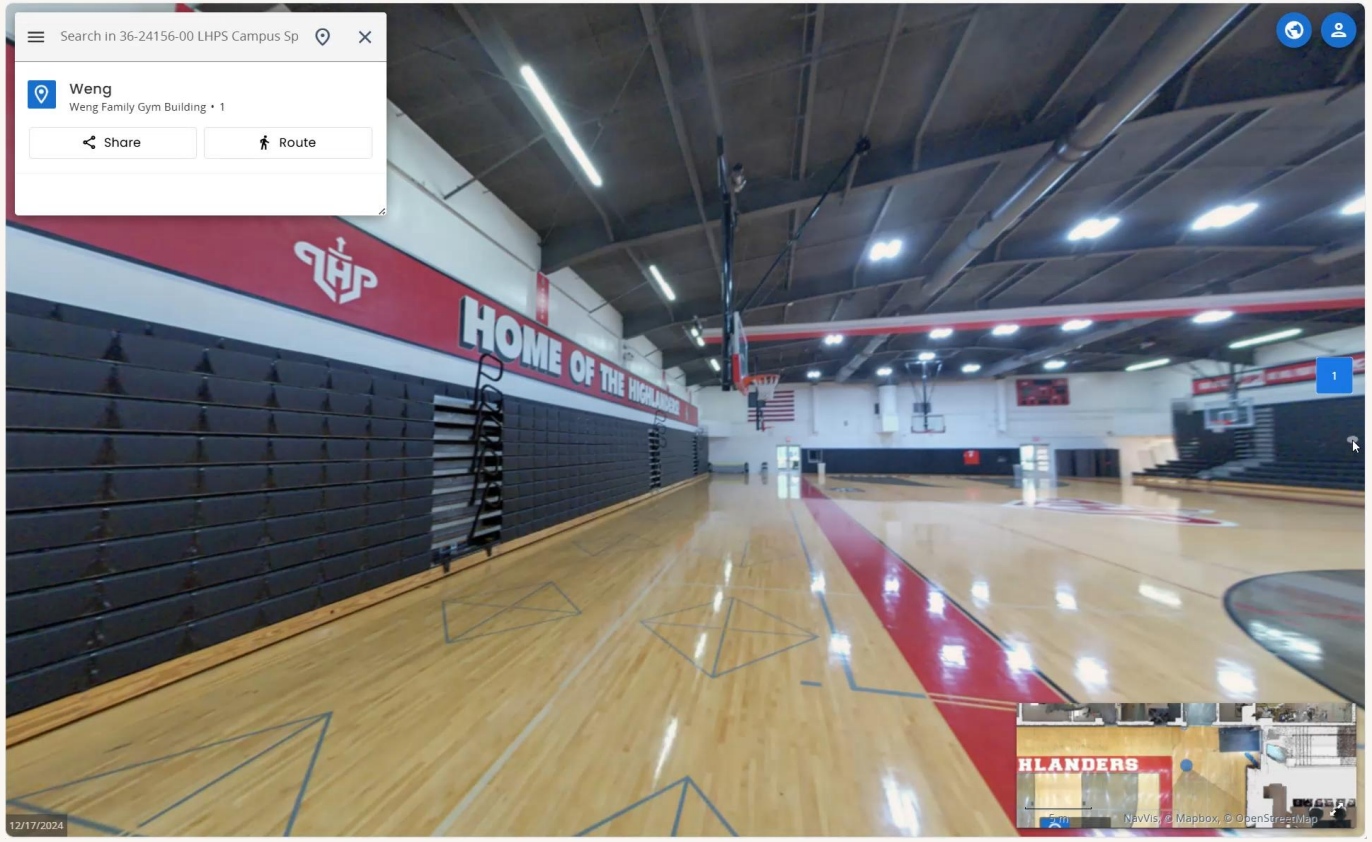
1970
Year Established

DEPARTMENT PLAN

- *Building Support*
- *Core Learning - Main*
- *Core Learning - Support*
- *Community*
- *Circulation*
- *Enrichment - Main*
- *Enrichment - Support*



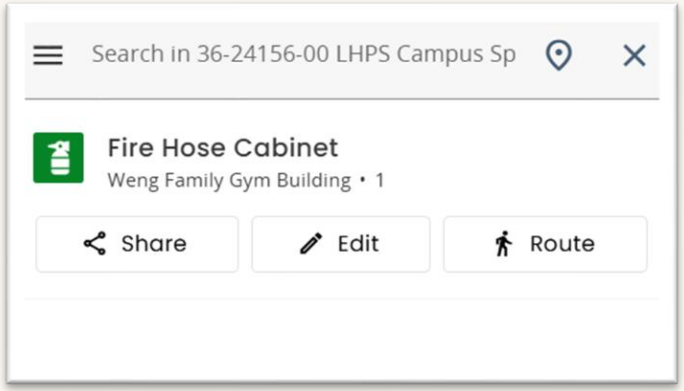
The colored floor plan (below) illustrates an example of a departmental plan generated as part of a space allocation study. Each color designation denotes a division of spaces such as academic, core learning, circulation, etc. allowing for a quick visual identification of space assignments. The Image (above) showcases a view from the reality capture scan, grounding the digital plan in physical context to validate spatial accuracy. This integration of spatial data was integral to departmental mapping.



Enhancing Your Facilities Data

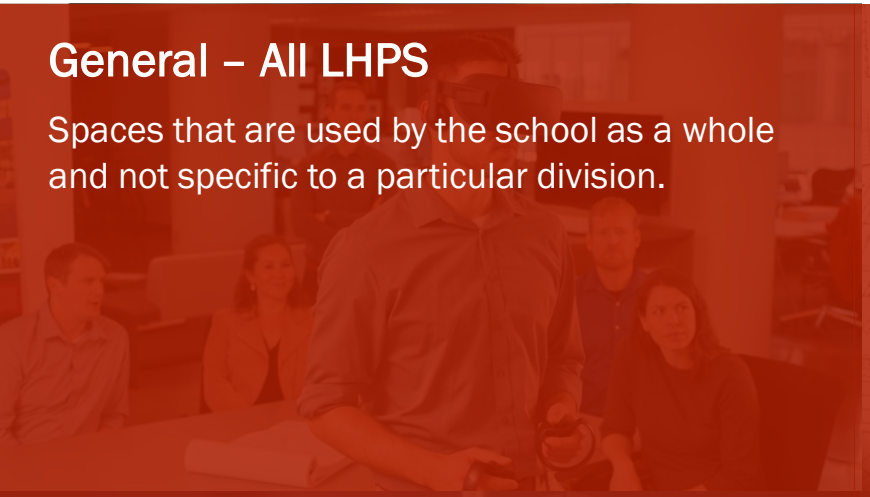
LiDar Scanning Technology

Pro-Tip: Creating points of interest can help you manage everything from fire safety devices to mechanical equipment.



SPACE **DIVISION CATEGORIES**

For purposes of this study, space was divided up into each school division, a shared division by all, and additional support and circulation spaces.



General – All LHPS

Spaces that are used by the school as a whole and not specific to a particular division.

Circulation

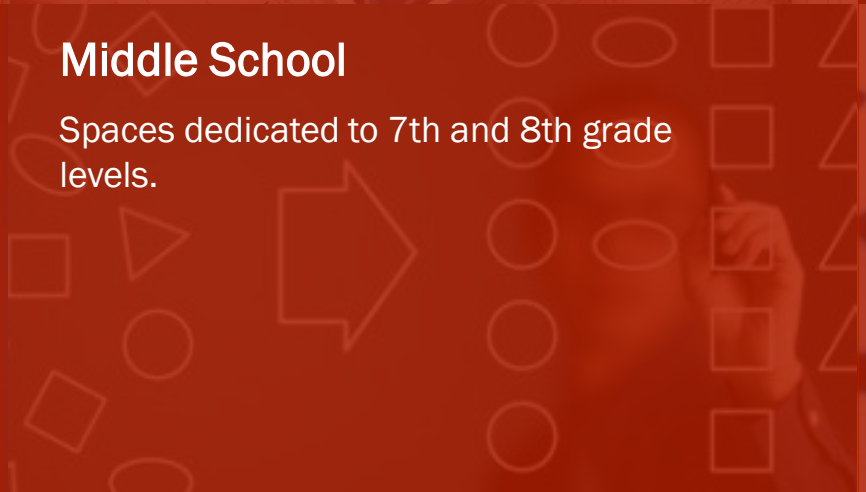
Corridors, pathways, or spaces for occupant circulation as well as egress components such as stairwells.

Building Support

Includes all building support and vacant spaces.

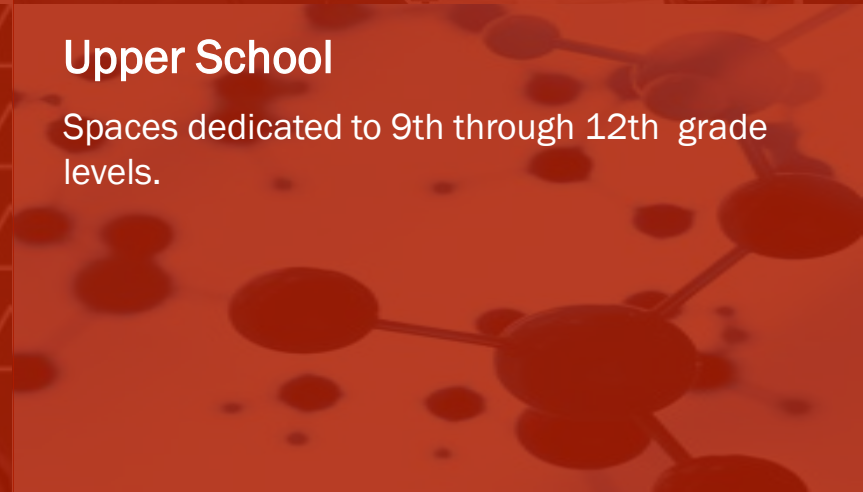
Lower School

Spaces dedicated to Pre-kindergarten through 6th grade levels.



Middle School

Spaces dedicated to 7th and 8th grade levels.



Upper School

Spaces dedicated to 9th through 12th grade levels.

DEPARTMENTS OF SPACE DIVISION CATEGORIES

Space was further divided up into departments with a consistent methodology to space use assignment throughout all divisions.

Administration
Private & Open Offices for various positions such as administration, faculty, & staff.

Administration Support
Supporting spaces to administrative functions. Examples - copy, break, workrooms, teacher's lounges, mailrooms.

Athletics
Spaces dedicated to athletics. Examples - gymnasiums, training facilities, sports Medicine, etc.

Building Support
Spaces necessary for building function including infrastructure rooms for mechanical, electrical, IDF, etc. as well as Restrooms, Utility Closets, and Storage dedicated to building maintenance.

Circulation
Corridors, pathways, or spaces for occupant circulation as well as egress components such as stairwells.

Community
Communal spaces for gathering. Examples - event rooms, unions, chapels, and collaborative areas.

Core Learning
Instructional Spaces such as classrooms & labs. Includes specialty instructional spaces such as production booths and scenic shops.

Core Learning - Support
Supporting spaces to Core Learning. Examples - storage, resource rooms, lab prep areas

Enrichment
Spaces supporting additional learning opportunities. Examples - music, ceramics, robotics, and foreign languages.

Enrichment - Support
Spaces supporting additional learning opportunities. Examples - music, ceramics, robotics, and foreign languages.

Exceptional Student Educations (ESE)
Dedicated Occupational and Speech Therapy areas.

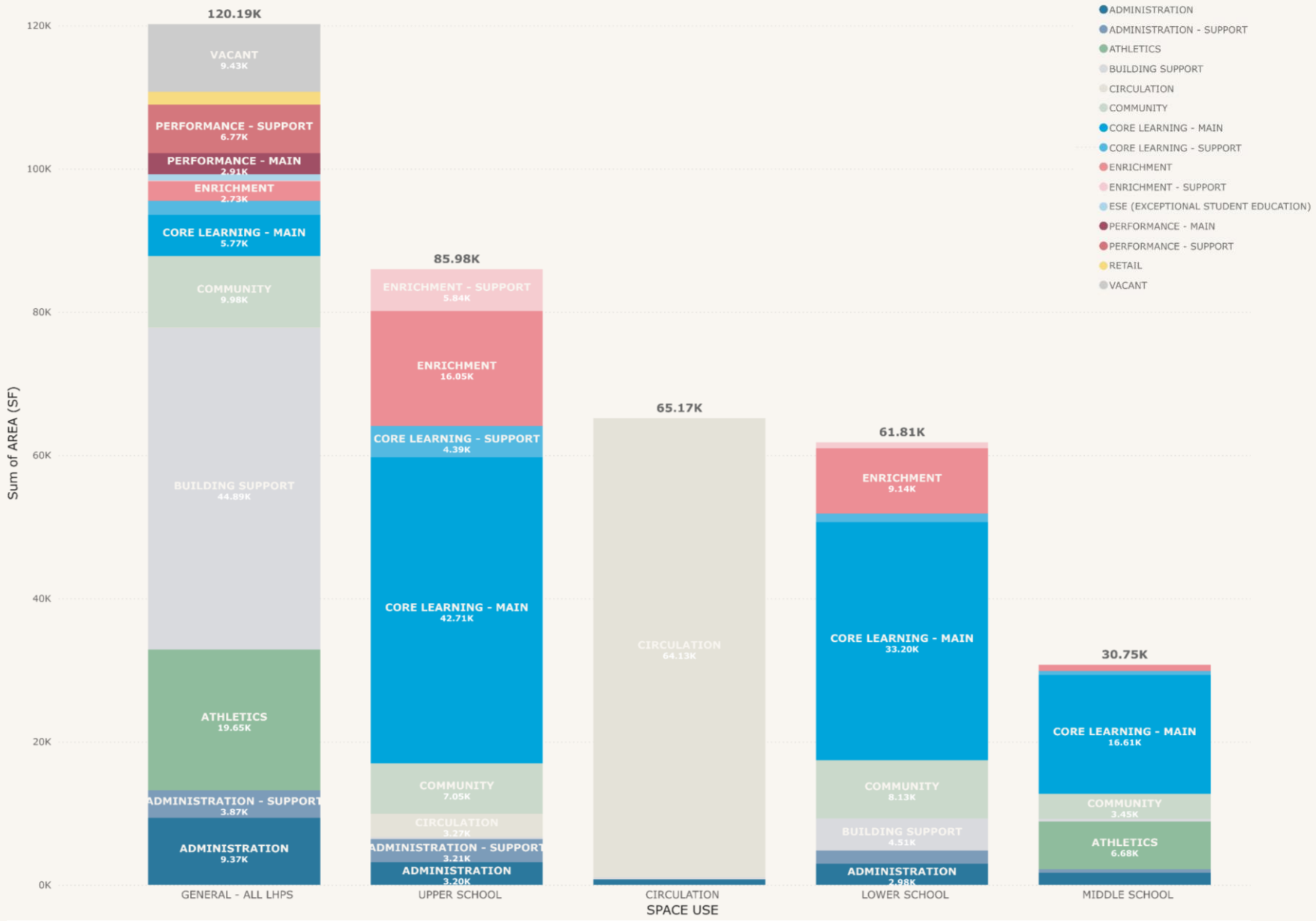
Performance
Stage area dedicated to performances.

Performance - Support
Audience Seating and technical production spaces supporting the main performance area.

Retail
Spaces dedicated to the sales of goods. Examples - concession, café, and school stores.

Vacant
Rooms or Spaces that are vacant and have no function assigned.

BREAKDOWN OF **INTERIOR AREAS PER DIVISION**

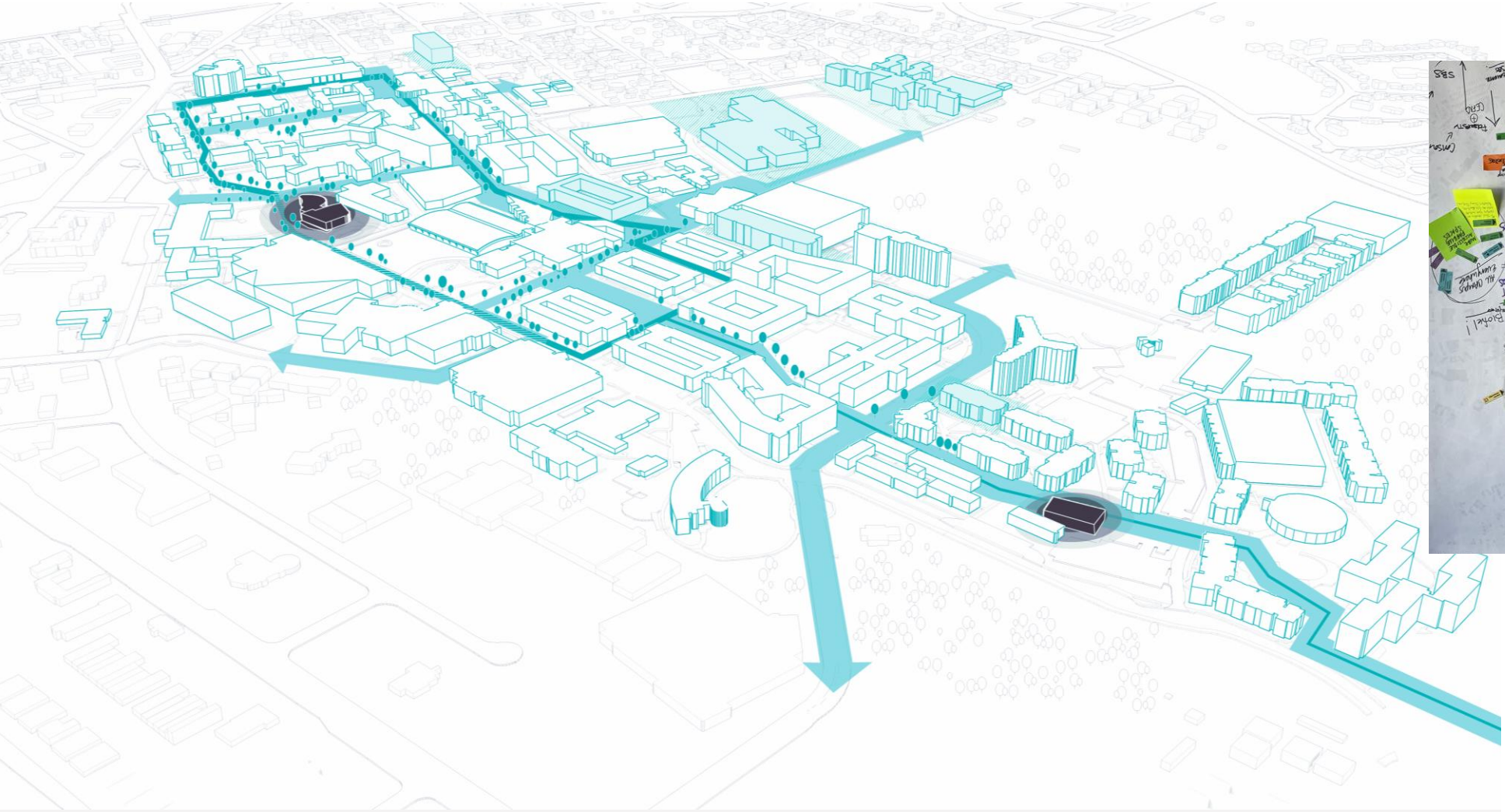


Summary of Area (SF)	Department	SPACE USE
774	ADMINISTRATION	CIRCULATION
259	BUILDING SUPPORT	CIRCULATION
64133	CIRCULATION	CIRCULATION
9371	ADMINISTRATION	GENERAL - ALL LHPS
3869	ADMINISTRATION - SUPPORT	GENERAL - ALL LHPS
19648	ATHLETICS	GENERAL - ALL LHPS
44889	BUILDING SUPPORT	GENERAL - ALL LHPS
44	CIRCULATION	GENERAL - ALL LHPS
9984	COMMUNITY	GENERAL - ALL LHPS
5766	CORE LEARNING - MAIN	GENERAL - ALL LHPS
1945	CORE LEARNING - SUPPORT	GENERAL - ALL LHPS
2732	ENRICHMENT	GENERAL - ALL LHPS
112	ENRICHMENT - SUPPORT	GENERAL - ALL LHPS
888	ESE (EXCEPTIONAL STUDENT EDUCATION)	GENERAL - ALL LHPS
2911	PERFORMANCE - MAIN	GENERAL - ALL LHPS
6772	PERFORMANCE - SUPPORT	GENERAL - ALL LHPS
1834	RETAIL	GENERAL - ALL LHPS
9429	VACANT	GENERAL - ALL LHPS
2978	ADMINISTRATION	LOWER SCHOOL
1818	ADMINISTRATION - SUPPORT	LOWER SCHOOL
4508	BUILDING SUPPORT	LOWER SCHOOL
8133	COMMUNITY	LOWER SCHOOL
33201	CORE LEARNING - MAIN	LOWER SCHOOL
1208	CORE LEARNING - SUPPORT	LOWER SCHOOL
9141	ENRICHMENT	LOWER SCHOOL
822	ENRICHMENT - SUPPORT	LOWER SCHOOL
1715	ADMINISTRATION	MIDDLE SCHOOL
478	ADMINISTRATION - SUPPORT	MIDDLE SCHOOL
6682	ATHLETICS	MIDDLE SCHOOL
380	BUILDING SUPPORT	MIDDLE SCHOOL
3452	COMMUNITY	MIDDLE SCHOOL
16608	CORE LEARNING - MAIN	MIDDLE SCHOOL
548	CORE LEARNING - SUPPORT	MIDDLE SCHOOL
887	ENRICHMENT	MIDDLE SCHOOL
3201	ADMINISTRATION	UPPER SCHOOL
3210	ADMINISTRATION - SUPPORT	UPPER SCHOOL
263	BUILDING SUPPORT	UPPER SCHOOL
3271	CIRCULATION	UPPER SCHOOL
7050	COMMUNITY	UPPER SCHOOL
42713	CORE LEARNING - MAIN	UPPER SCHOOL
4390	CORE LEARNING - SUPPORT	UPPER SCHOOL
16047	ENRICHMENT	UPPER SCHOOL
5836	ENRICHMENT - SUPPORT	UPPER SCHOOL

363,900 SF

DATA INFORMED BY PLAN

Project B
Northern Arizona University



Using the **6 Guiding Principles of Information Security**

Confidentiality | *Accessibility* | *Authorization*

Integrity | *Authentication* | *Accounting*

How does one create the most innovative campus in the United States using data?

DEFINING **PRIORITIES**

WHO

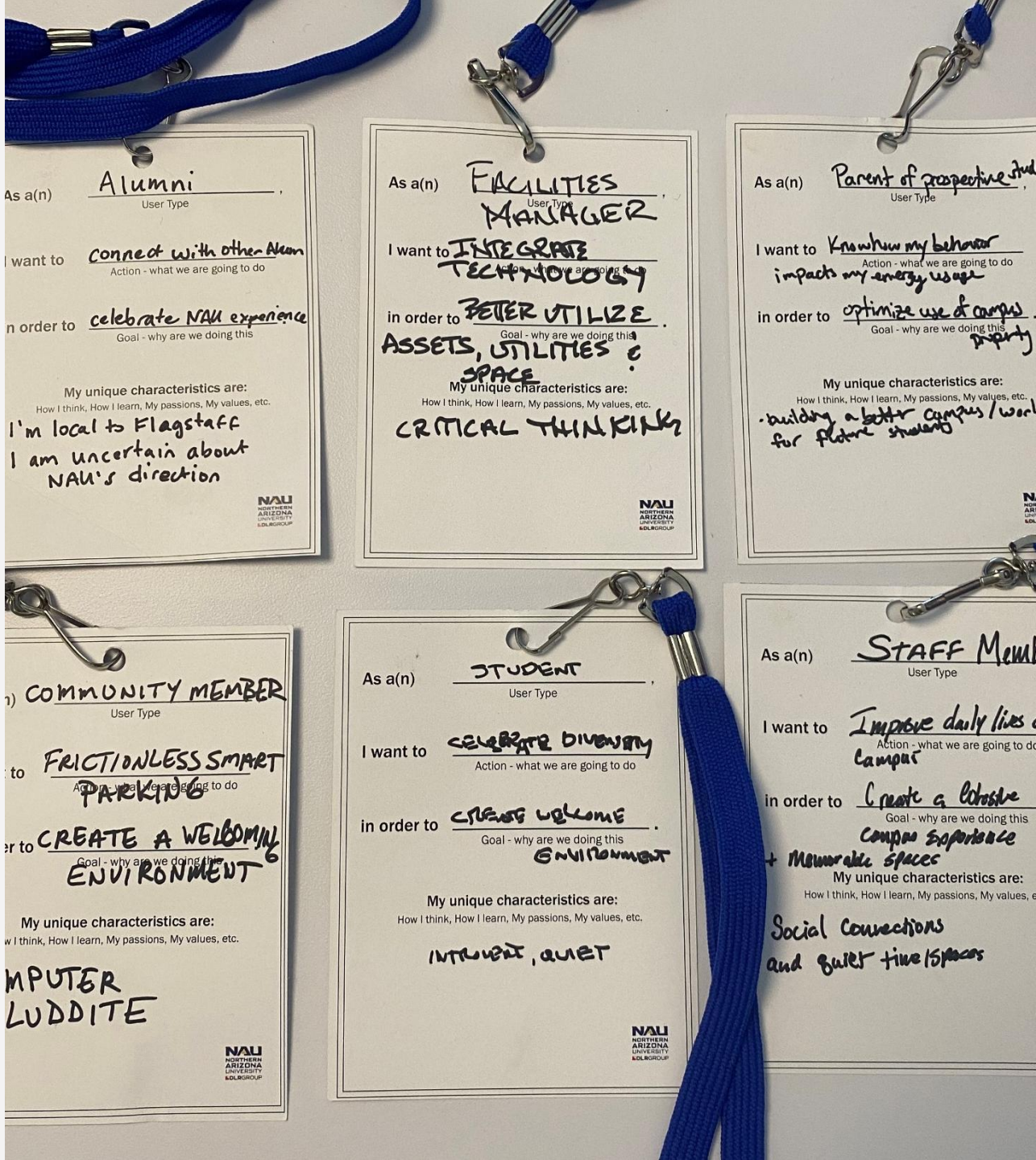
WHAT

WHY

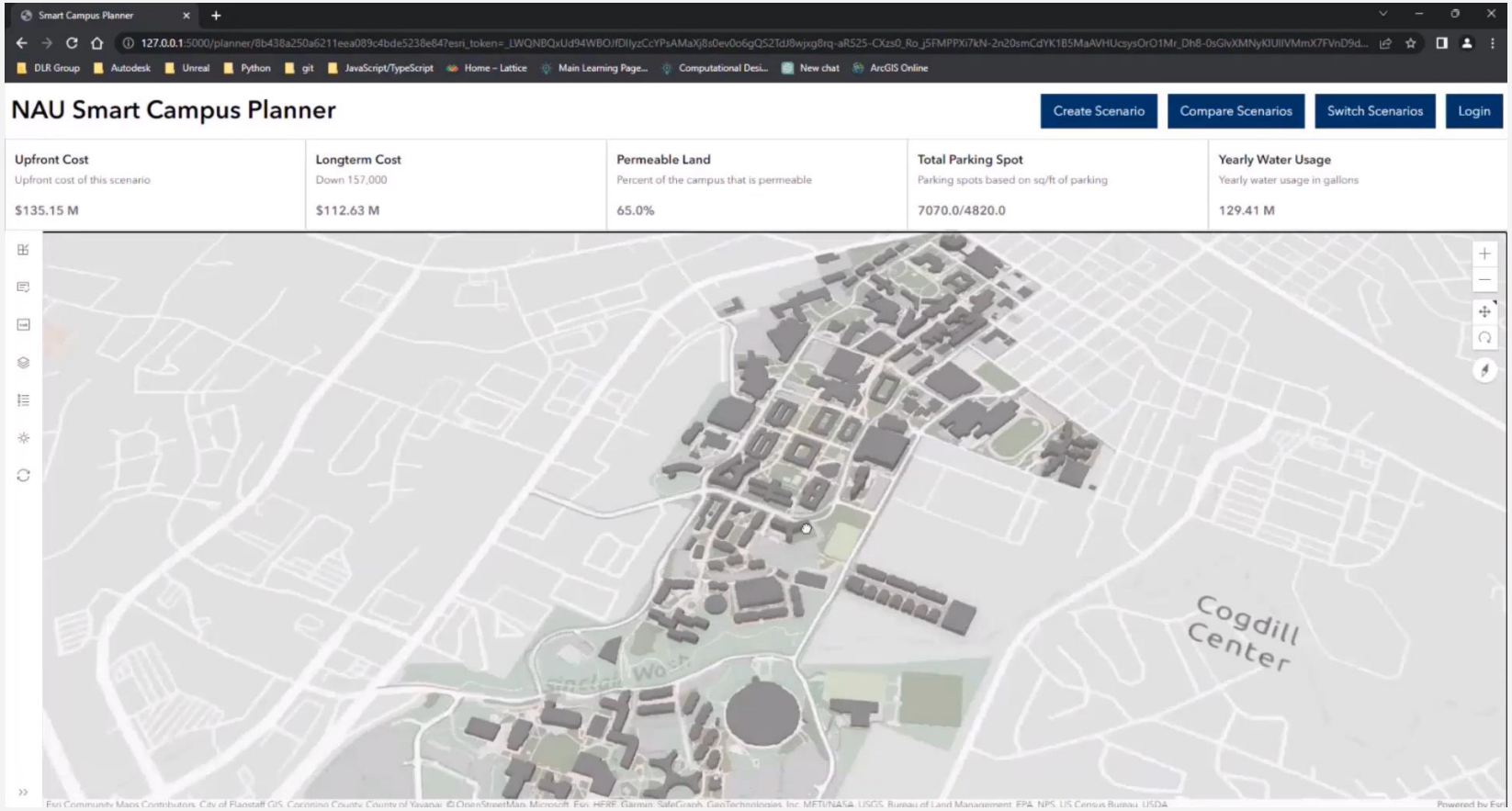
HOW

Precedent

When solving for the future of an innovative campus, we asked users: *What are the most important points of focus as a Smart, Sustainable Master Plan is implemented?*



STARTING **POINT**



Create Scenarios

Test ideas or proposals for buildings, pathways, green space, etc.

Compare Scenarios

Compare cost, water use, land use, parking availability, and more

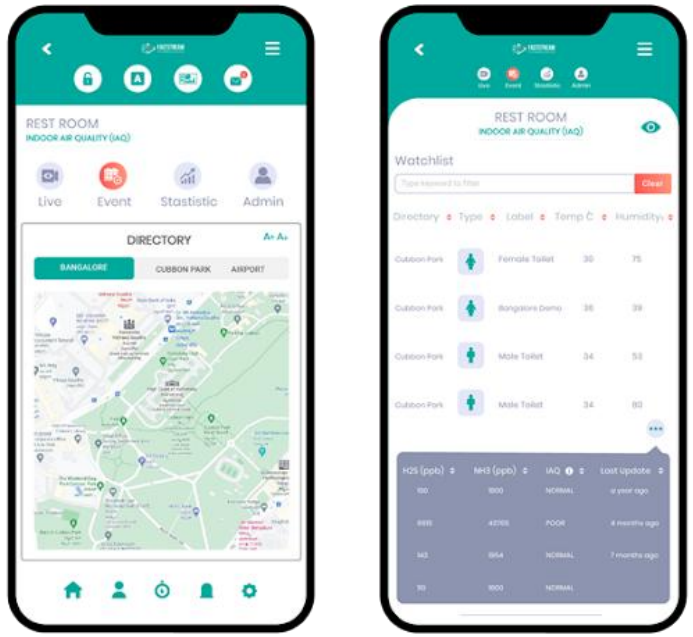
Visualize Data

Interactive 3D campus map pulls from real data like square footage, deferred maintenance, and space assignments

INFORMING THE TWIN

So many enabled devices and so many apps to see them

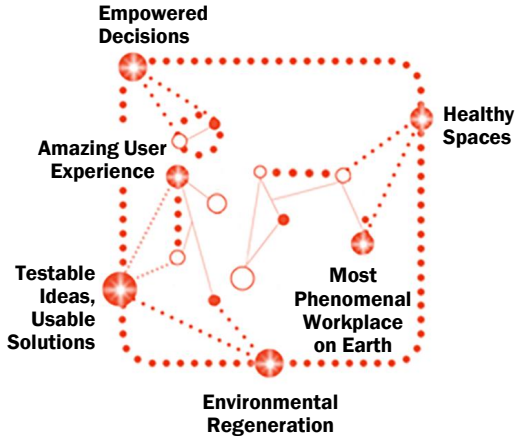
From maintenance to a users experience the data can be connected and used in many ways.



DATA INFORMED BY PLAN

Project C
Workplace Intelligence

How can workplace collaboration be enhanced while also supporting user well-being through improved building performance?

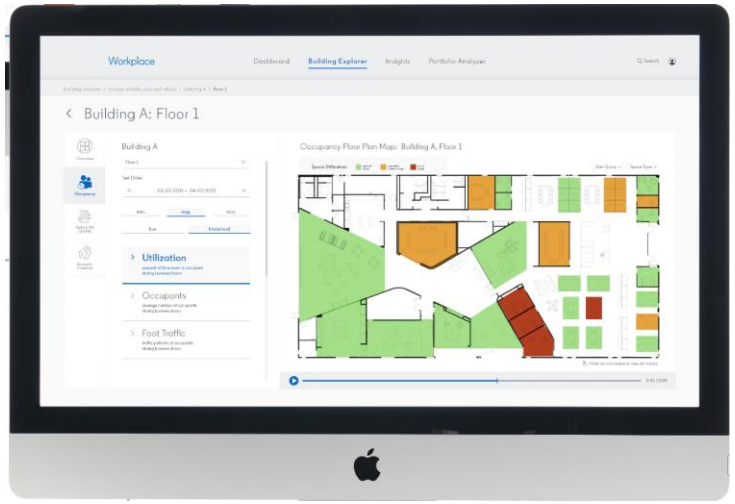


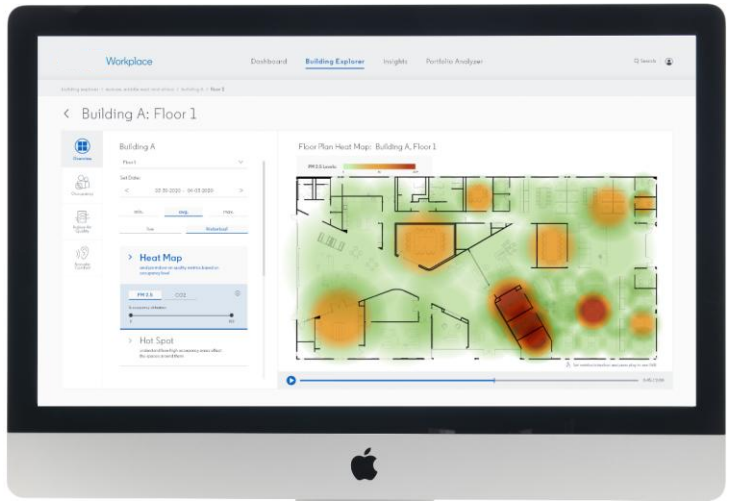
450,000+ sf
Office Space

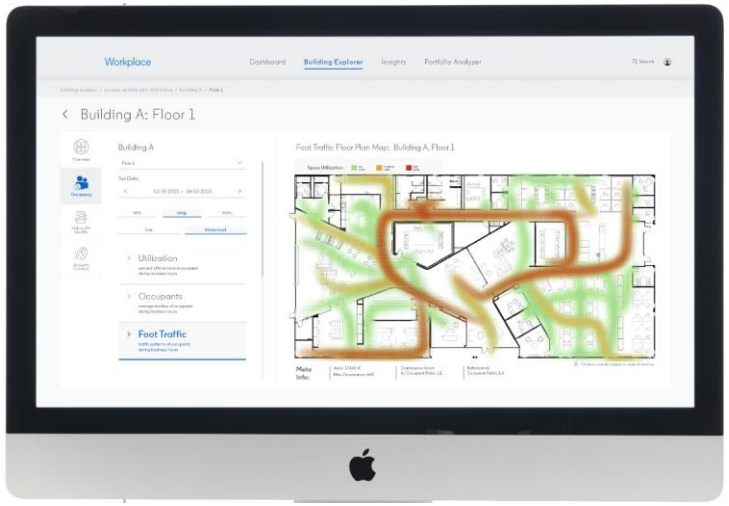
Workplace Client
LEED Platinum, WiredScore Platinum, WELL Gold, Net-Zero

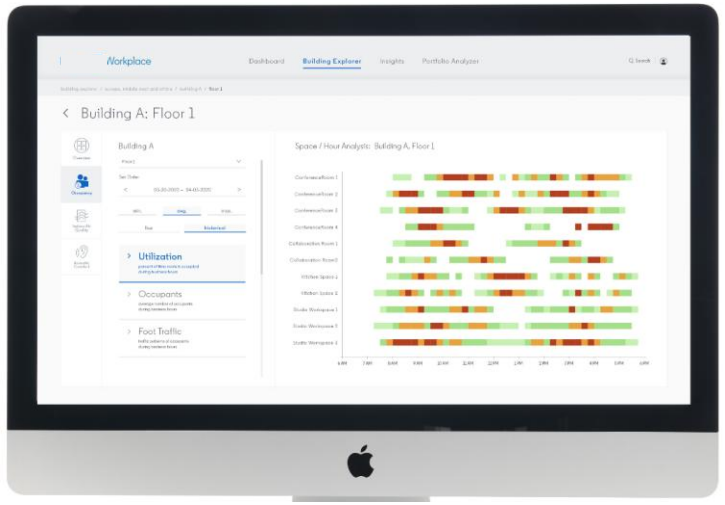
2023
Year Completed

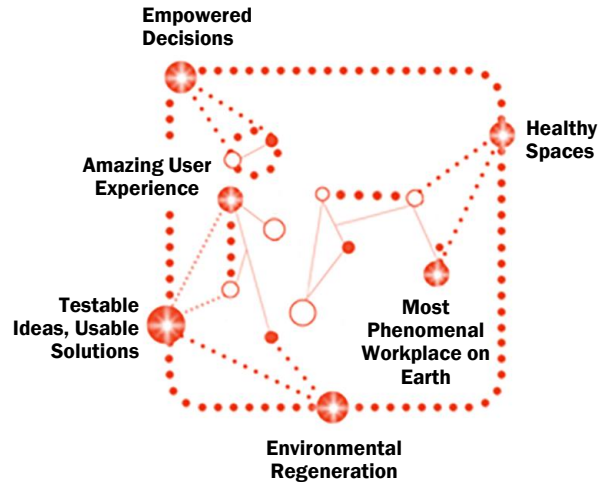
USER **INTERFACE**





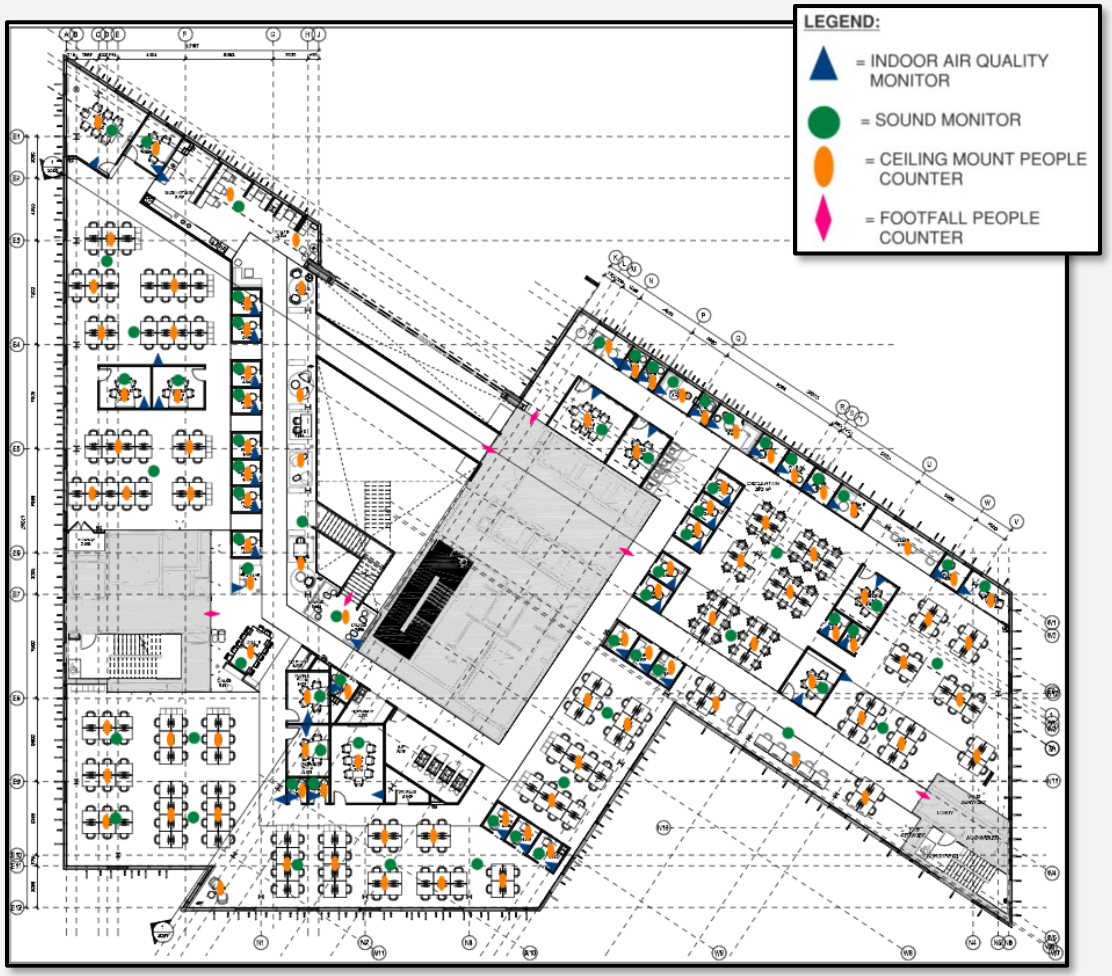




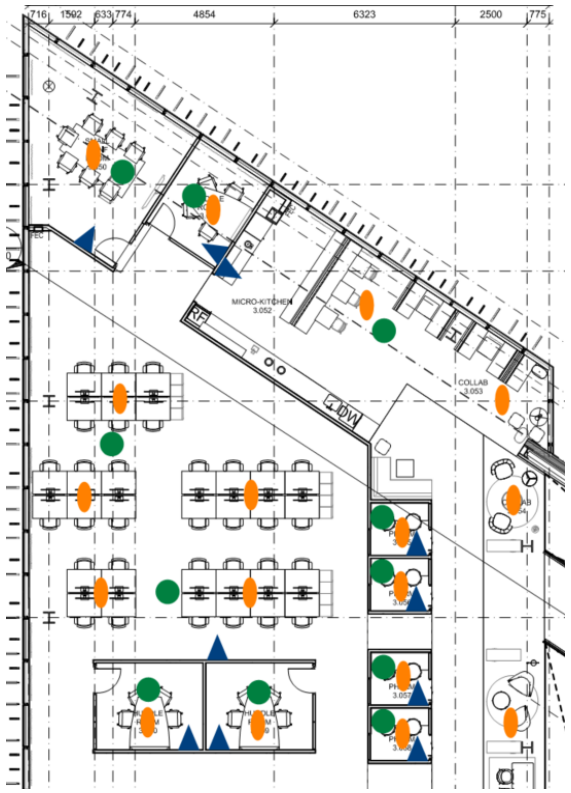


SENSOR **COUNTS** AND **COSTS**

Map where sensors are needed vs. wanted



FLOOR LEVEL	SENSEDGE MINI - IAQ MONITOR	SONITUS CUSTOM EM2030 - SOUND MONITOR	VERGESENSE - CEILING MOUNT PEOPLE COUNTERS	DENSITY - FOOTFALL COUNTERS
lg	8	14	0	9
dg	14	21	0	8
1	33	44	93	0
2	47	59	113	0
3	47	53	110	0
4	28	33	50	0
5	34	44	83	0
6	29	41	68	0
7	18	18	21	0
MONITOR TOTALS	258	327	538	17
COST ANALYSIS				
Single Monitor First Cost	$ 700	$ 1,100	$ 300	$ 895
Total Hardware First Cost	$ 180,600	$ 359,700	$ 161,400	$ 15,215
Annual Subscription Cost	$ -	$ 39,240	$ 53,800	$ 13,515
Monitor Life Expectancy (yrs)	10	10	5	5
Recommended Recal Frequency (yrs)	1.5	2.0		
Sensor Replacement / Recalibration Cost	$ 450	$ 1,350		
Total Estimated Cost (10 year period)	180,600.0	752,100.0	860,800.0	165,580.0
*Costs above do not include installation and wiring costs				



Ceiling Mounted People Counter

VERGESENSE

IoT Sensor

Overview

Ceiling mounted device counts the number of people in its field of view below it. Approved by Client security team.

Sensor layouts of aligning in a grid aligned with the ceiling, vs above workstations in discussion.

Power & Data

POE

User Experience / Benefits

- Transition from assigned seating to flexible work environments – which spaces are the top destinations for employees to work at and why
- Provides information for analytics to understand desk usage behaviors
- Analyze if spaces are being used as intended.
- Is a collaboration space being used as a private office?
    - Is an open areas collaboration team table not being used?
- Creating a metric for current and future demand of different space types.
    - Should we add in more conference rooms, call rooms, or open office area.
    - Can we make one of the multiple large conference rooms into two mediums conference rooms

Design

- Allow for additional POE infrastructure in tenant fit out

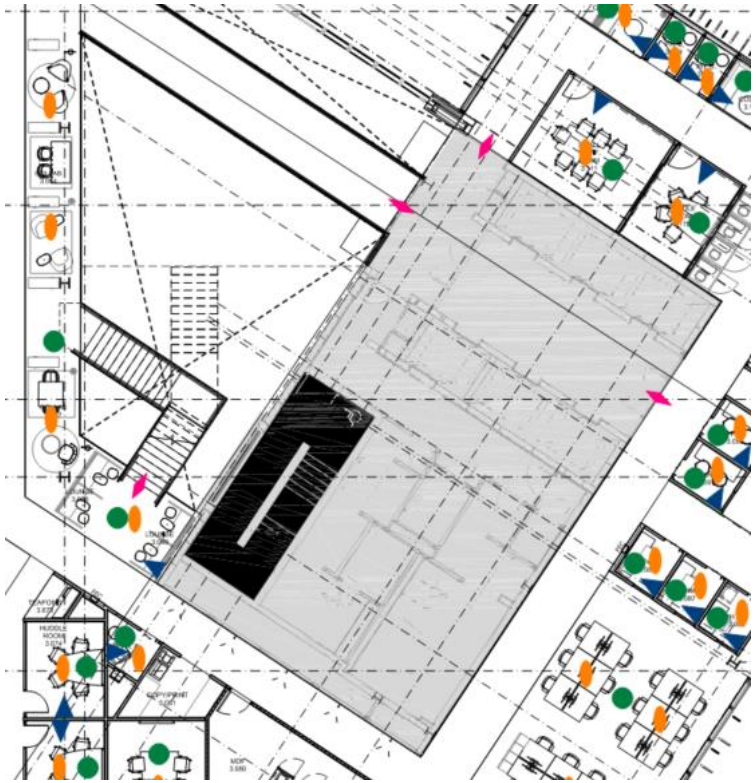
Operations

- Confirm Vergesense subscription includes software updates only, and coordination when adding or moving devices
- Confirm if maintenance responsibility is Client or facilities team

Footfall People Counter

DENSITY

IoT Sensor



Overview

Above entryway/stairwell device to count number of people entering/exiting a doorway. When placed around all entryways to an area, and networked together, they provide a total count of people in the space. Approved by Client security team.

Current use cases in discussion:

- Counting the amount of people in the cafeteria
- Counting the amount of people on each floor of the office
- Counting the amount of people taking elevators vs stairwells

Power & Data

POE

User Experience / Benefits

- Café Optimization
- Display number of people in the cafeteria on Client app or other user interfaces and nudge for optimal lunchtime
- Understand how many employees are on each floor and analyze trends over time

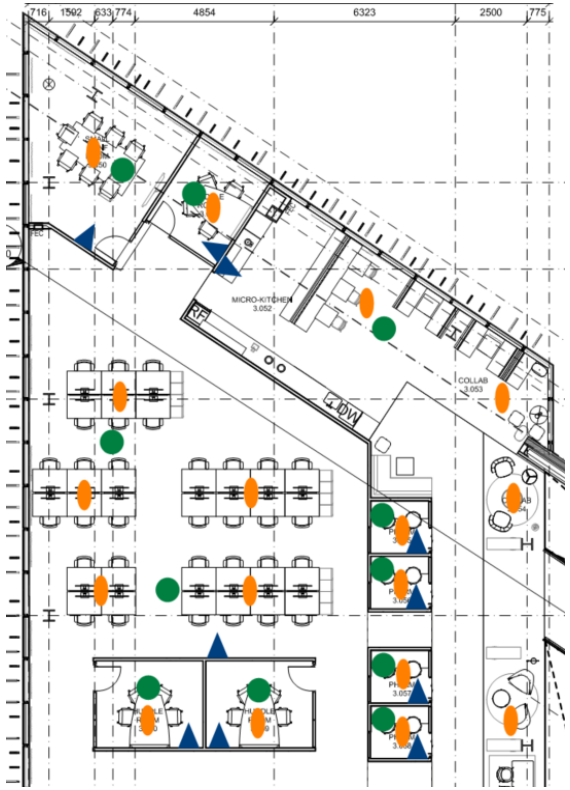
Design

- Allow for additional POE infrastructure in tenant fit outs, and potentially above base building stairwells based on Client requirement of counting stairwell vs elevator usage

Sound Monitor

SONITUS

IoT Sensor



Overview

Ceiling mounted device monitors and logs noise. It can track various noise parameters such as decibels, frequencies and octave bands to better pinpoint the different sources of noise. Approved by Client security team.

Power & Data

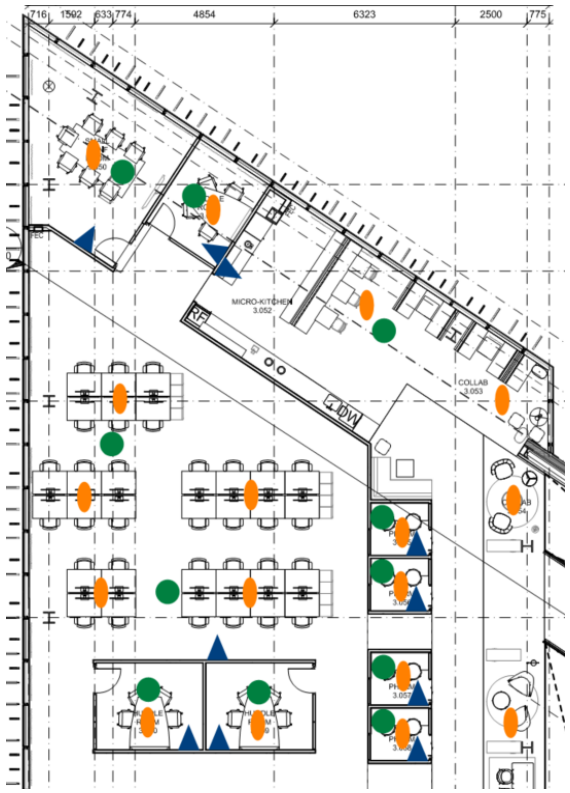
POE

User Experience / Benefits

- Understand how a space is being used
  - Individual heads down work vs team collaboration
- Identify sources of acoustical discomfort
  - Loud noise interruptions
  - Loud HVAC unit
  - Lacking noise insulation between conference rooms
- Direct an employee looking for a quiet office to the quietest location
- Understand acoustics and adjacencies of teams, too loud or too quiet and why?
- Control AV equipment based on the acoustics

Design

- Allow for additional POE infrastructure in tenant fit outs



KAITERRA SENSEDGE MINI

IoT Sensor

Overview

Mounted on a wall at breathing zone heights, the sensor measures temperature, humidity, PM2.5, TVOC, and CO2.
The two sensor cartridges are easily replaceable, offering cheaper and easier calibration in comparison to other products.

Kaiterra sensedge had been approved, sensedge mini in under review. Manufacturer has indicated it is the same platform and does not expect security changes.

Power & Data

POE

User Experience / Benefits

- Gain a better understanding of air quality trended data
- Air quality and occupant comfort validation
- Analyze how cleaning chemicals impact air quality
- Using analytics to troubleshoot air quality issues in the office
- Identify changes in air quality from filtration and HVAC system upgrades

Design

- Allow for additional POE infrastructure in tenant fit outs

Operations

- Replacement sensor cartridges are approximately $100 each. Replaceable by any user, no technician required.
- Kaiterra has provided replacements to any malfunctioning monitors in the past.

COORDINATION OF DATA AND DEVICES

OPERATIONAL TWIN

AUTODESK® BIM 360™

ASSET TWIN

invicara

TENANT HUMAN EXPERIENCE TWIN

CONVERGED NETWORK

SkySpark

IoT Gateway Virtual Machine or Hardware

Vendor Servers Virtual Machine or Hardware

BASE BUILDING

- Metering Systems
- Building Management Systems
- Video Systems
- Lighting Systems
- Access + Security Systems

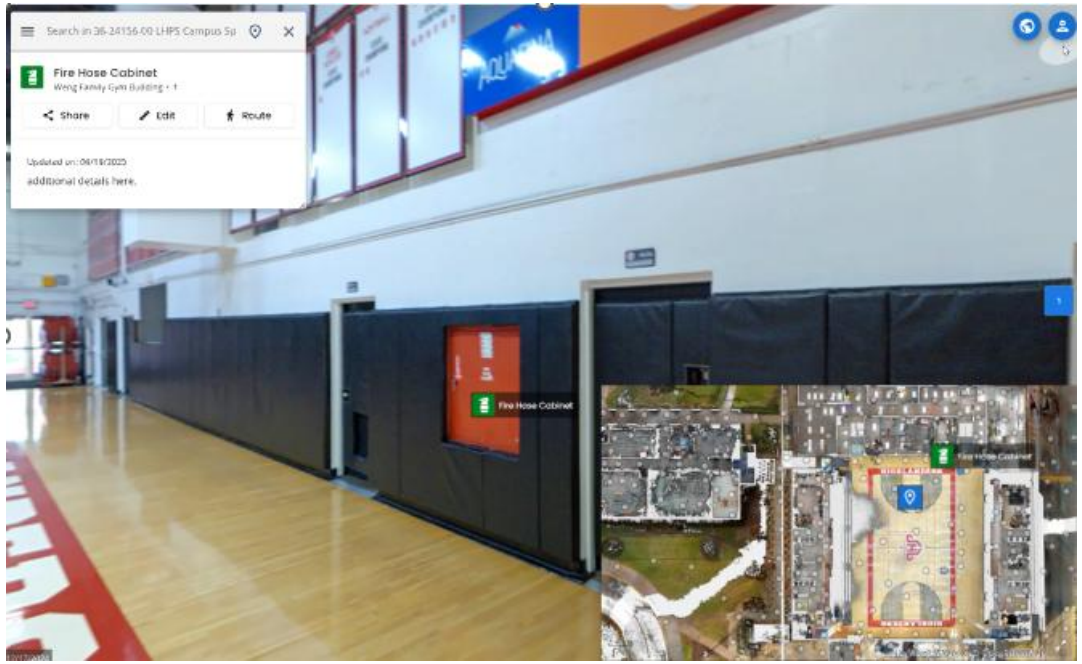
TENANT

- Building Management Systems
- IAQ Sensors
- Occupancy Sensors
- Sound Sensors
- Lighting Systems
- Cafeteria People Counting

IMAGINE A WORLD WHERE...

Project A **Future**

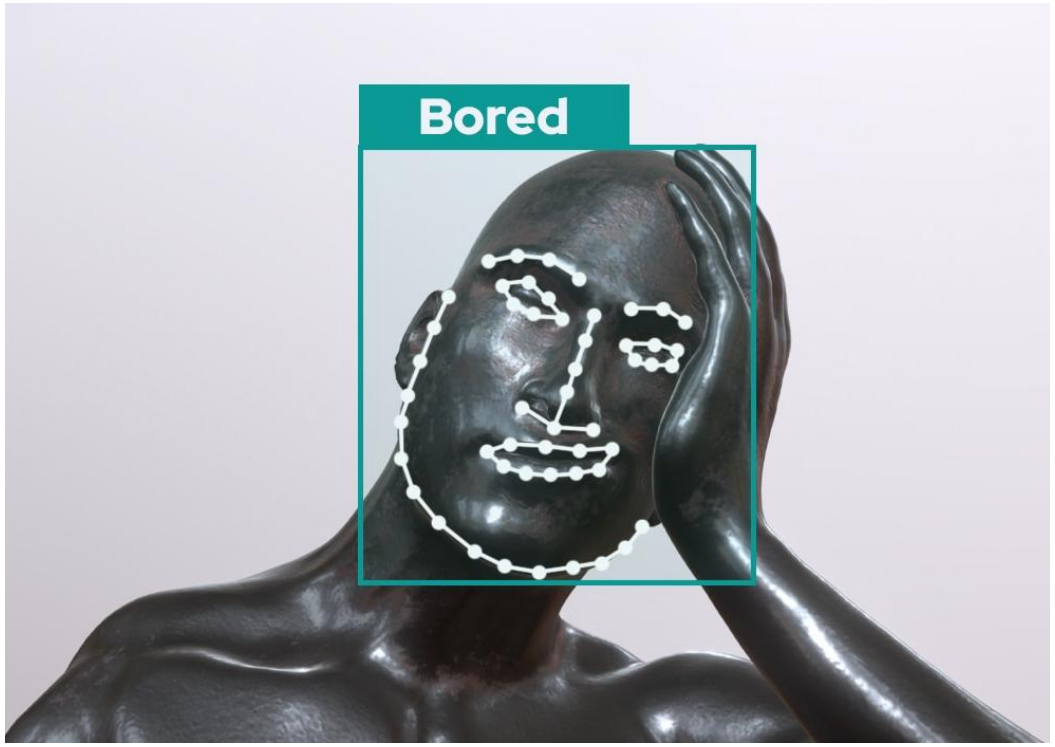
ENRICHING THE **TWIN**



It's all possible, the question is how much does it cost and what is the reliable data source.

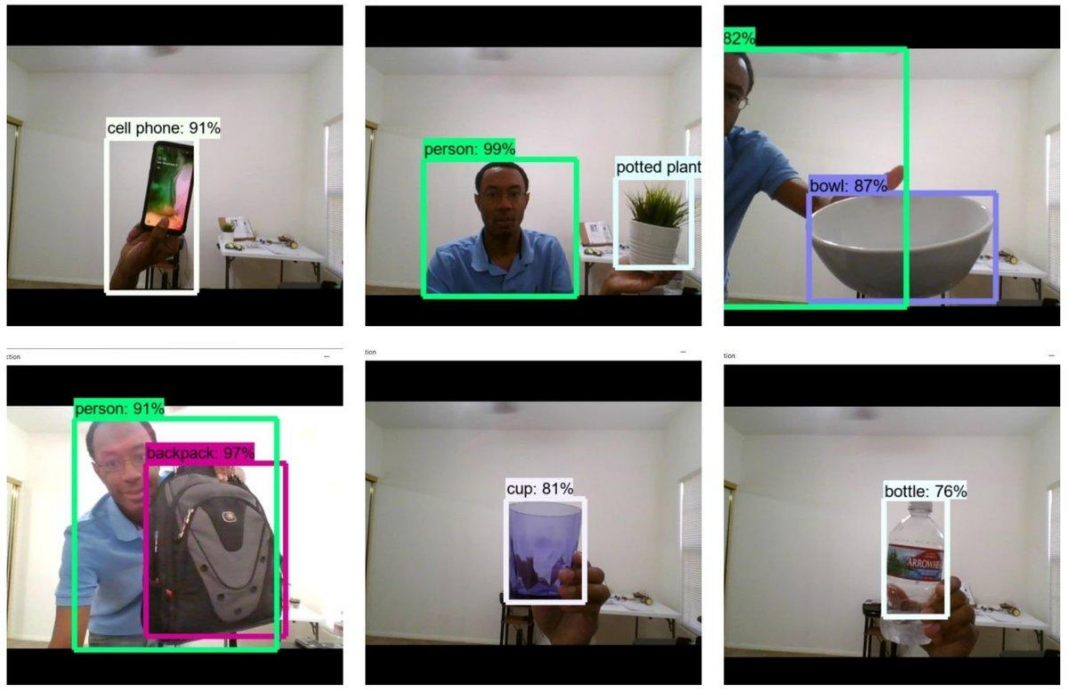
Maintenance apps can be used to update maintenance data. Rather than checking all the tags, the data can be used to colorize a map by dates or status.

ENRICHING THE **TWIN**

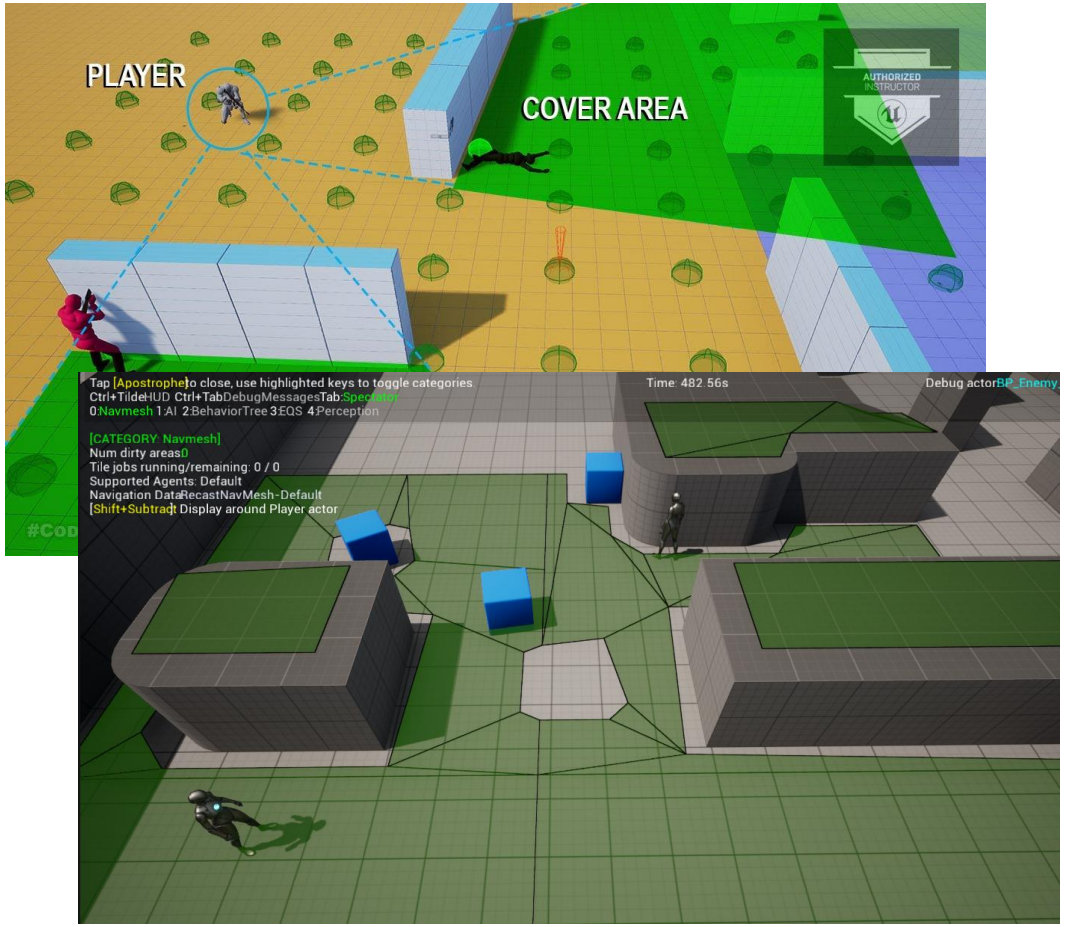


Understanding what's happening is possible.

Understanding the challenges that come with that and how to protect your students while protecting yourself is what is next.

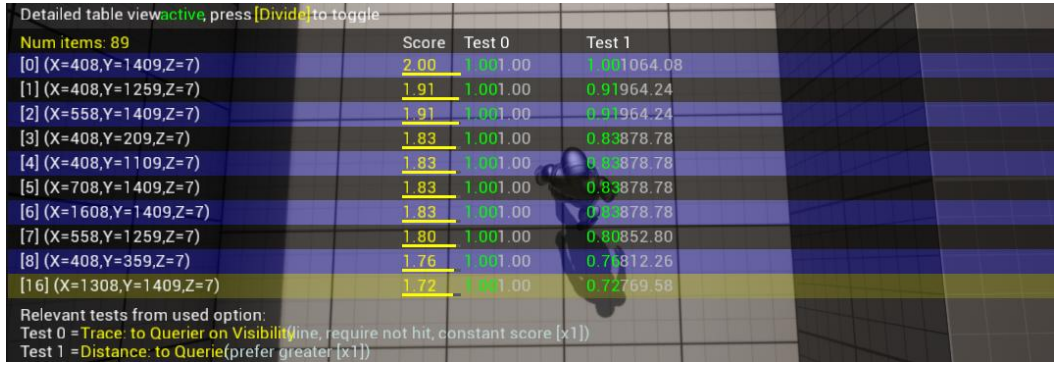


ENRICHING THE **TWIN**



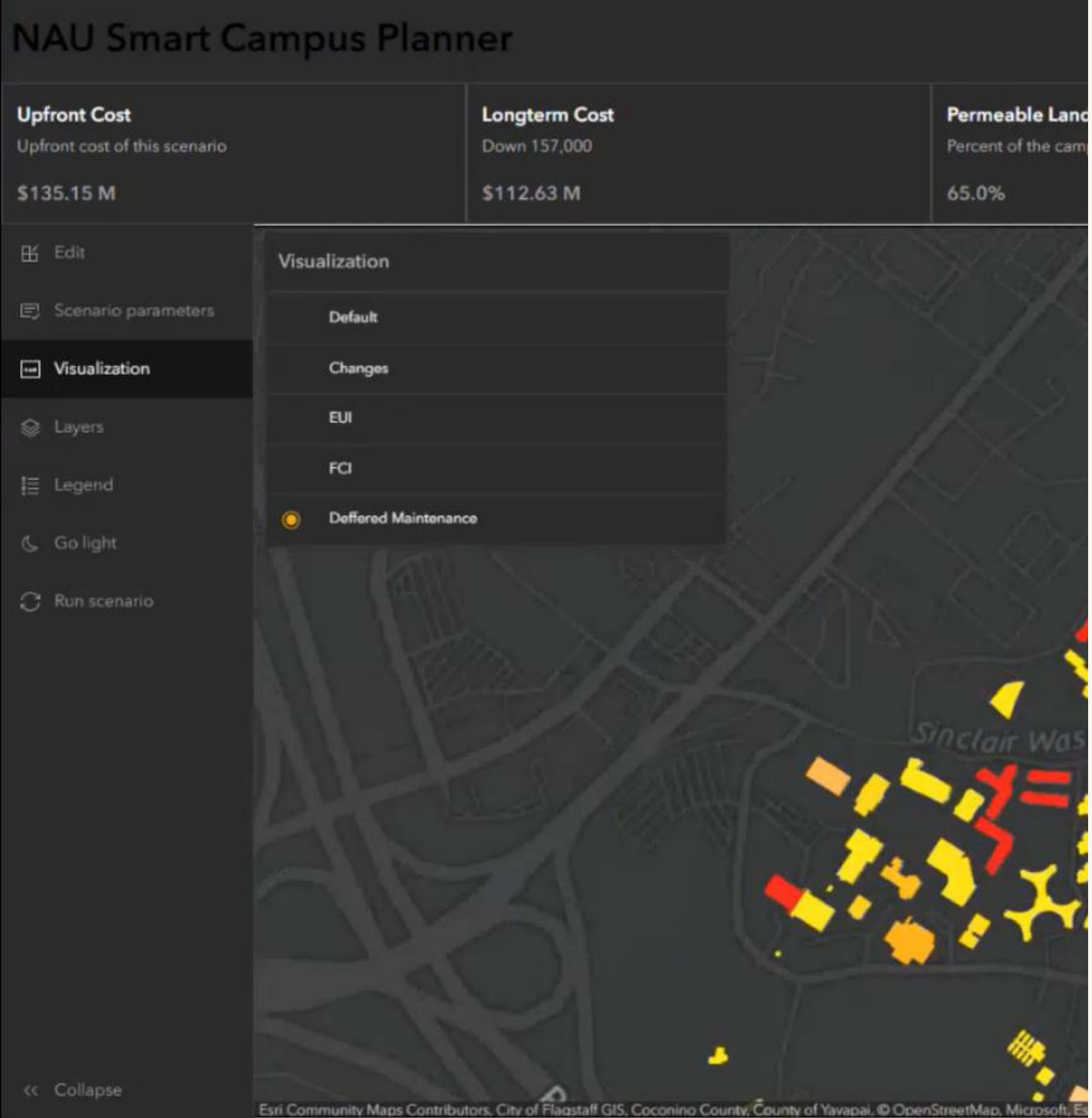
Scenario planning can be done in many ways.

Gaming engines have AI agents that can be custom developed, trained, and deployed in your virtual world…



IMAGINE A WORLD WHERE...

Project B **Future**



Visualizing Data

Essentials For Optimization and Decision Making

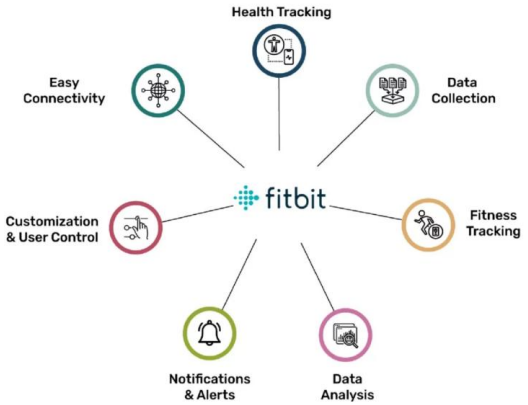
Smart planning tools use layered data to simulate scenarios, optimize resources, and support informed decision-making across campus environments.

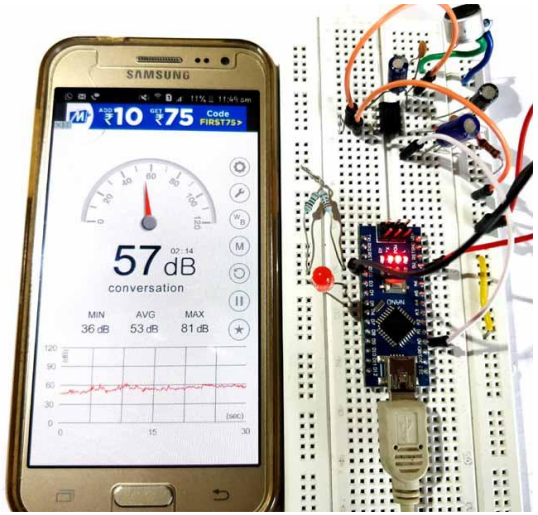
- **GIS-based visualization tools**
- **Visualize multiple layers of data into actionable insights**
- **Track campus wide maintenance needs**

TWINSIGHTS

How can we use data to make the best user experience through technology?

Imagine what we could do if you opted in your fitbit to a digital twin system that tracked sound and air quality.





IMAGINE A WORLD WHERE...

Project C **Future**

SMART **KITCHEN**

Indentify the problem

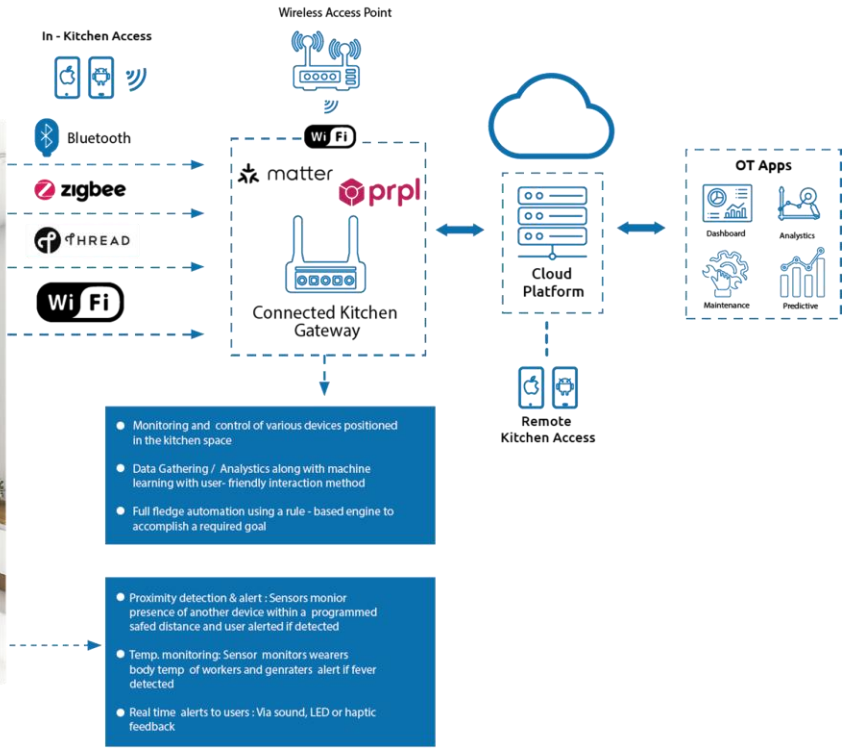
Food waste

ROI

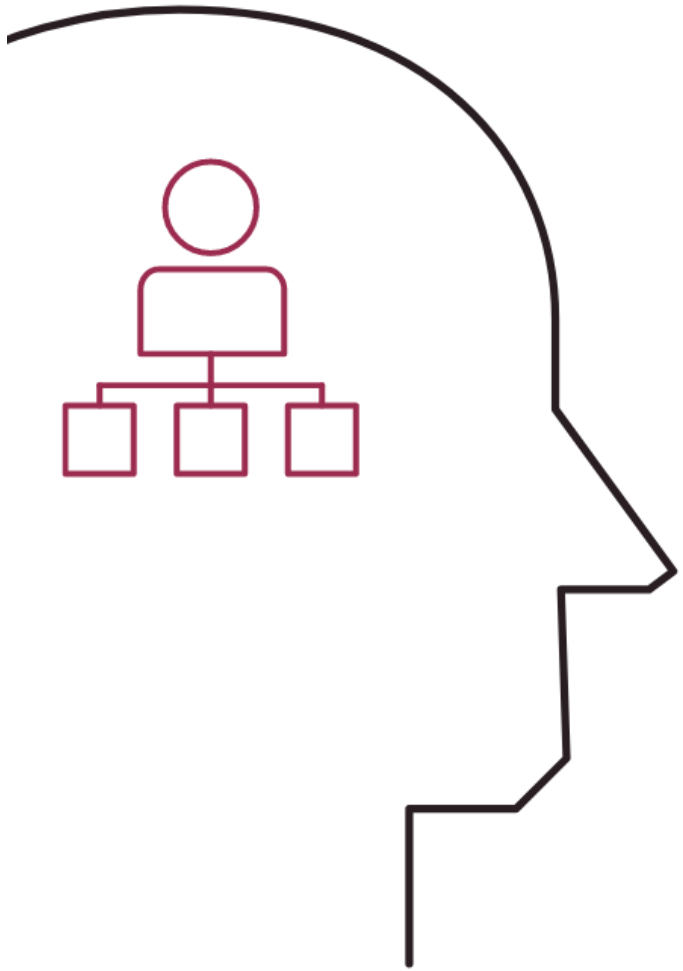
Owner: Productivity increases
Employee: Time saved
Facility: Right sizing your approach for accurate pricing

Different types of sensor node in the kitchen

Groceries container - bin	Water leakage sensor	Sink blockage removal	Gas leakage sensor	
Power outlet	Smart lights	Water quality	Waste bin	Touchless soap dispensar
Tempreature / heat sensor	Sensor based water tap	Motion sensor	Gas leakage sensor	
Smart lights	Automatic knob control	Smoke fire / detector	Soical distance tag	
Automatic main door unlock	Kitchen survillance	Water pressure sensor	Wireless egg tray	
Touchless paper towel dispenser				



SITE MANAGEMENT – UX JOURNEY



DECISION	JOURNEY	ACTION	FOLLOW UP
1 ASSIGN A TICKET / PERSON / FIX FOR A PROBLEM IN REAL TIME	recieve via alert / recieve via occupant complaint → investigate issue	assign to tech / dismiss / defer	review results / provide feedback / schedule follow up alert
2 REARRANGE, REPLACE, OR EXPAND A FURNITURE SYSTEM	recieve via alert / recieve via occupant complaint → investigate issue	assign to tech / dismiss / defer	review results / provide feedback / schedule follow up alert
3 REACT TO EMPLOYEE QUESTIONS OR CONCERNS WITH COMPARISONS BASED ON DATA	recieve via alert / recieve via occupant complaint → investigate issue	assign to tech / dismiss / defer	review results / provide feedback / schedule follow up alert
4 REPURPOSE UNDERUTILIZED AREAS	recieve via alert / recieve via occupant complaint → investigate issue	assign to tech / dismiss / defer	review results / provide feedback / schedule follow up alert
5 PREDICT NEEDS: ON SCHEDULE, AHEAD OF SCHEDULE, OR SLOWER THAN SCHEDULED ACCORDING TO DATA TRENDS	recieve via alert / recieve via occupant complaint → investigate issue	assign to tech / dismiss / defer	review results / provide feedback / schedule follow up alert

positive experience
negative experience
optimize
insight
decision
response
prediction

DATA GAP ANALYSIS

ACOUSTIC COMFORT

Acoustic Comfort (d)
Space acoustic comfort

BUILDING AUTOMATION SYSTEM

BAS (3)
Building HVAC system data

FACILITY MANAGEMENT SYSTEM

Service Now (3)
Work Orders, Service Requests, Vendors

360 Faciility (3)
Work Orders, Service Requests, Vendors

Jira (3)
Help desk and ticketing system

FOOD

Food Survey (3)
Food satisfaction surveys

Menu (3)
Food menus for each location

Food Waste Data (3)
Food waste information

INDOOR QUALITY

Senseware (d)
Indoor Air Quality

MISCELLANEOUS

Workday (3)
Employee data - title, location, manager, department, etc.

Aruba (3)
Wifi usage by employee and building, geolocation

Lucid (3)
Energy Management Data

Project Knowledge Base (3)
Workplace project details

Dark Data/Ghost Data (3)
All of the renegade spreadsheets

O350 (3)
Office 365

OCCUPANCY

Density (i)
People Sensors

VergeSense (i)
People Sensors

Cisco Spark (3)
Room occupancy sensors via conference hardware

RETAIL

Sequentra (3)
Lease details

Trirega (3)
Lease details

Oracle (3)
Opex and Capex Financial information

ROOM META DATA

Workplace App (3)
Custom workplace app for LinkedIn Employees/Contractors

TRANSPORTATION

Street Line (3)
Parking lot sensors to determine number of availbable spaces

Charge Point (3)
App for scheduling electric car charging time

Lyft (3)
Lyft program ridership details

Trip Shot (3)
Commuter/intercampus bus ridership details

Scoop (3)
Carpool ridership details

Oobeo (3)
Valet parking details

BCD Travel (3)
Booking information: Flights, Hotels

SECURITY

Lenel (i)
Employee Badge, Badge Swipe Activity, Alarms

TDS (3)
External visitor data

LobbyConnect (3)
External visitor data

VIDEO CONFERENCING

Blue Jeans (3)
Video Conferencing information

Zoom (3)
Video Conferencing information

Teams (3)
Video Conferencing information

EventBoard (3)
Conference Room check in data

Outlook (3)
Conference room booking

VISUAL COMFORT

Visual Comfort (3)
Quality and quantity of light in a space

Precedent

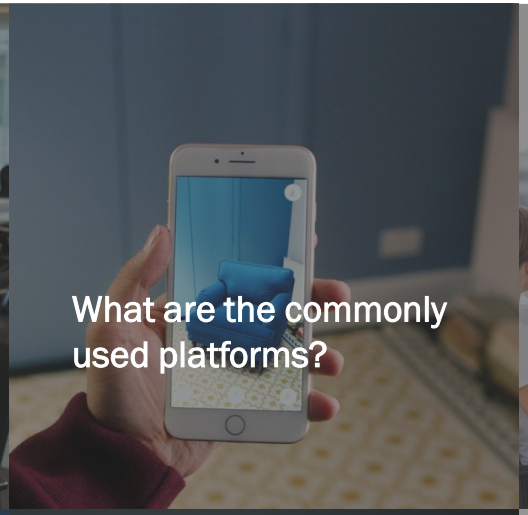
The data gap analysis provides an overview of known data points

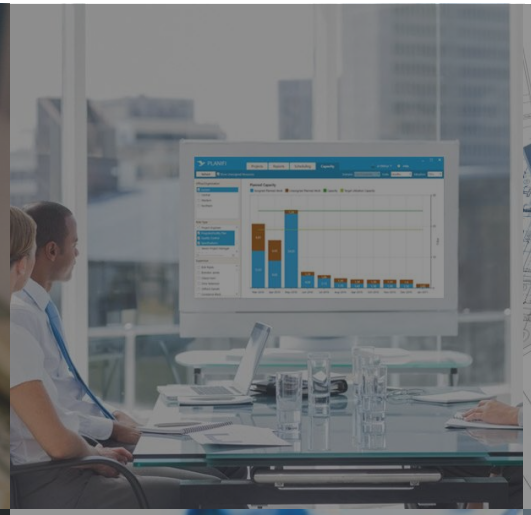
Identifies what data is currently available vs what data is needed

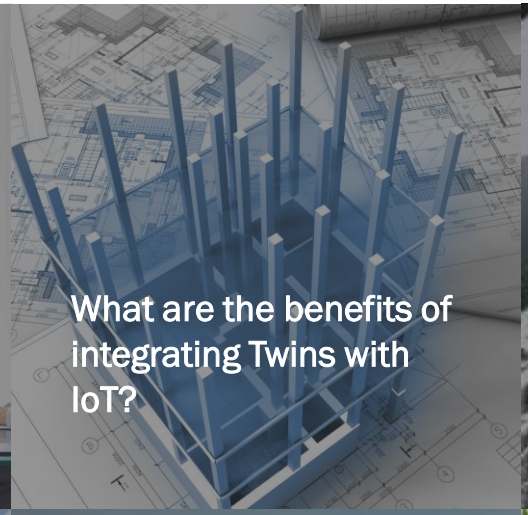
Informs next steps like deploying more sensors, updating databases, or refining data collection

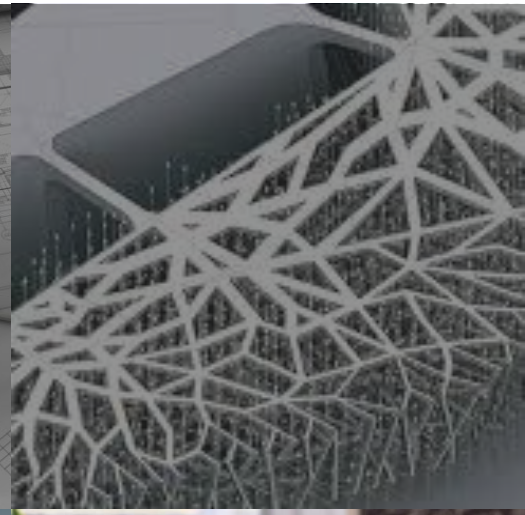
THOUGHT STARTERS

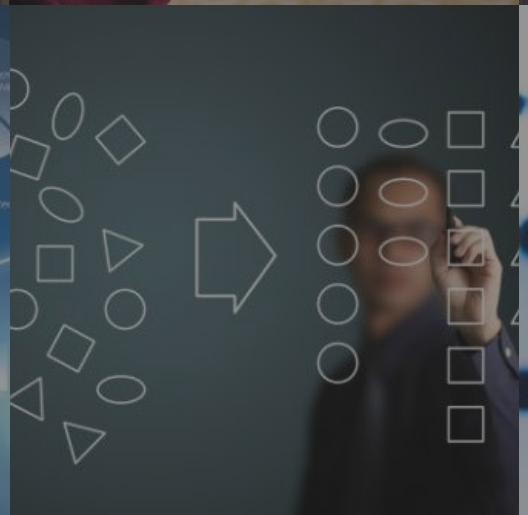
ANY QUESTIONS?

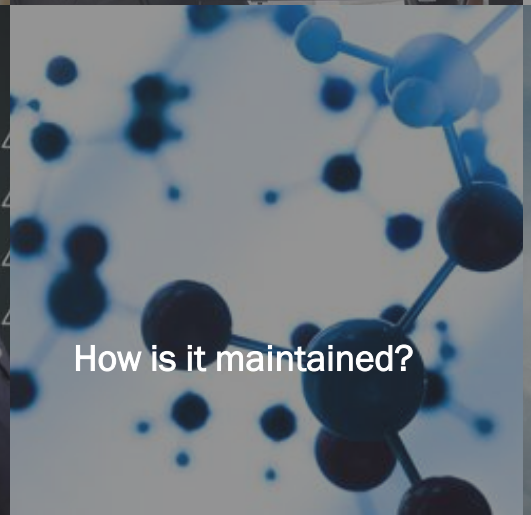


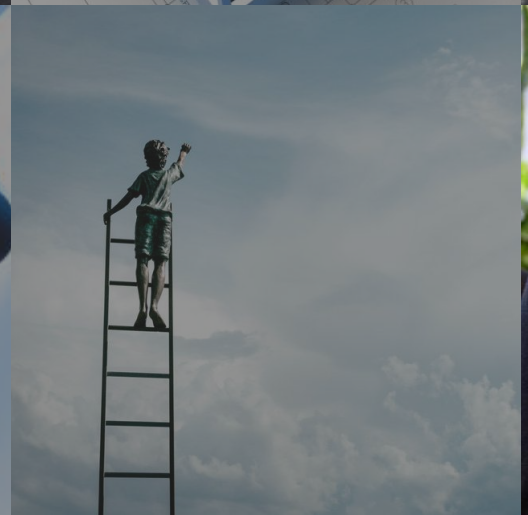












THANK YOU

This concludes The American Institute of Architects
Continuing Education Systems Course

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