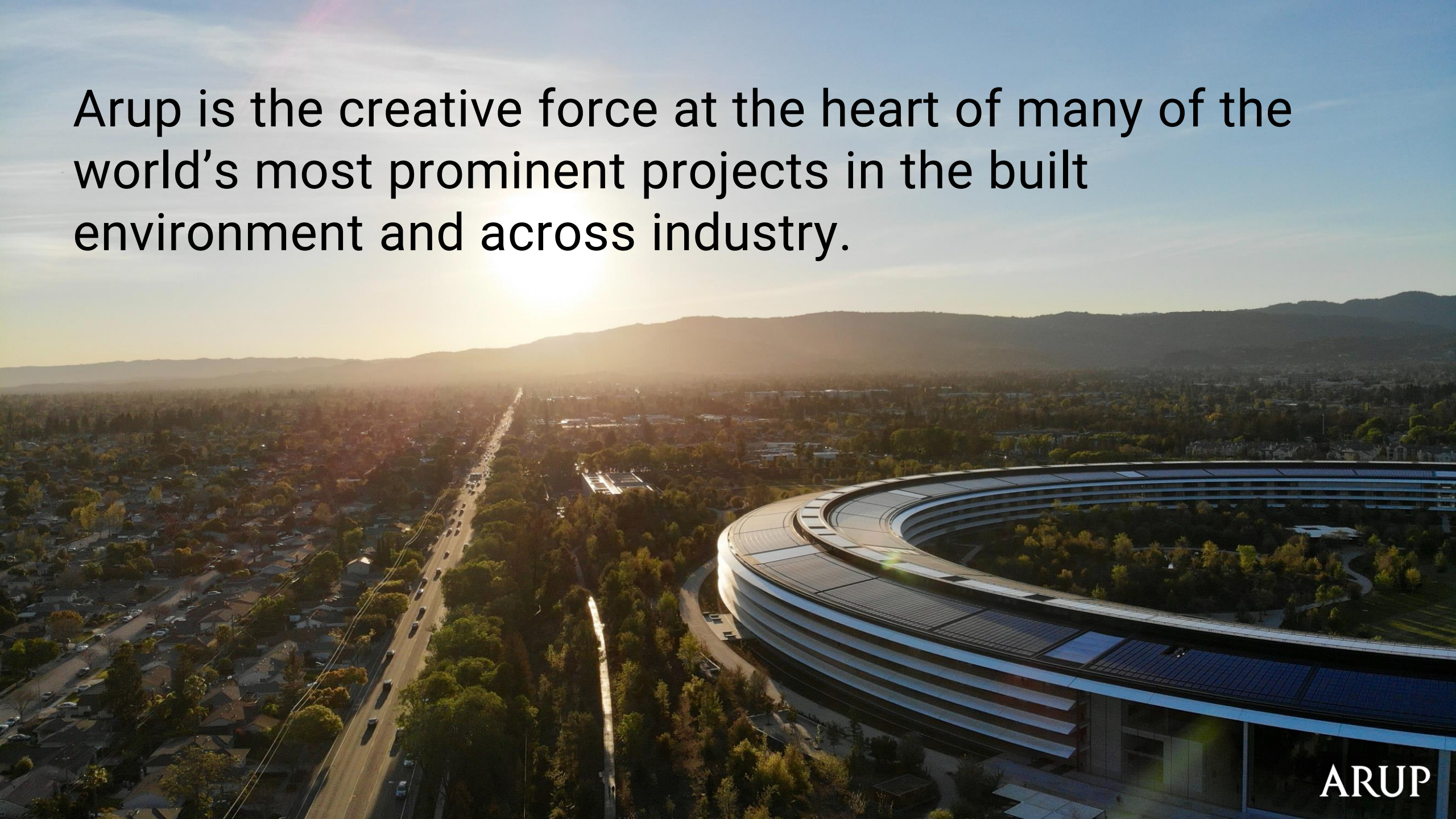
From Heathy Buildings to Smart Business

Using Technology to Reduce Risk and Enhance Project Value

September 2020

ARUP

Arup is the creative force at the heart of many of the world’s most prominent projects in the built environment and across industry.



We are truly global: 92
offices in 40 countries with
nearly 16,000 planners, designers,
engineers and consultants deliver
innovative projects across the world.
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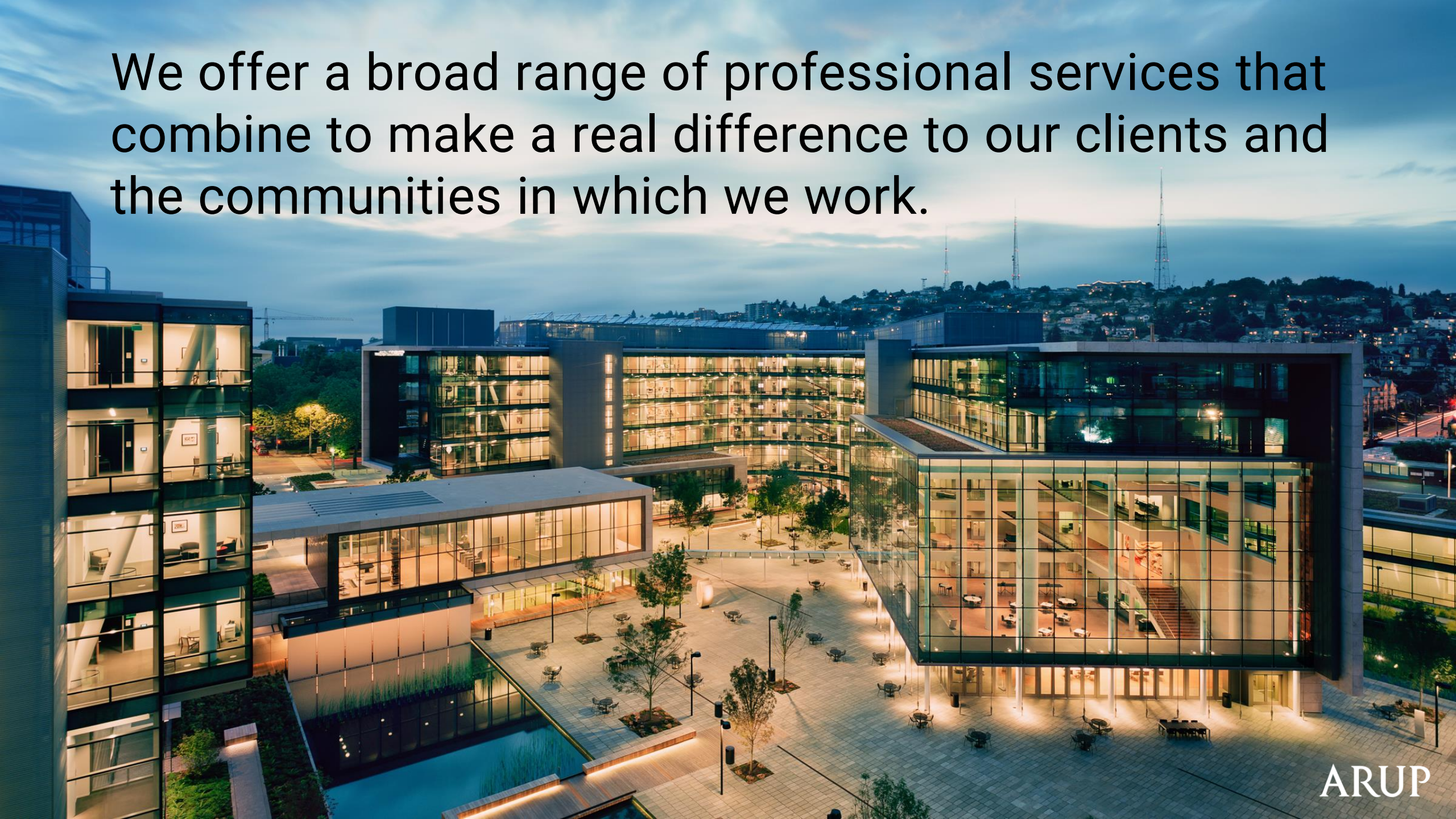
We offer a broad range of professional services that combine to make a real difference to our clients and the communities in which we work.



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Arup Presenters

Gideon D’Arcangelo
Arup | New York

Fiona Cousins
Arup | New York

Mark Walsh-Cooke
Arup | Boston

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Agenda

- HVAC tools and strategies to balance wellness and energy performance
- Smart Building technologies for Healthy Buildings
- Digital twins and enhancing building performance

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System Design for Health and Wellness

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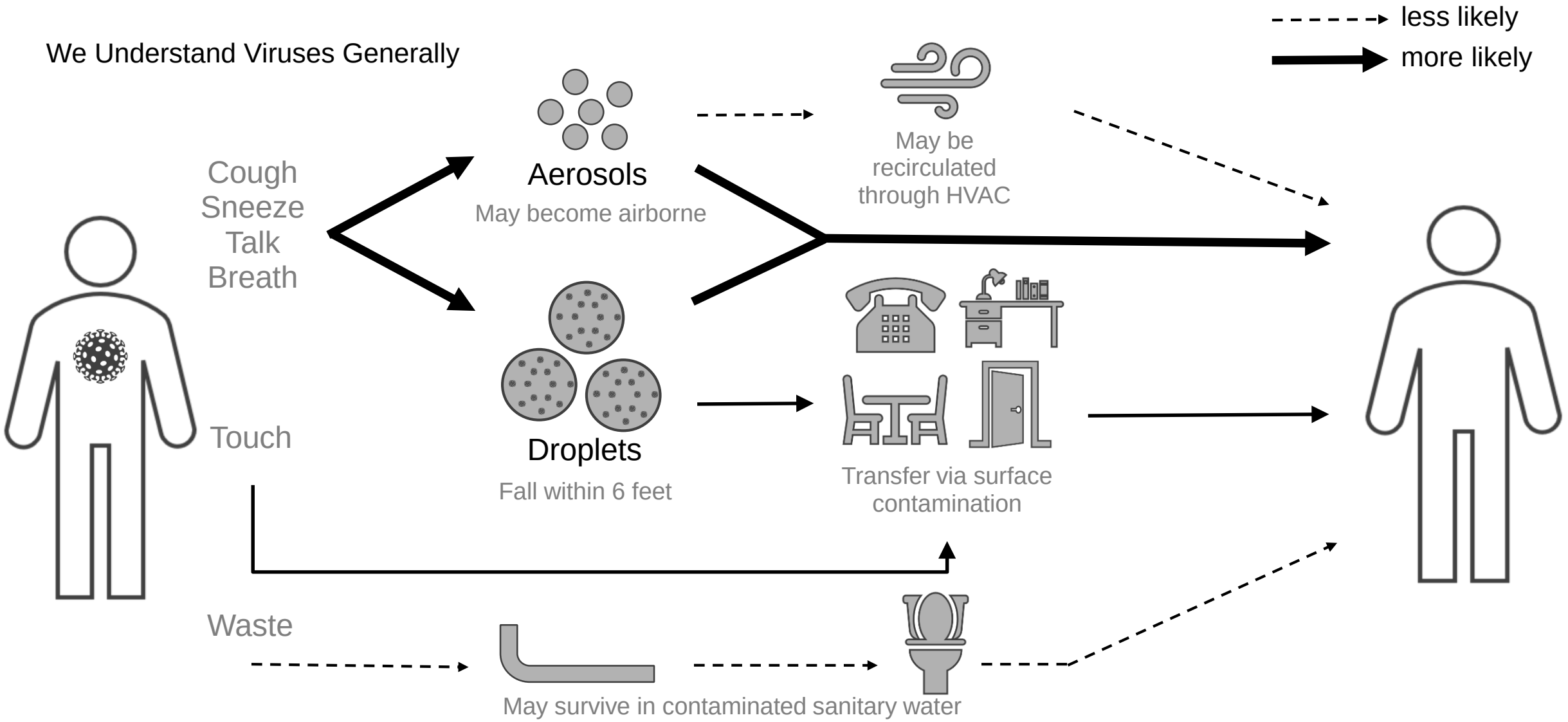
What We Know About Transmission



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We are the primary infectious vector

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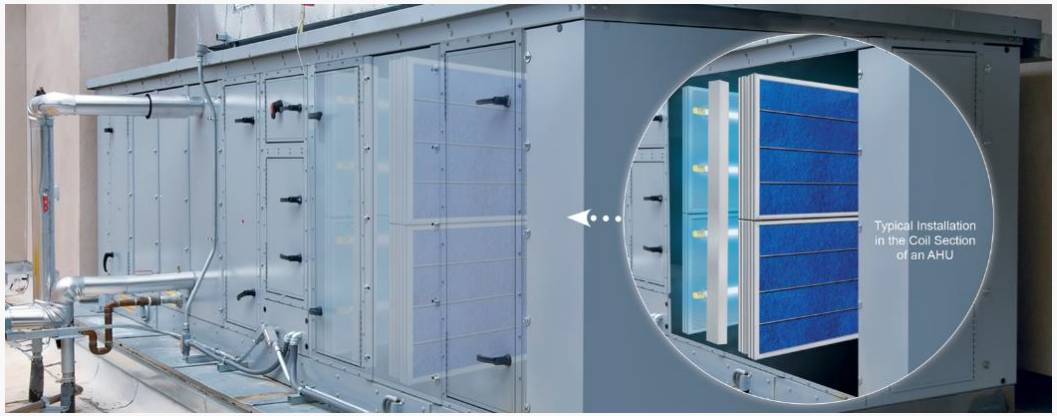
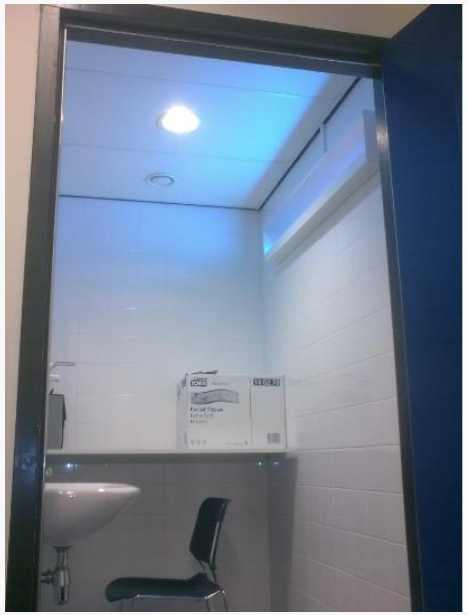
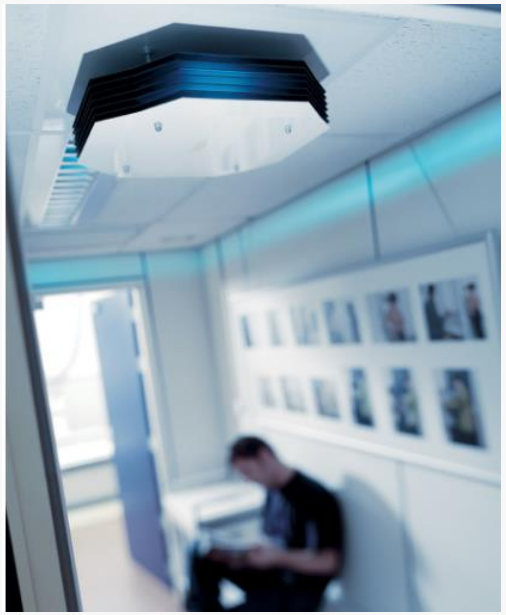
System Enhancements







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Communicating the benefits

Lessons learned from our own office design

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Lessons learned from our own office design

65% & 68% of staff said that their **productivity is positively impacted** by the office's environmental conditions (comfort, lighting, air quality), compared to 8% in our old office

52% & 43% of staff said they **feel more healthy in the office** compared to not in the office, compared to 2% in our old office

78% & 83% of staff said they felt the current **workplace supports creative thinking and collaboration**, compared to 37% in our old office

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WELL

fitwel℠

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WELL HEALTH-SAFETY RATED 2020

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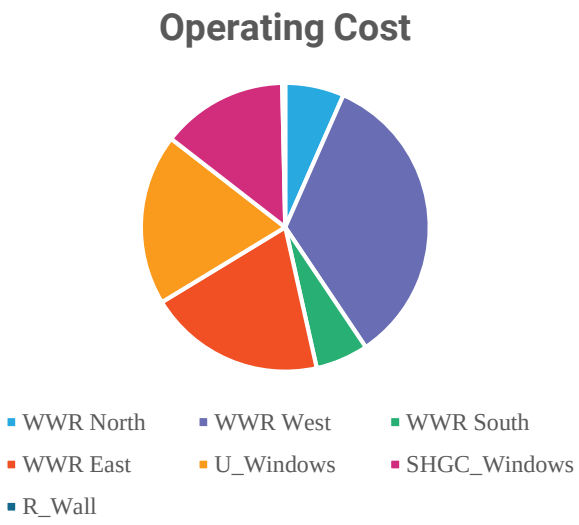
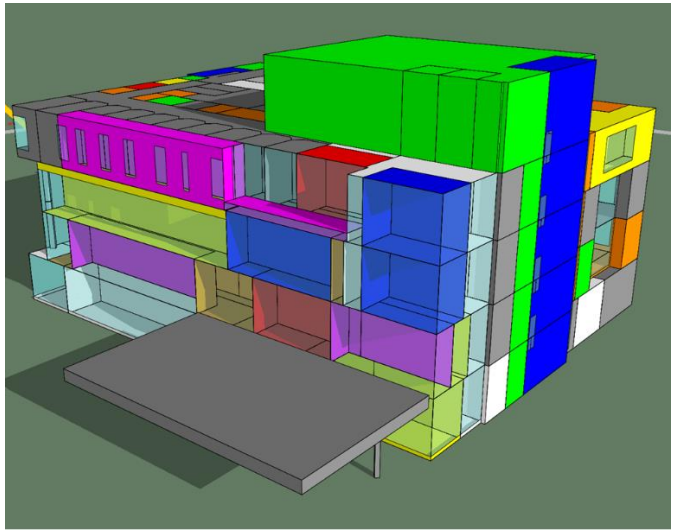
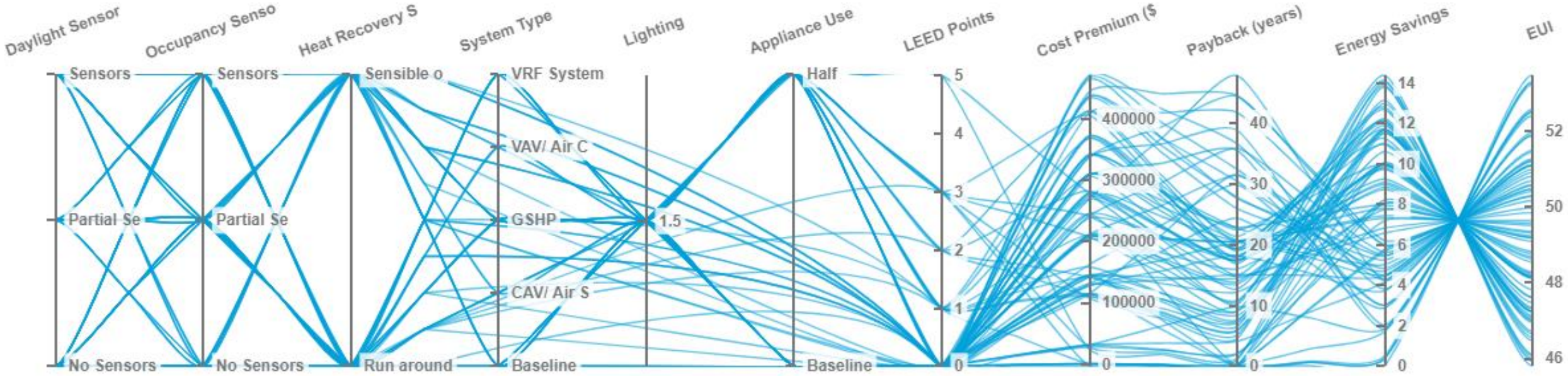
Parametric Energy Modelling with Machine Learning







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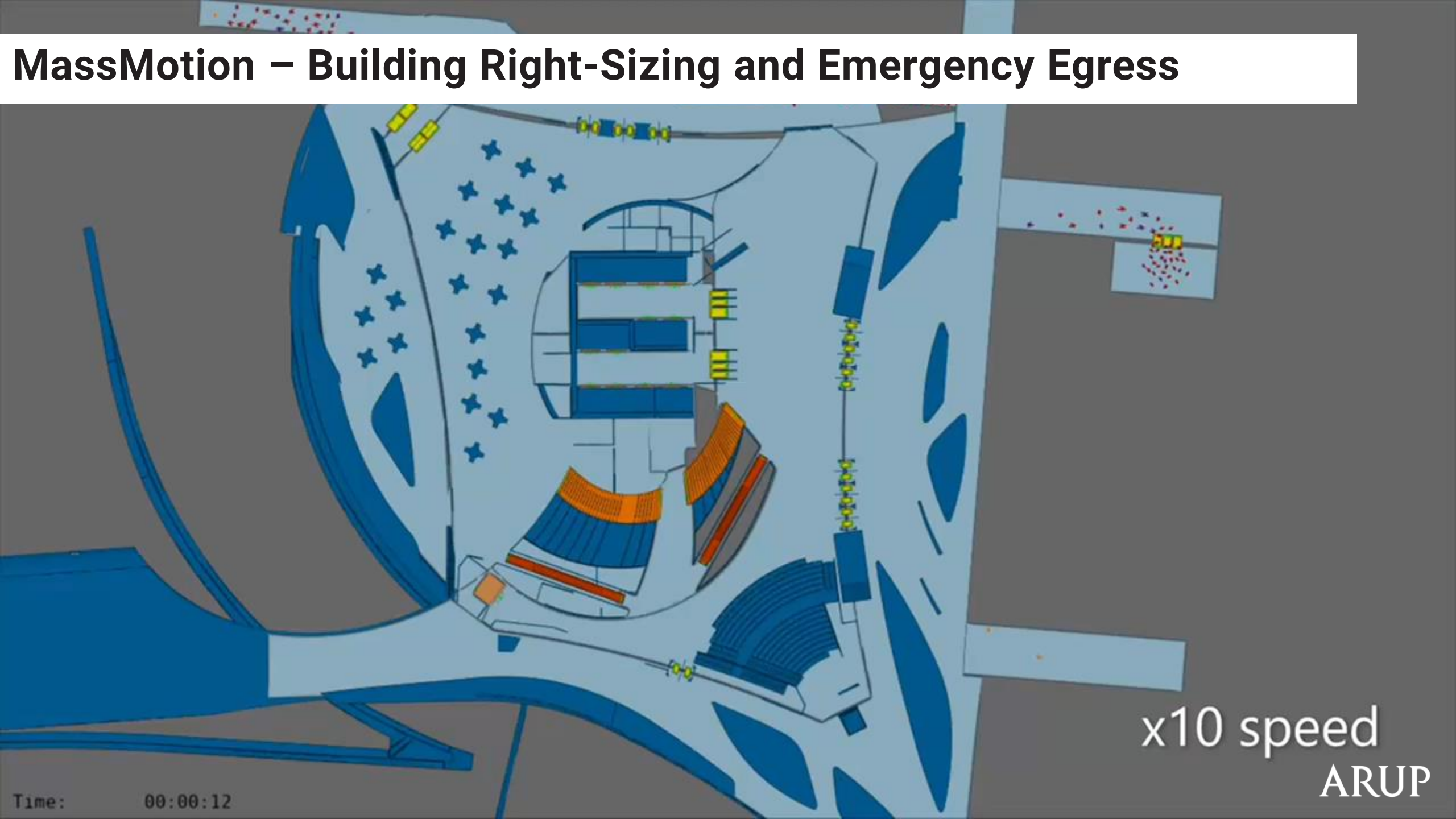
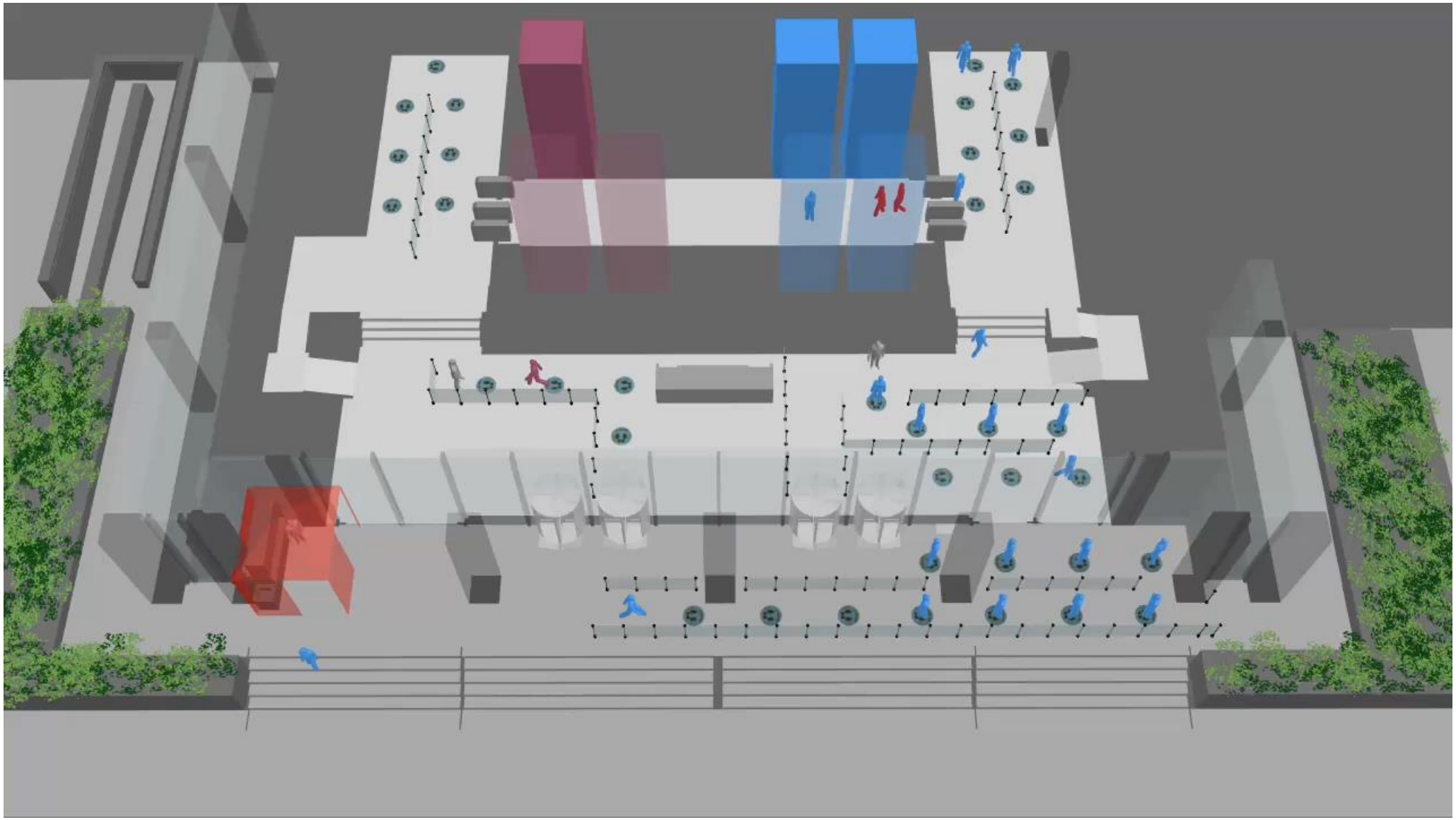
MassMotion – Building Right-Sizing and Emergency Egress



MassMotion with Social Distancing



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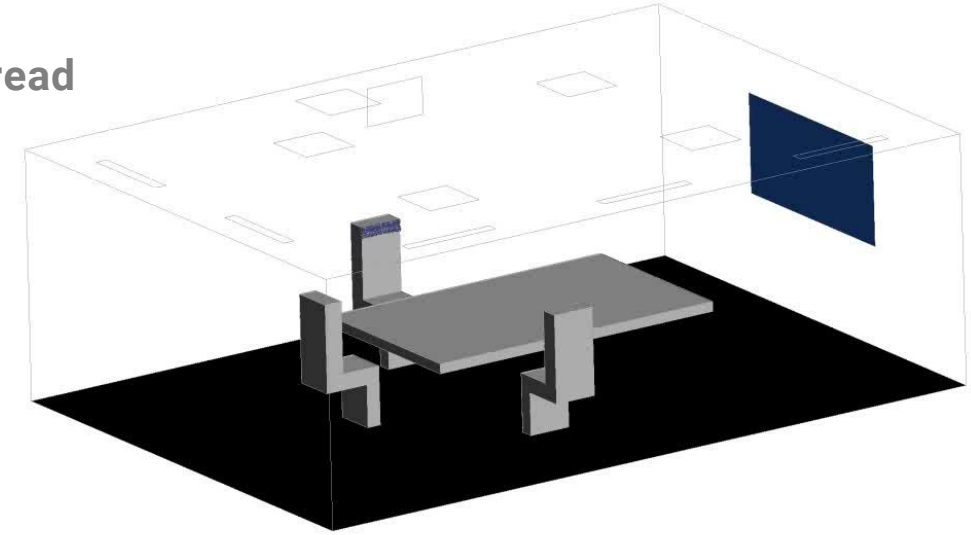
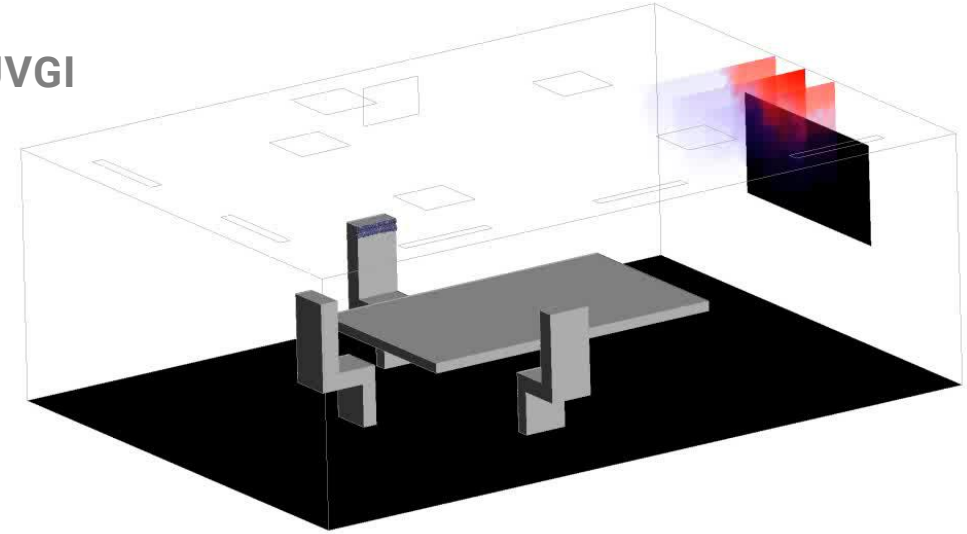
Computational Fluid Dynamics

Measuring UVGI Effectiveness

Untreated pathogen spread



Pathogen spread with UVGI



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MassMotion and CFD

Complex Spaces with Moving Sources

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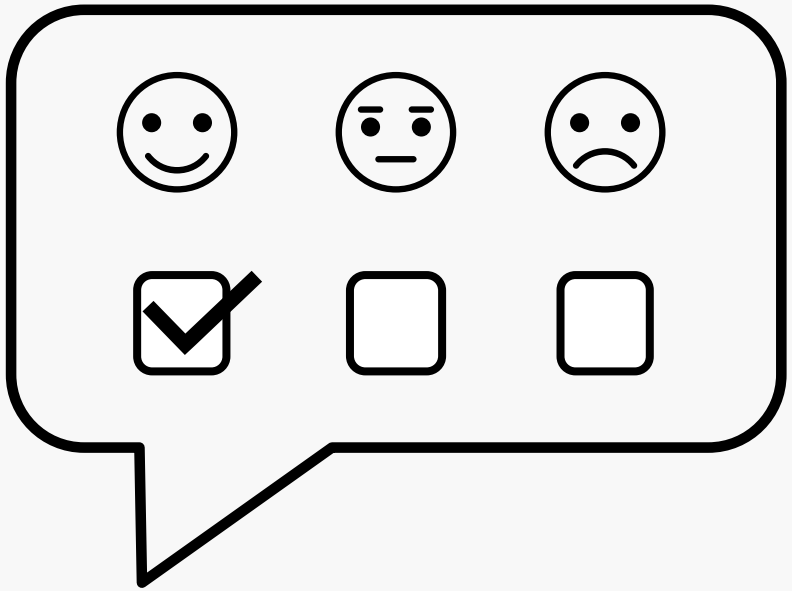
Indoor Environmental Monitoring

Quantitative and Qualitative Feedback

+



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Smart Building technologies and communications for Healthy Buildings

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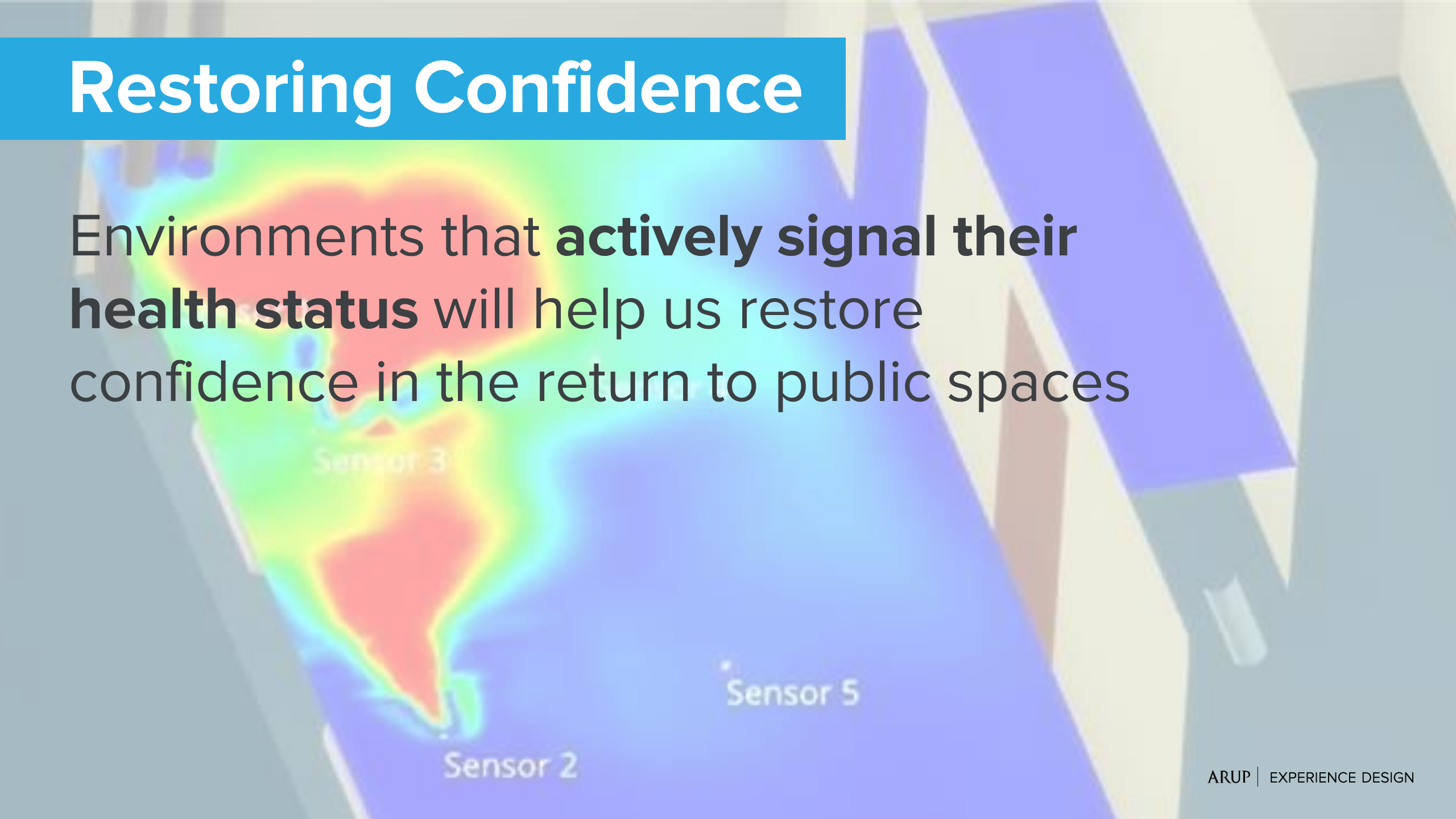
Restoring Confidence

Environments that **actively signal their health status** will help us restore confidence in the return to public spaces



Restoring Confidence

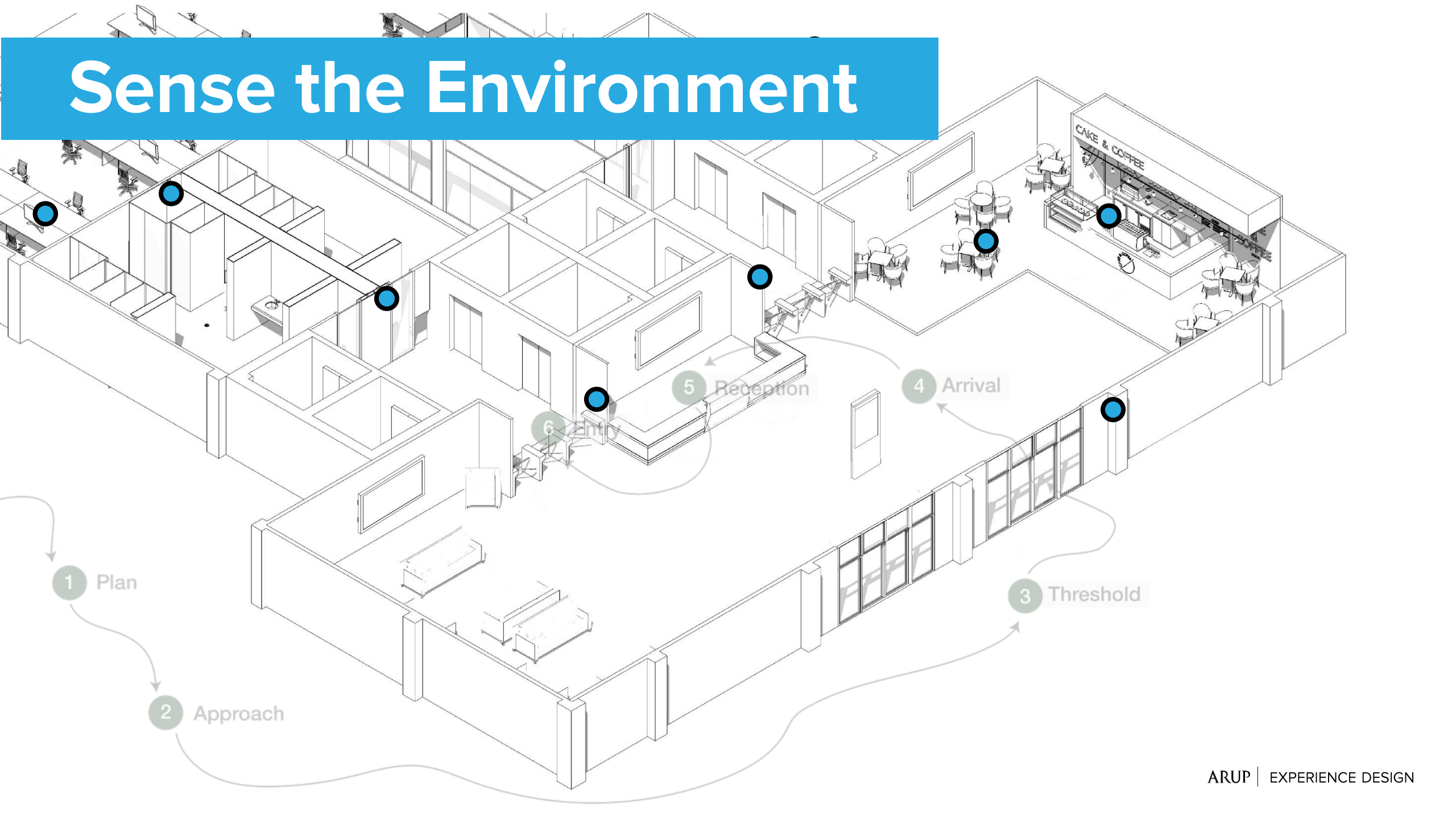
To create **health-aware environments** that keep people empowered on their journey back to daily life, we can:

- **Map** the pathways of return
- **Sense** the environments people are entering
- **Share** the data generously

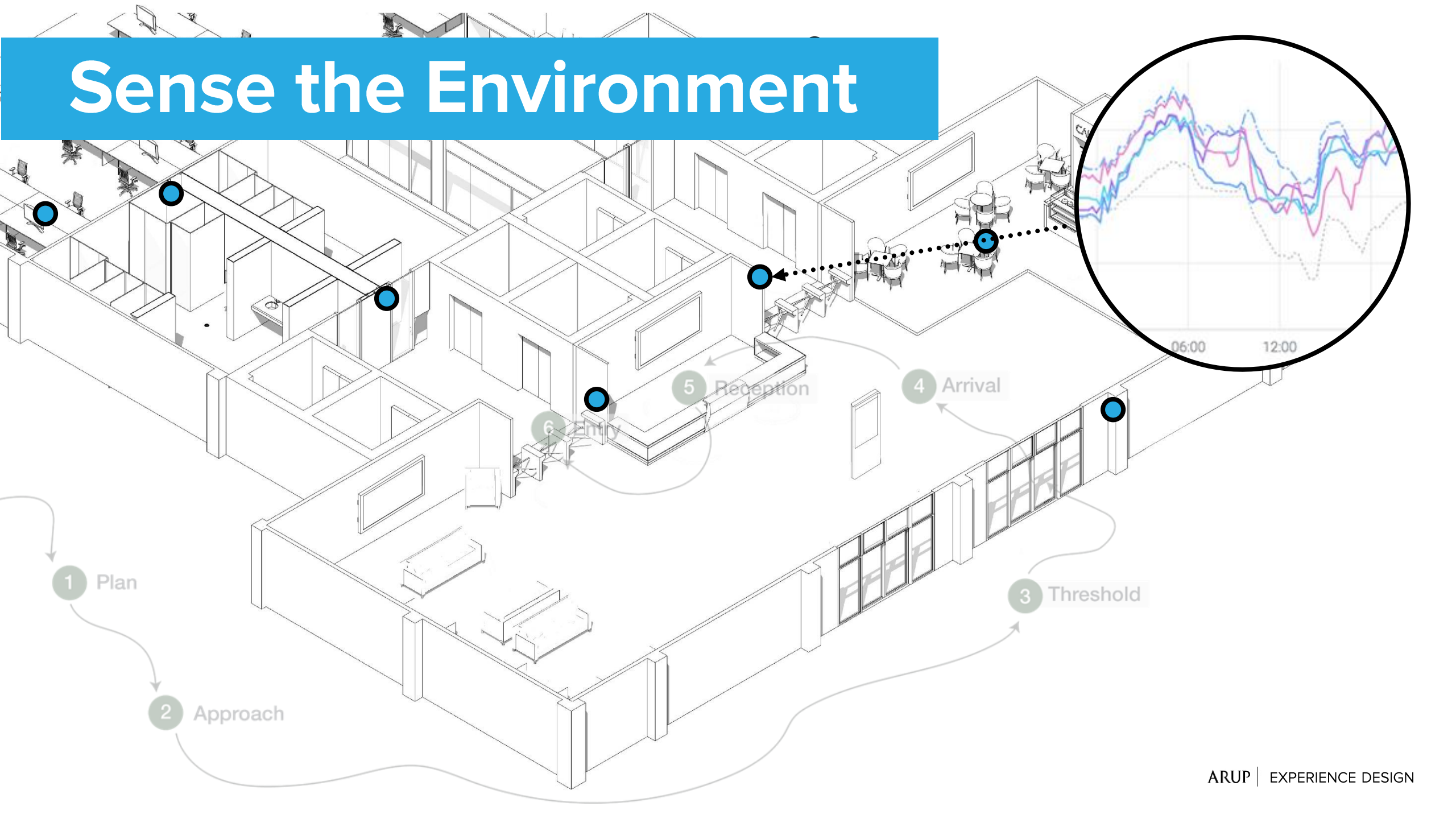
Map the Pathways

Map the Pathways

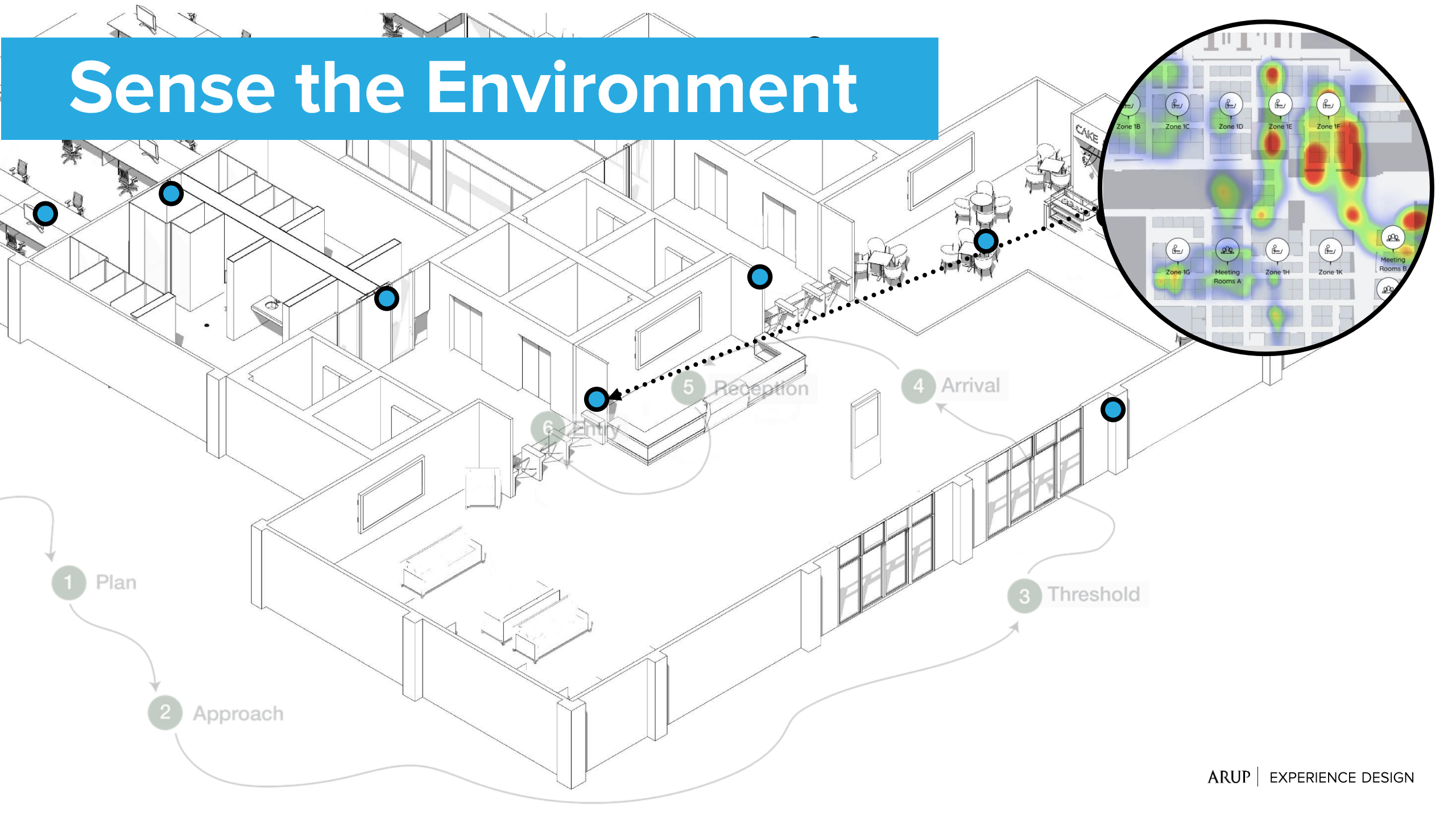
Sense the Environment



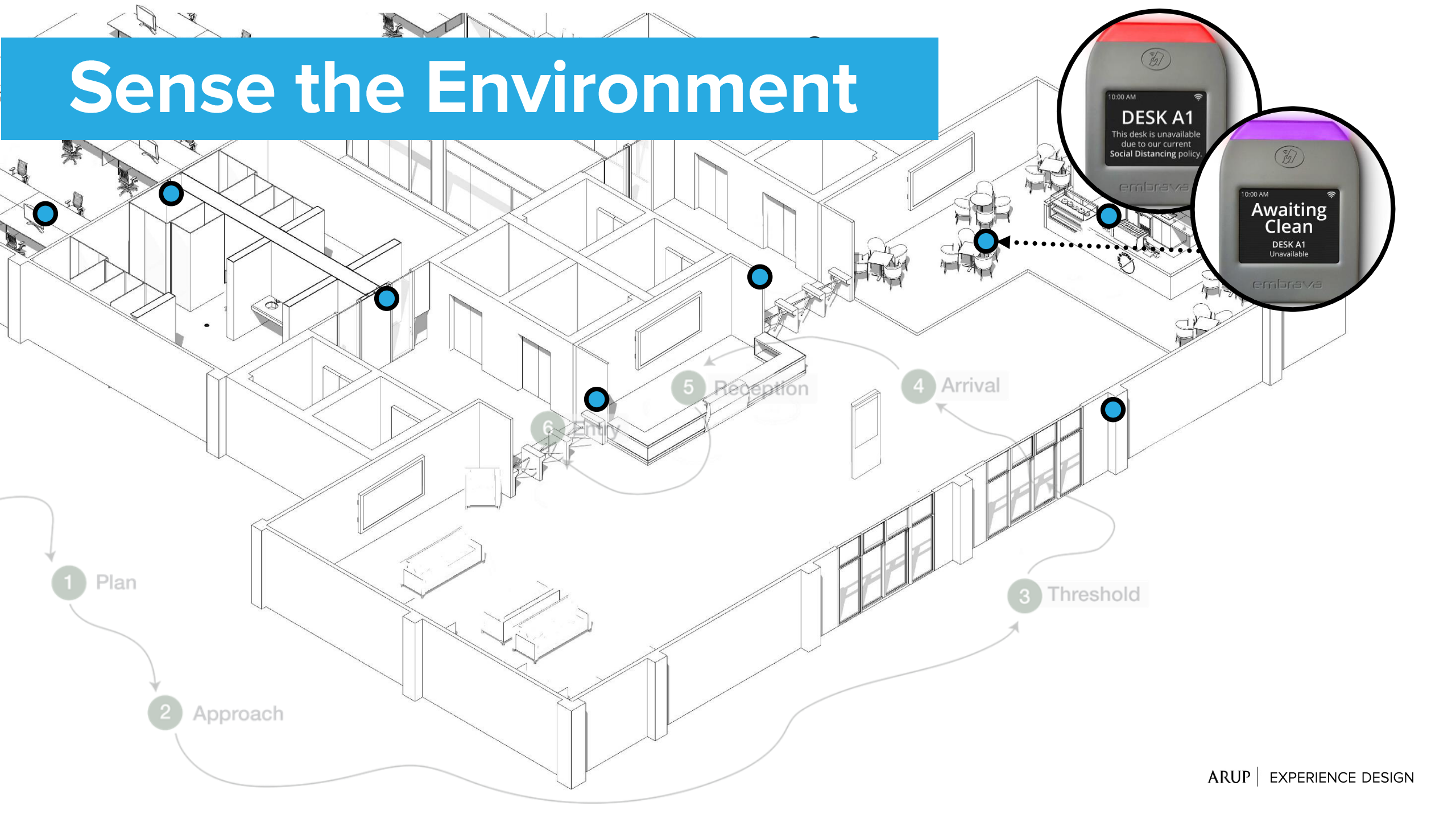
Sense the Environment



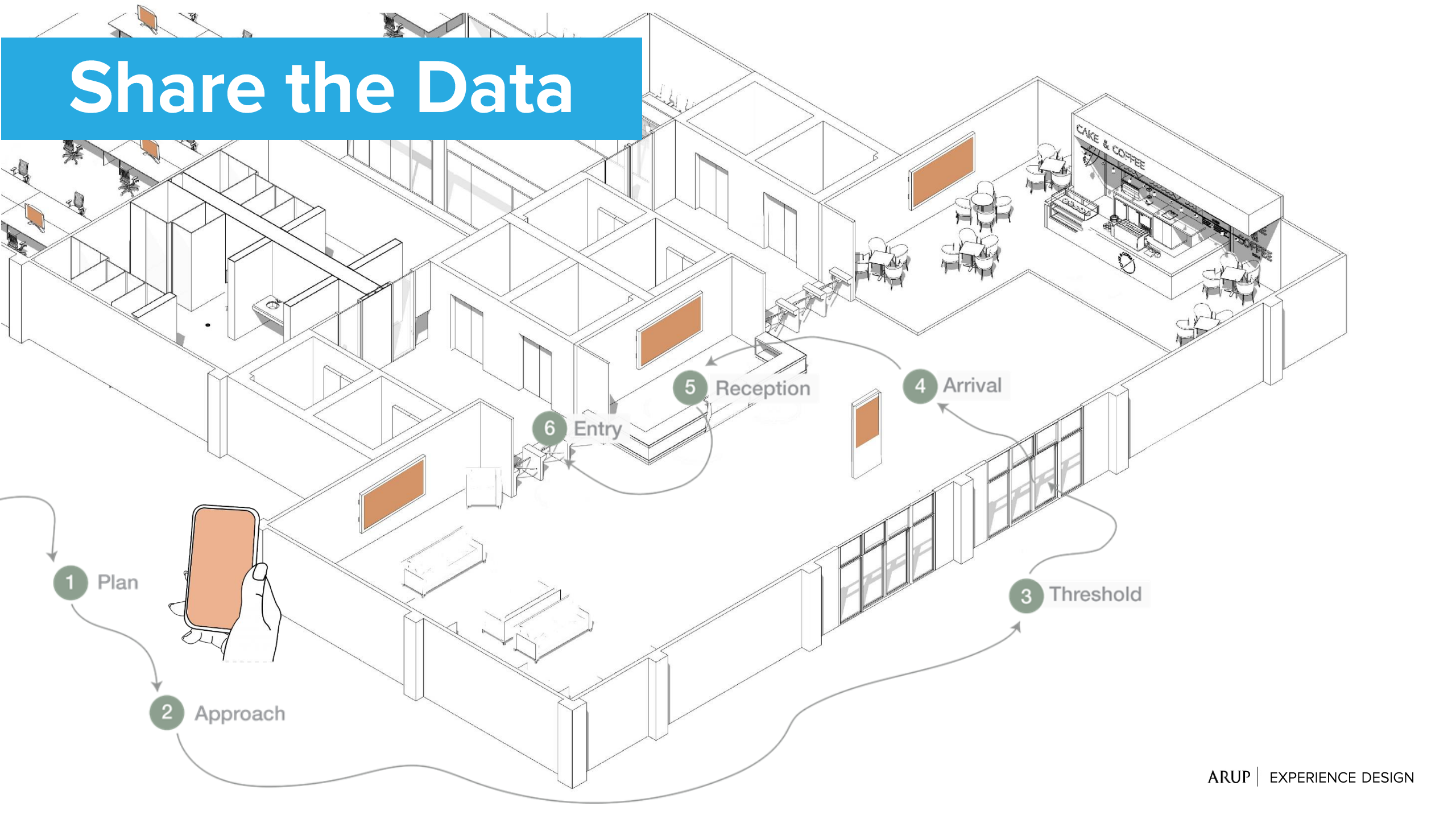
Sense the Environment



Sense the Environment



Share the Data



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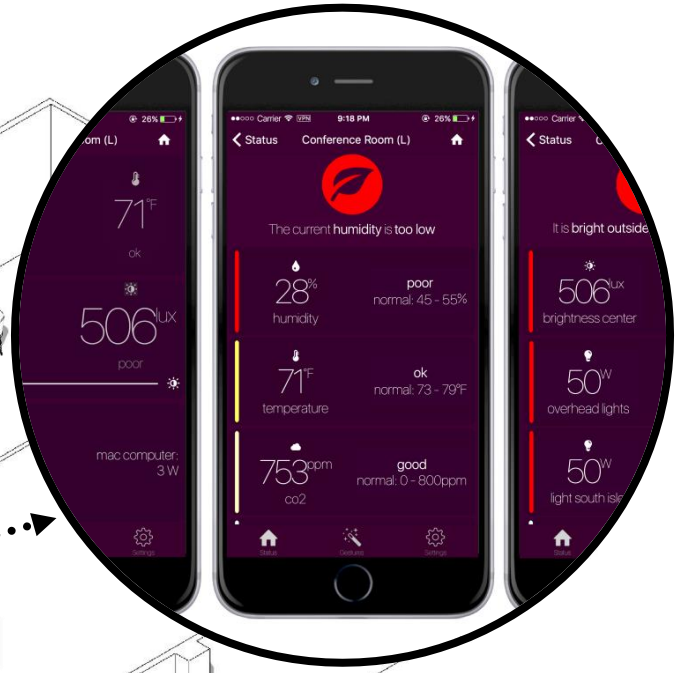


1 Plan

2 Approach

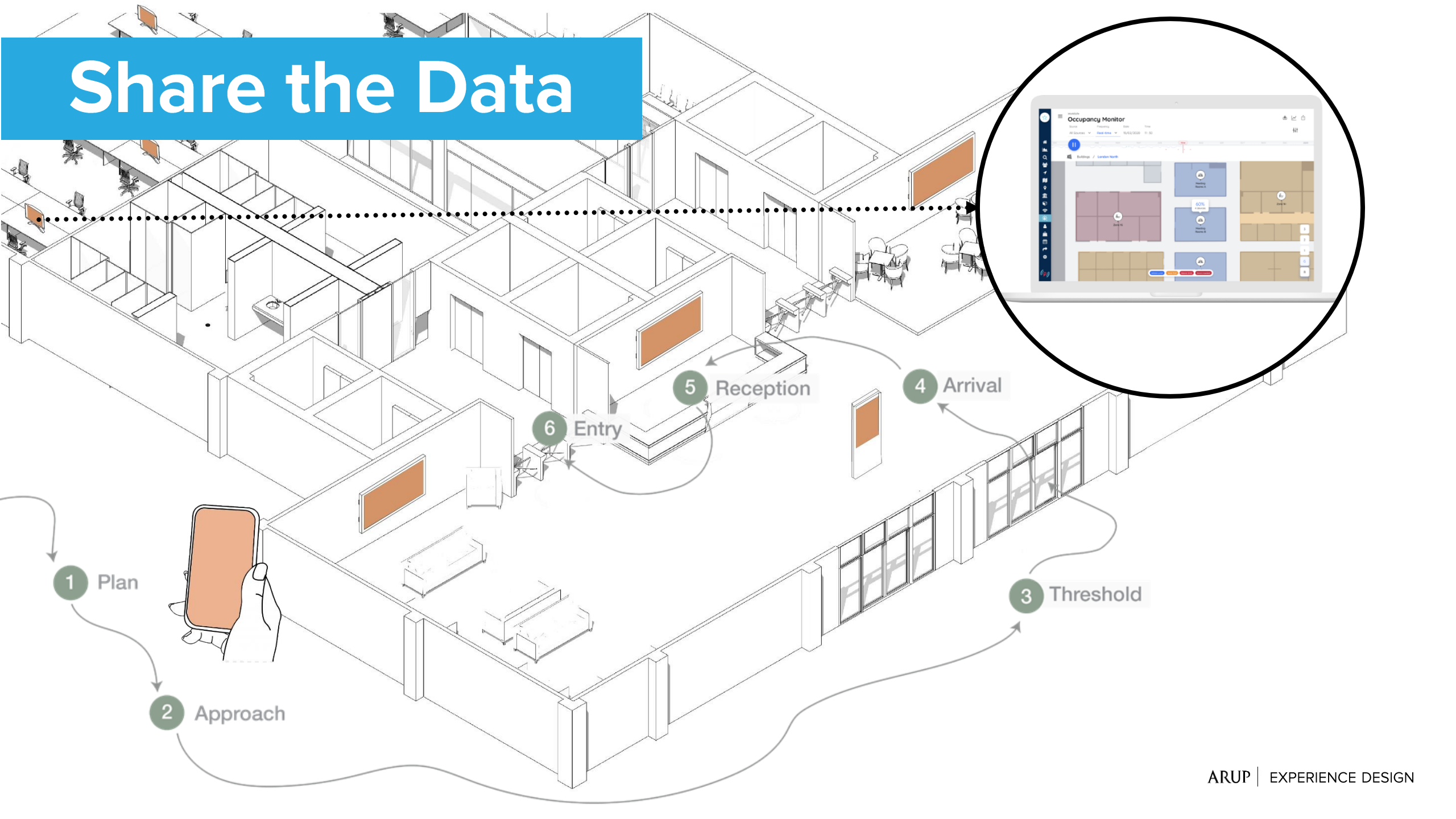
3 Threshold

4 Arrival

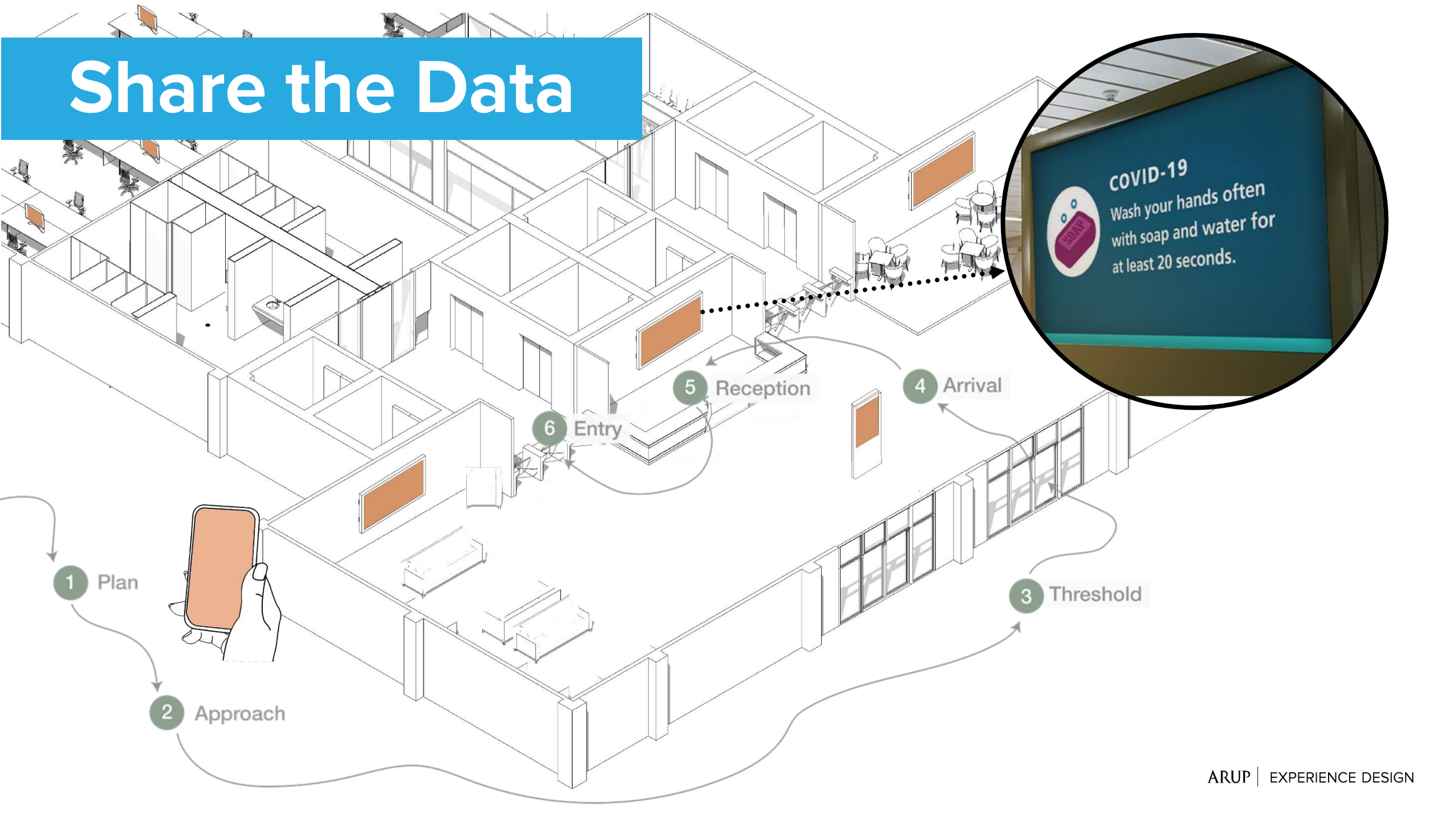
5 Reception

6 Entry

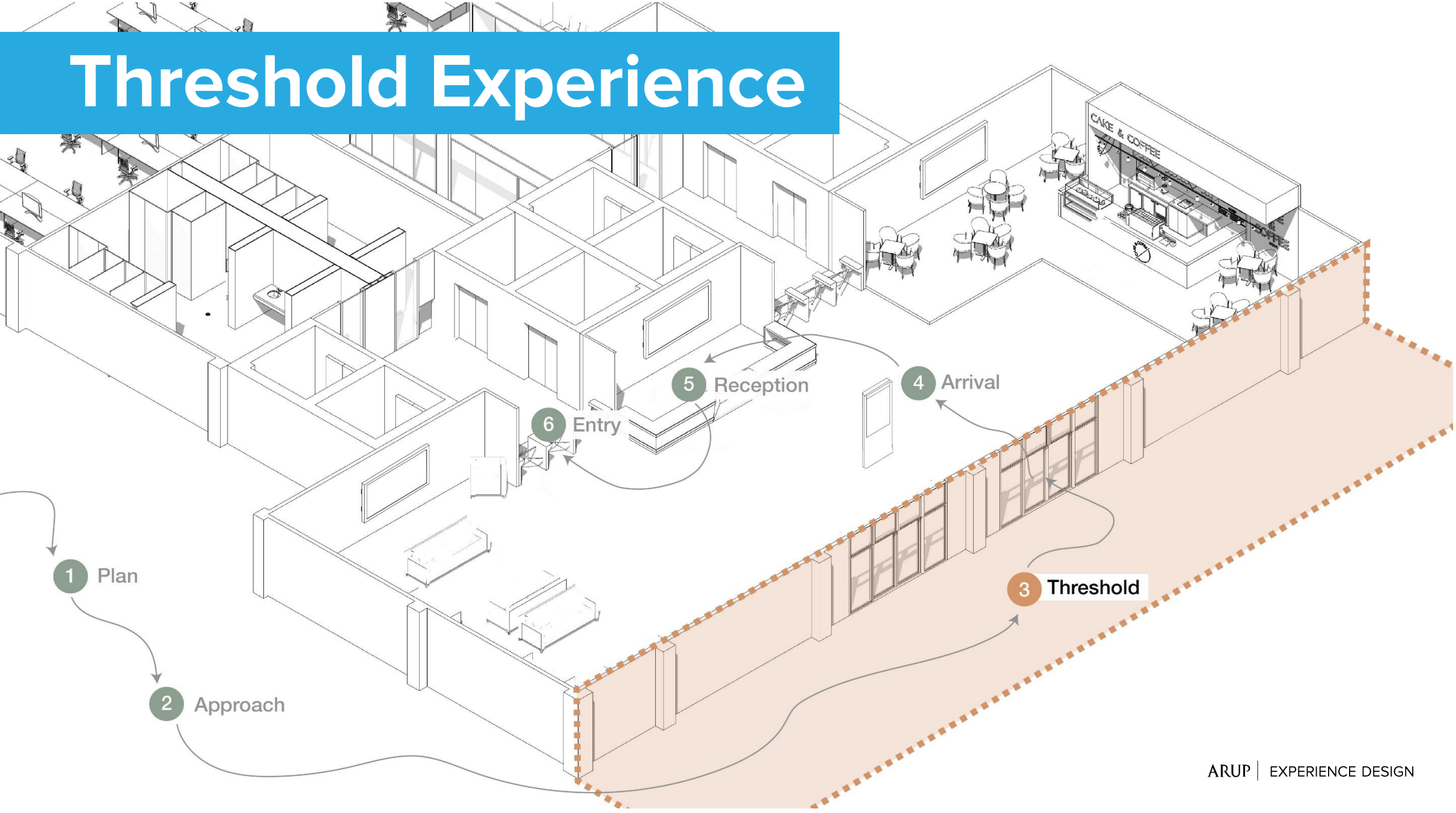
Share the Data



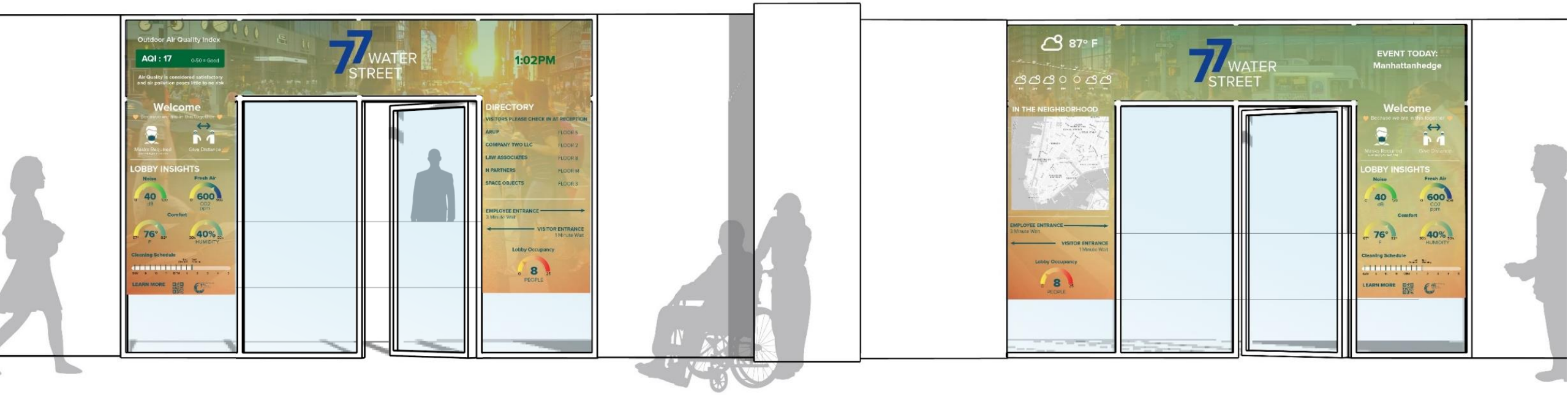
Share the Data



Threshold Experience



Threshold Experience



Threshold Experience

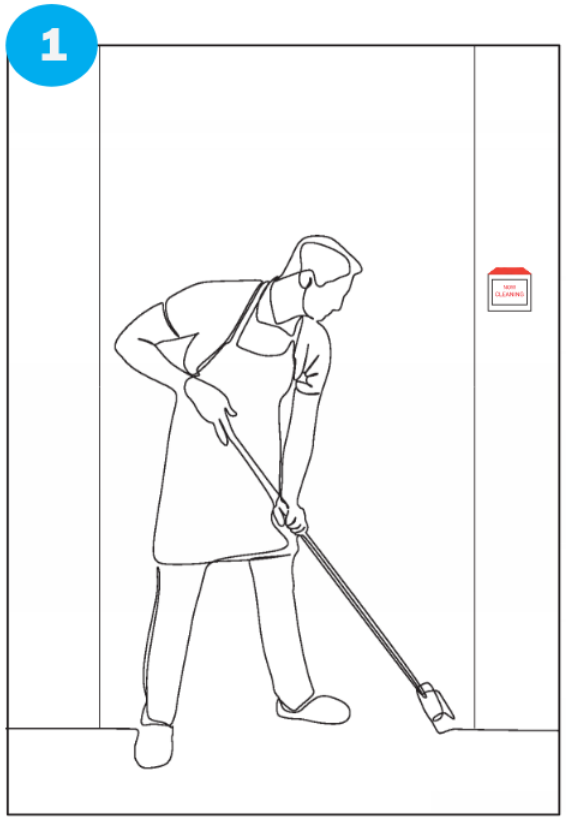
Threshold Experience

Case Study: Cleaning Status

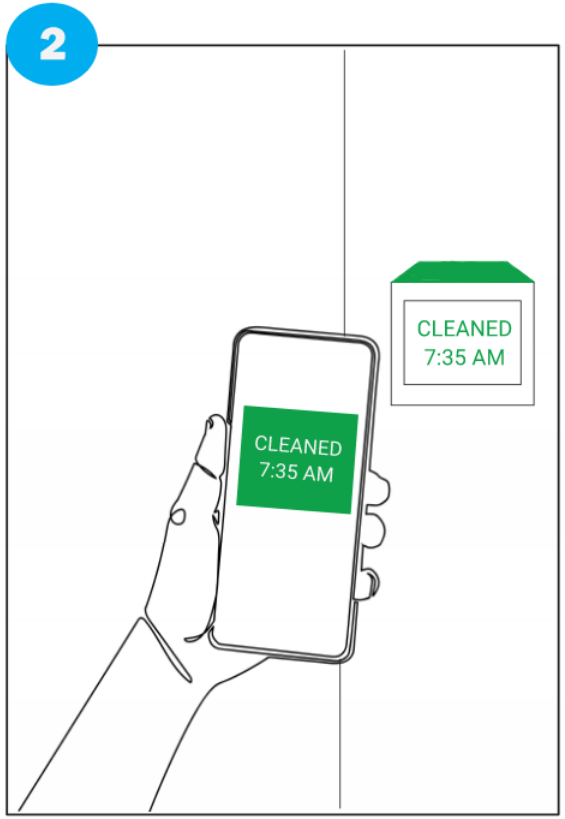
This is an overview of systems that provide very simple ways for:

- **Custodial staff** to indicate an asset has been sanitized
- **Employees** to register a need for an asset to be cleaned

Workflow – Custodian

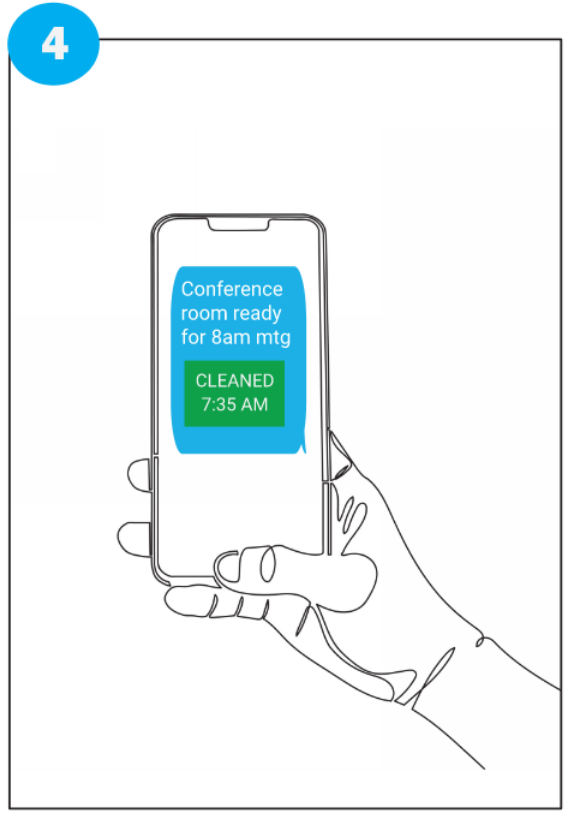


CUSTODIAN
cleans room



CUSTODIAN
badges reader

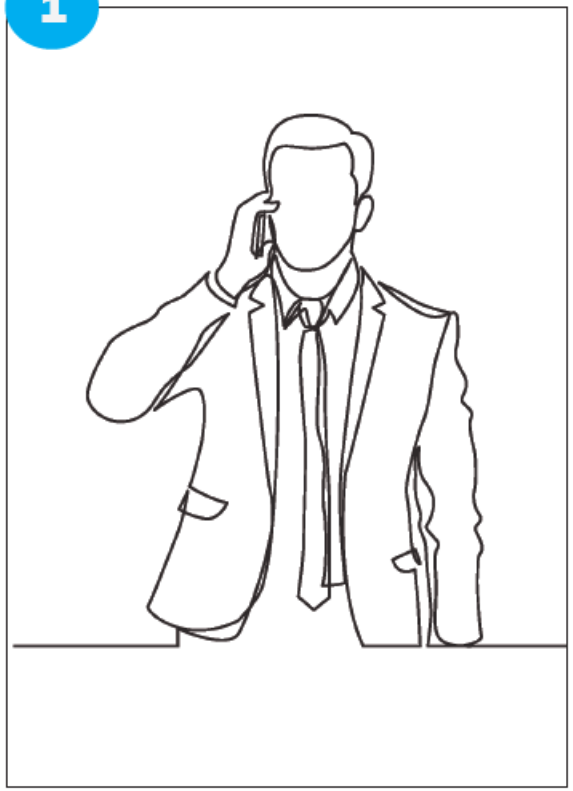
FACILITIES MANAGER
sees status



EMPLOYEE
gets notice

Workflow – Employee

1



EMPLOYEE
finishes meeting
needs room cleaned

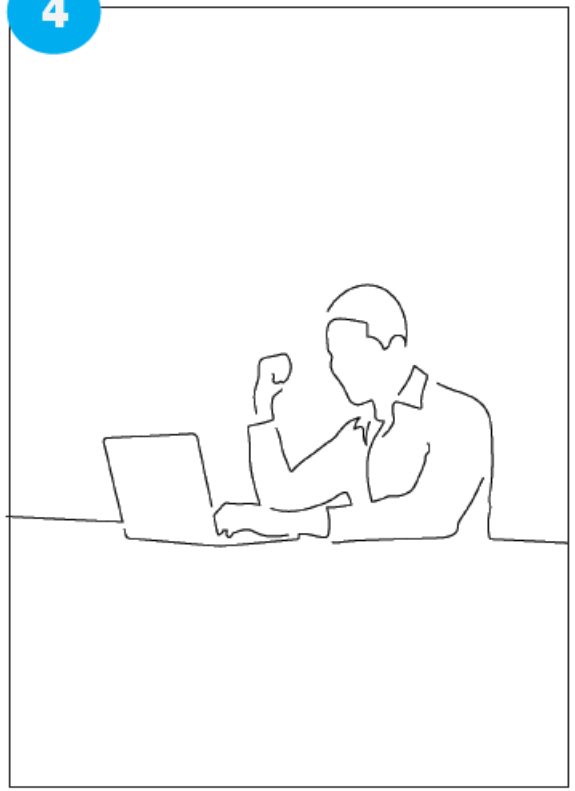
2

EMPLOYEE
badges reader

3

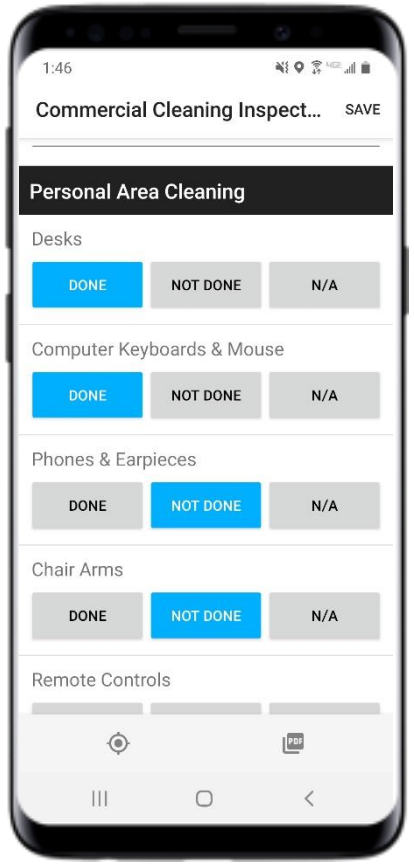
CUSTODIAN
gets notice

4

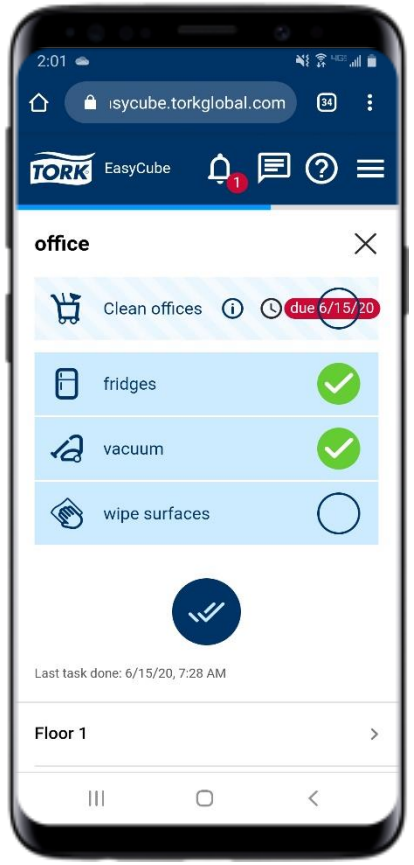


FACILITIES MANAGER
sees status

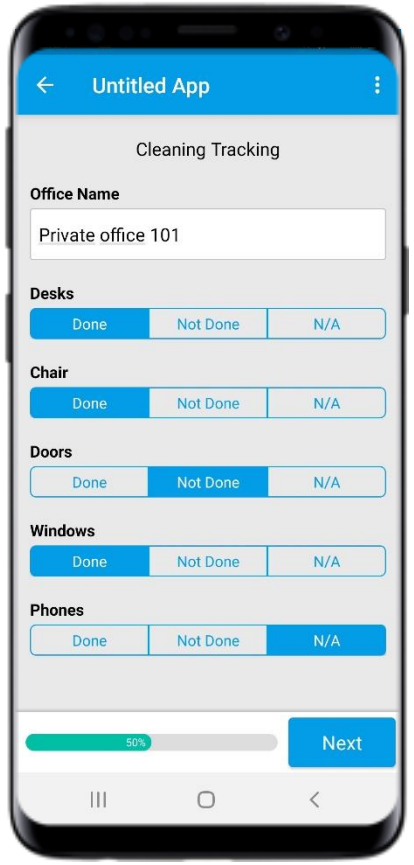
Data Collection



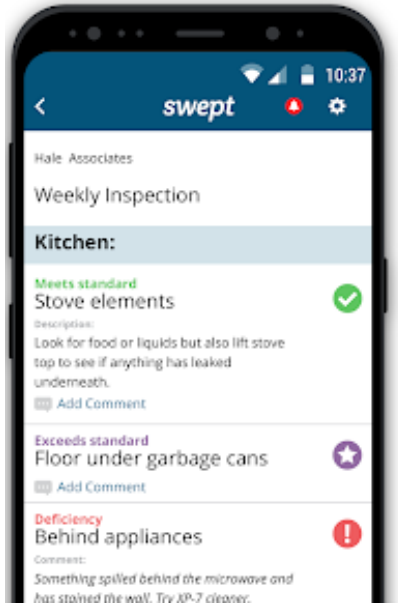
Fulcrum



TORK EasyCube



gocanvas



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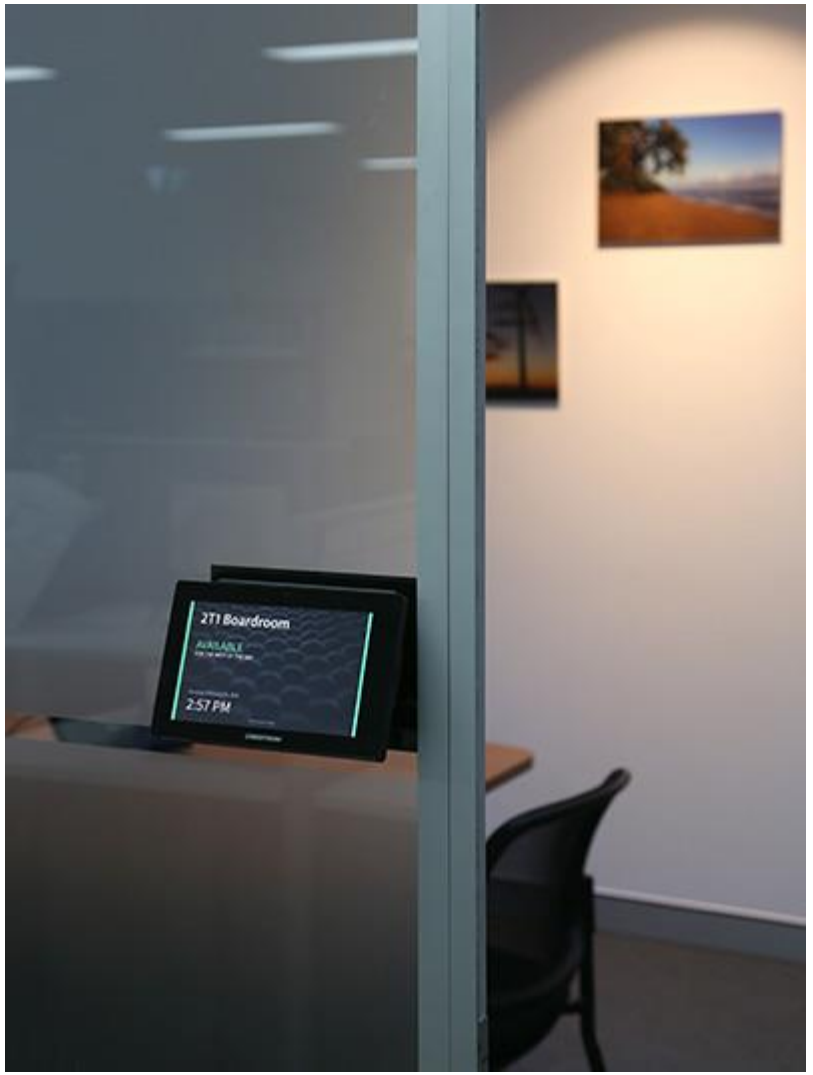
Data Display

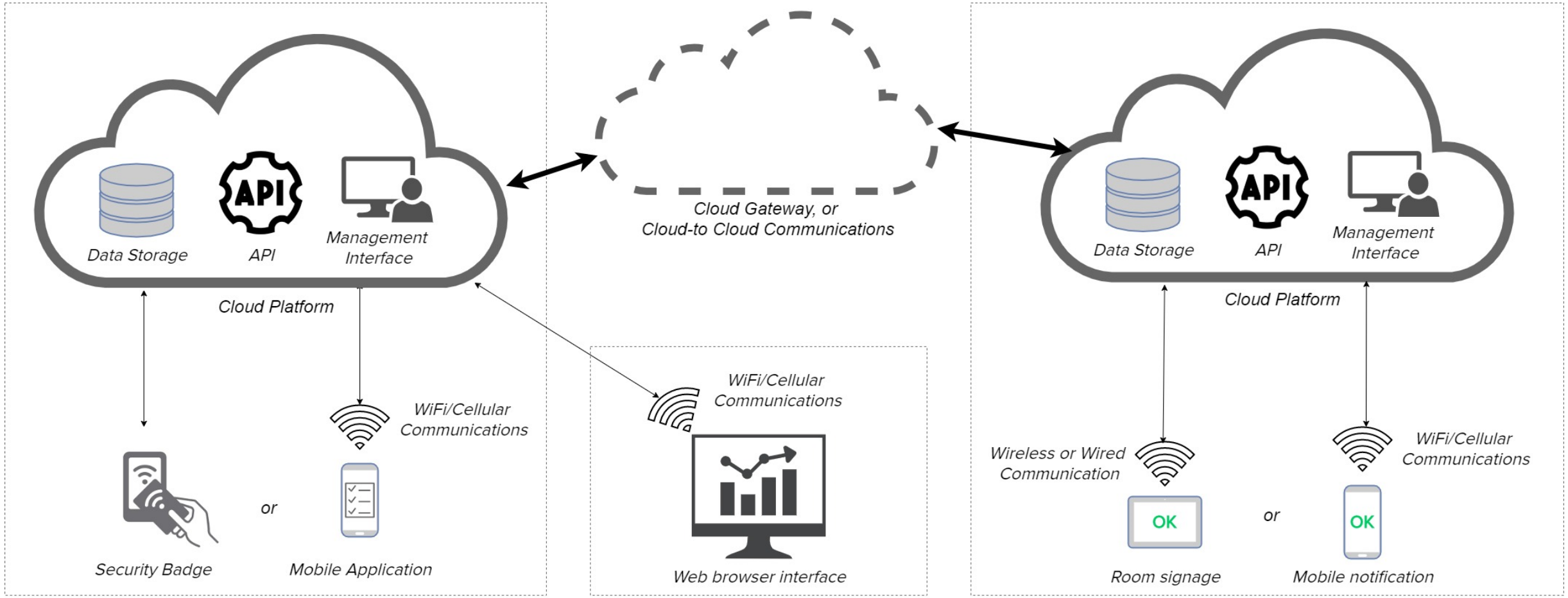
embrava.

visix



CRESTRON

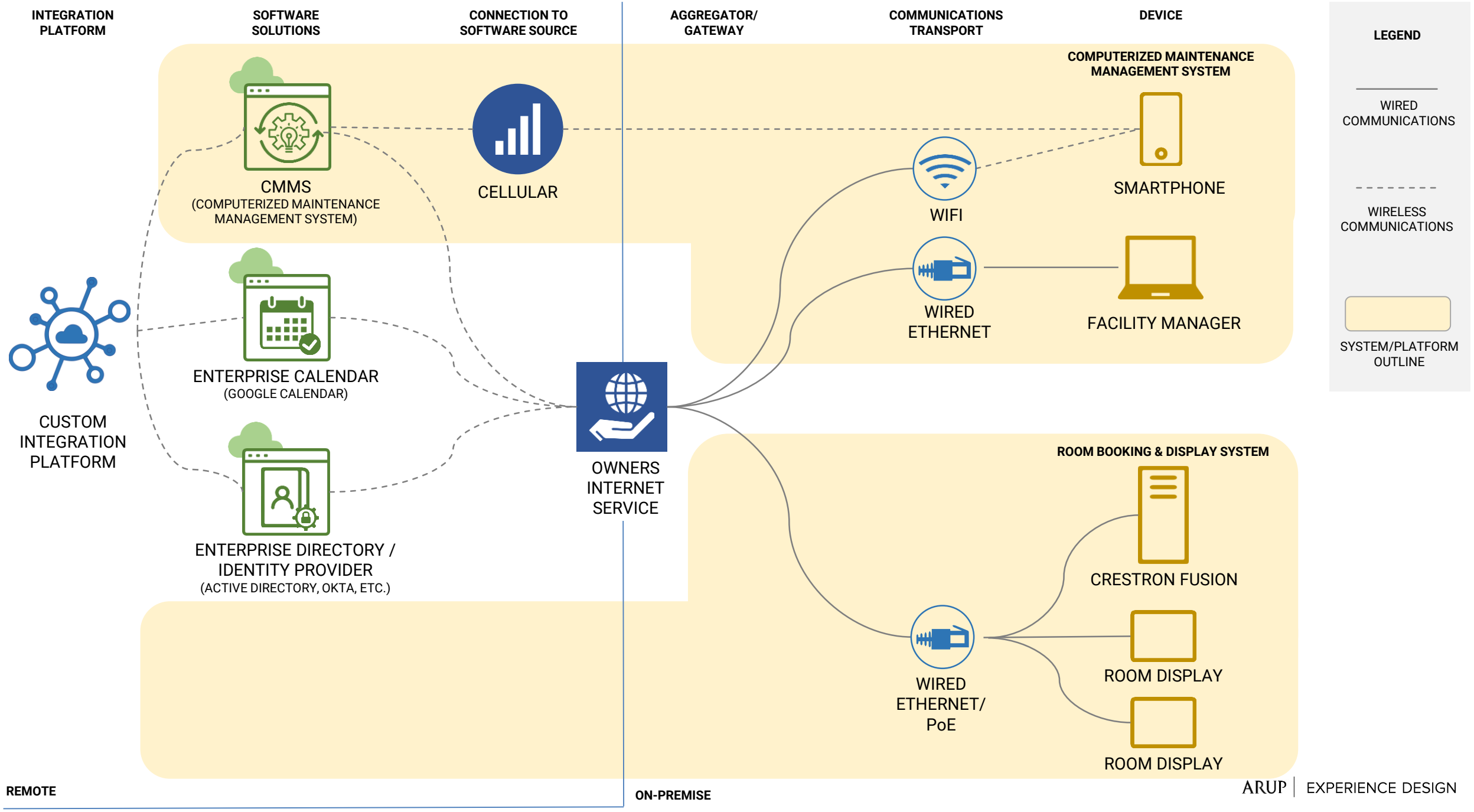
Technical Architecture



Data Collection

Data Analysis

Data Display & Communication


INTEGRATION PLATFORM
SOFTWARE SOLUTIONS
CONNECTION TO SOFTWARE SOURCE
AGGREGATOR/ GATEWAY
COMMUNICATIONS TRANSPORT
DEVICE
LEGEND
WIRED COMMUNICATIONS
WIRELESS COMMUNICATIONS
SYSTEM/PLATFORM OUTLINE
COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM
CMMS
(COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM)
CELLULAR
WIFI
SMARTPHONE
WIRED ETHERNET
FACILITY MANAGER
ENTERPRISE CALENDAR
(GOOGLE CALENDAR)
CUSTOM INTEGRATION PLATFORM
OWNERS INTERNET SERVICE
ENTERPRISE DIRECTORY / IDENTITY PROVIDER
(ACTIVE DIRECTORY, OKTA, ETC.)
ROOM BOOKING & DISPLAY SYSTEM
CRESTRON FUSION
WIRED ETHERNET/ PoE
ROOM DISPLAY
ROOM DISPLAY
REMOTE
ON-PREMISE
ARUP | EXPERIENCE DESIGN

Cleaning Status: Value Proposition

Employees will expect **more frequent communications** about cleaning protocols

This system, because of its transparency, **builds confidence** in the return to workplace.

Make the Experience Positive

Technology-enabled environments that signal their health will:

- Help people feel **better informed** in their decisions
- Make people feel cared for and **anticipated**
- **Build trust** in the return to daily life

Digital twins and enhancing building performance

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Defining a digital twin

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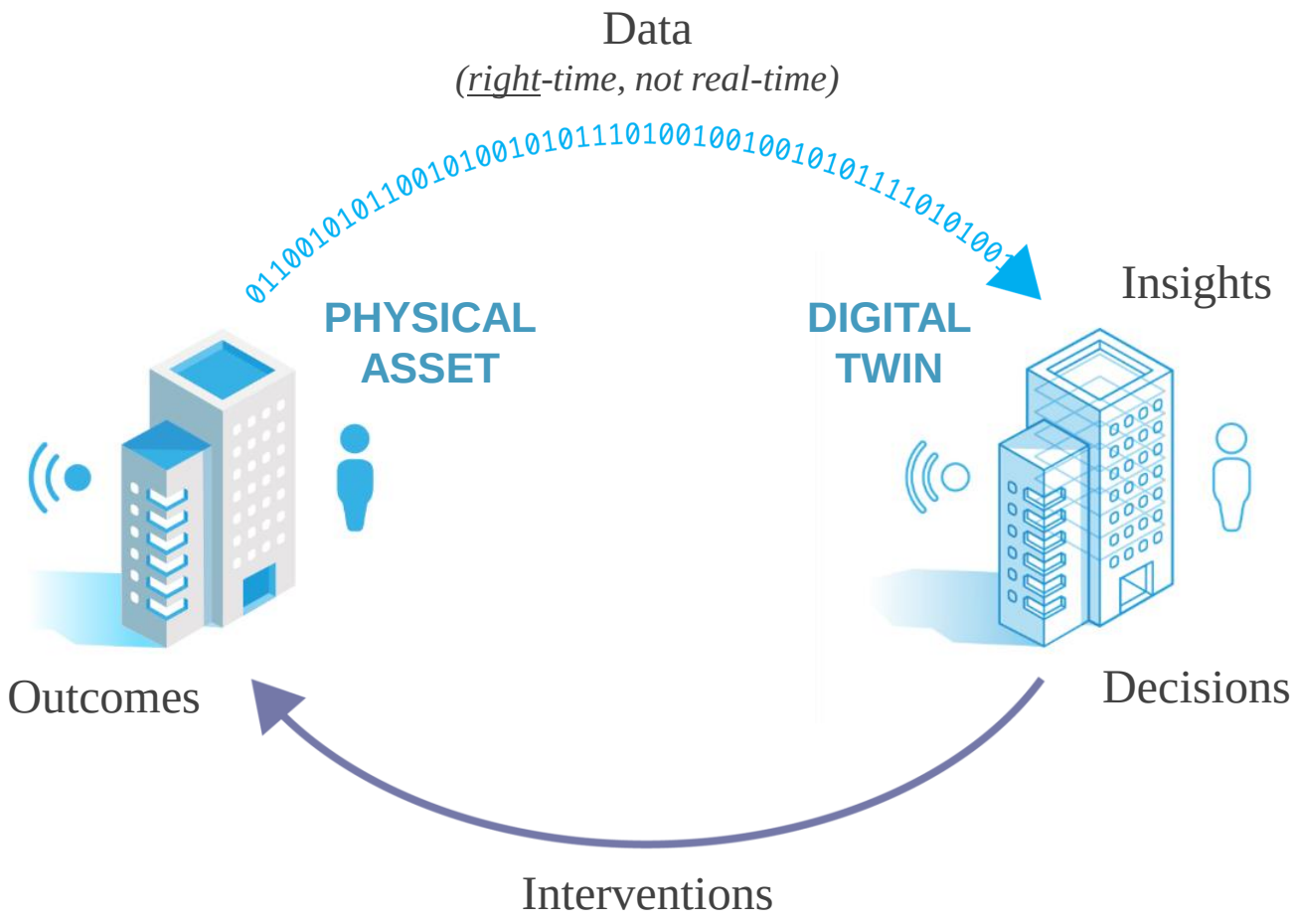
> A realistic digital representation of assets, processes or systems in the built or natural environment, at a level of accuracy or detail that is suited to its purpose or use-case
>
> What distinguishes a twin from any other digital model or replica is a **connection** or **relationship** between the physical and digital.



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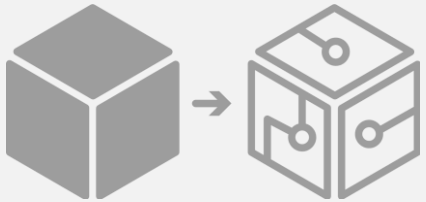
Activities– combining Arup's engineering & design strength with advanced digital expertise

ASSESSMENT & ROADMAP

- Digital twin approach strategy & roadmap
- User-centred design & research
- Solution architecture & assurance
- Data strategy (inc inventory, governance, mgmt & exploitation)



CREATE BASELINE DIGITAL TWIN

- Remote sensing, drones & photogrammetry
- Asset & data creation
- Immersive experiences & visualisations
- IoT, connected sensors, 5G & Edge computing
- Technology integration & management

MANAGE & MAINTAIN TWIN

- AI & machine learning
- Data analytics & insights
- Technology management
- Integrated asset & data planning & management
- Operational readiness
- Digital fabrication
- Advanced engineering

DEVELOP MATURITY

- Digital & data maturity assessment
- Business & investment case development
- Programme management
- Technology due diligence
- Organisational change

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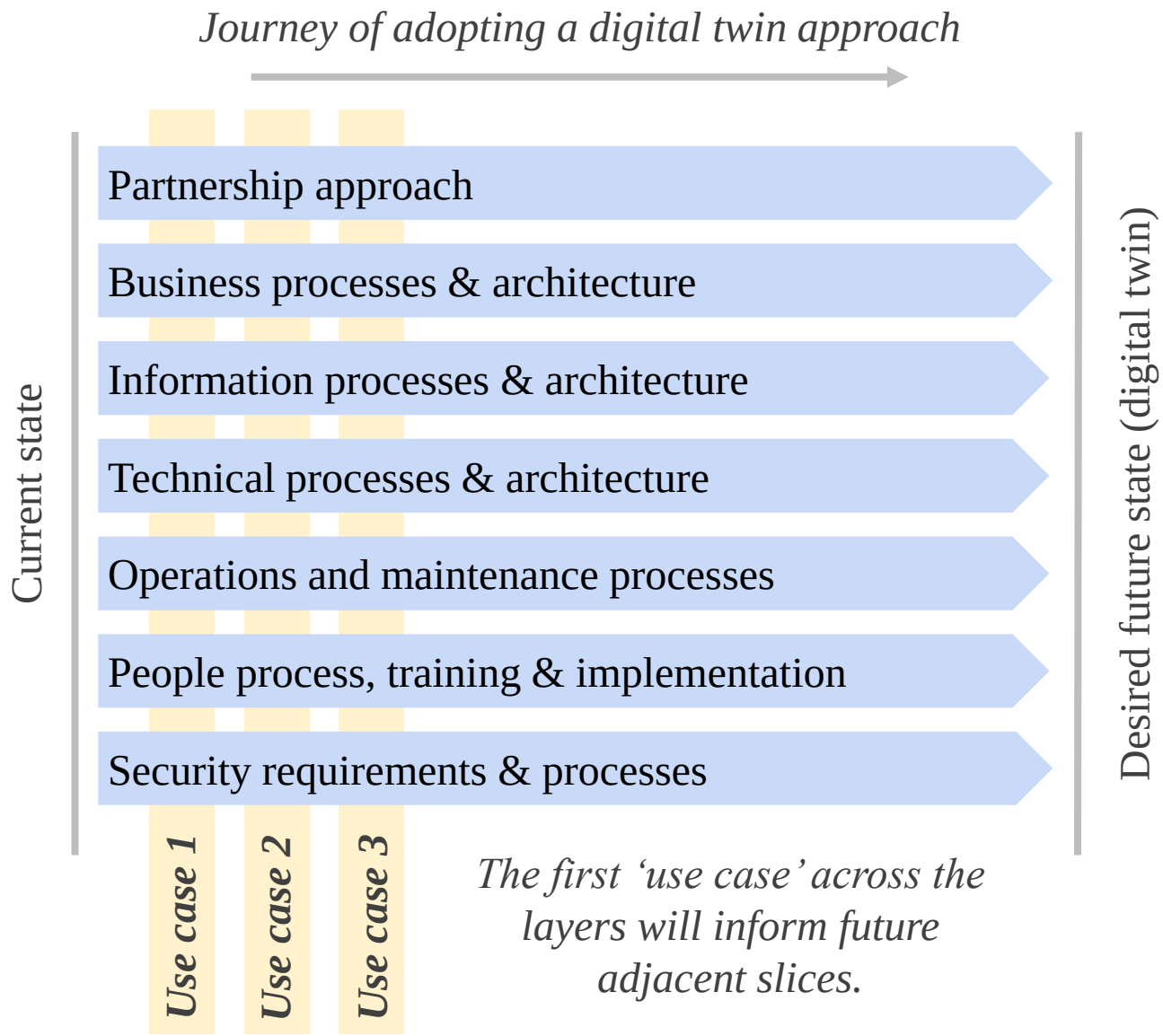
“Thin slice” approach



ADVANCED DIGITAL ENGINEERING

Neuron Smart Building Digital Platform

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Empowering data-driven building energy management & optimisation through AI/BIM

CHALLENGE

- 90% of a building's total electricity consumption in Hong Kong is through HVAC
- Accurate energy usage forecasts and optimised control of HVAC systems critical energy saving

SOLUTION

- Intuitive and fully customisable visualisation tool that enhances buildings' energy savings and efficiency, optimises operational workflows
- Use AI & big data technology to analyse **right-time** building data and provide performance insights

OUTCOME

- Building performance predicted and optimised through applying machine learning to historical data
- BMS adjust automatically to achieve better performance efficiencies and realise cost savings

Up to **30%**

Saving of energy consumption in a typical existing commercial building

ADVANCED DIGITAL ENGINEERING

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County Hall, The Hague, Dutch Government

Achieving carbon neutral buildings through adopting a digital twin approach

CHALLENGE

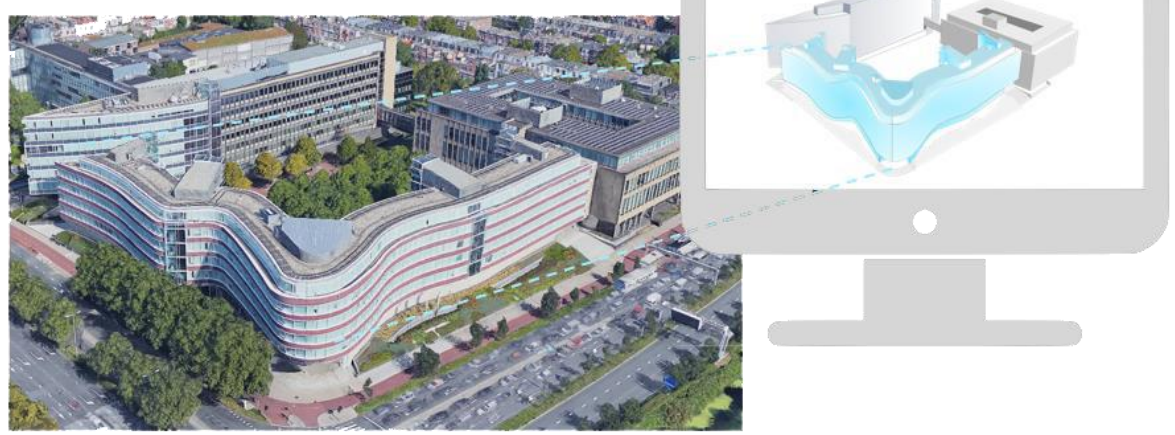
- Improve the County Hall comfort, energy efficiency and space utilization, making the building carbon neutral to help meet 2040 carbon reduction targets.

SOLUTION

- Data extraction of over 30,000 data points from the existing Building Management System, and
- Deployment of specifically tailored IoT sensors to measure user interaction
- 3D scanning to create baseline digital, which is connected to a detailed simulation model that uses extracted data points to optimise building efficiency

OUTCOME

- Two fold strategy to optimise the current functioning of the building, while renovating, uplifting and transitioning where necessary.



ADVANCED DIGITAL ENGINEERING

Queensferry crossing: inspection and maintenance

A cloud-based asset management system, closely monitoring condition and performance of the bridge

CHALLENGE

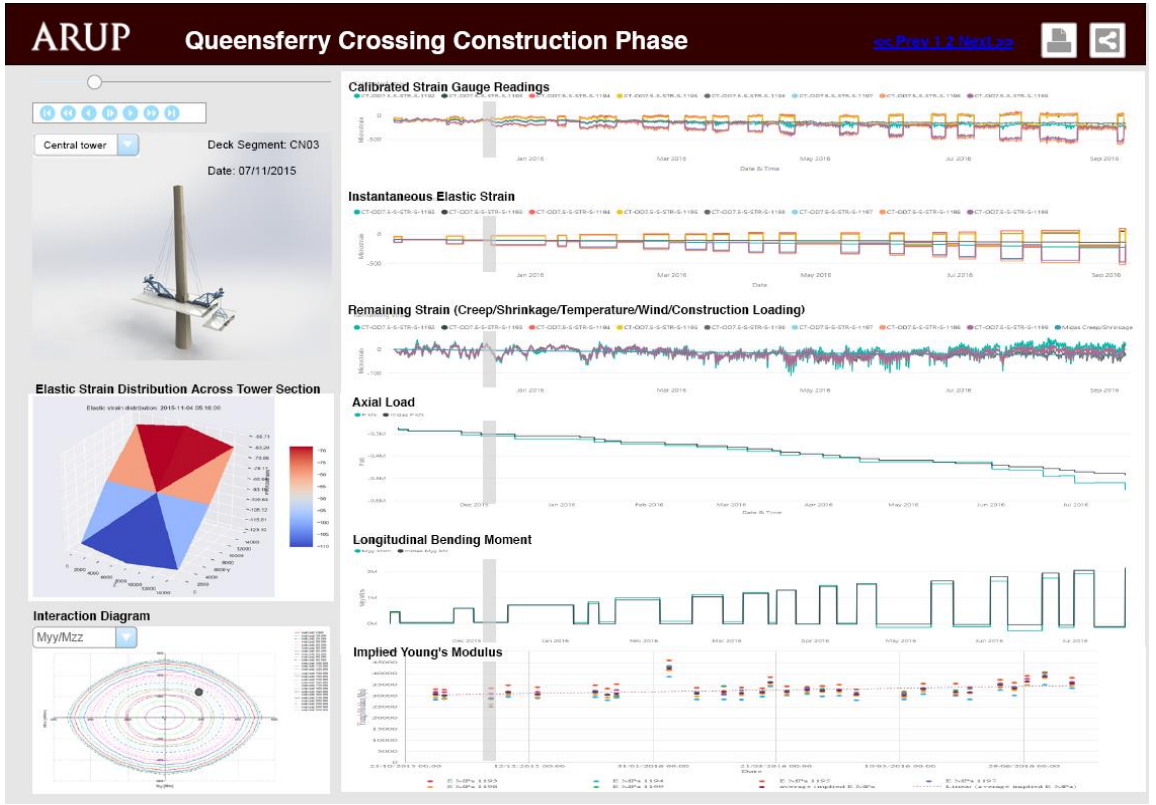
- Economical maintenance of the new Queensferry Crossing over its 120-year design life

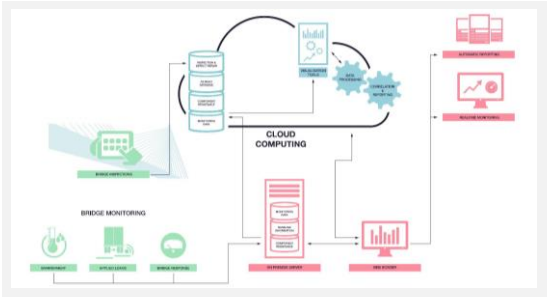
SOLUTION

- Digital asset management system, prioritised inspection regimes and structural health monitoring to track performance.
- Refined asset tagging and defect location system.
- Systematic storage, processing & reporting of inspection/monitoring data.

OUTCOME

- Cloud computing dramatically reduces storage costs, allowed integrated working (inspectors, QA, engineers)
- Standardisation and automatic generation of reports





ARUP

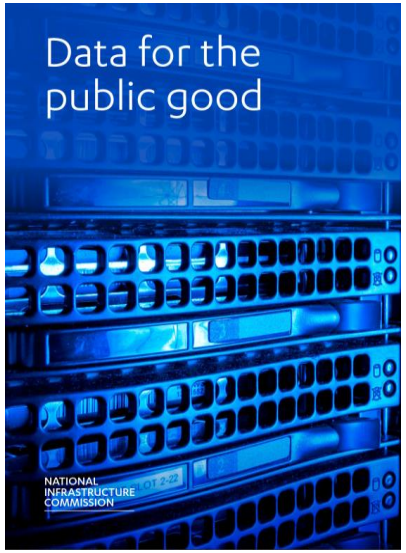
Ecosystem of connected digital twins

DATA

Visibility

Interoperability

Centre for Digital Built Britain



A National Digital Twin

to enable better outcomes from our built environment

An Information Management Framework

to enable secure data sharing and effective information management

ARUP

Systems-based view of the built environment (including energy infrastructure)

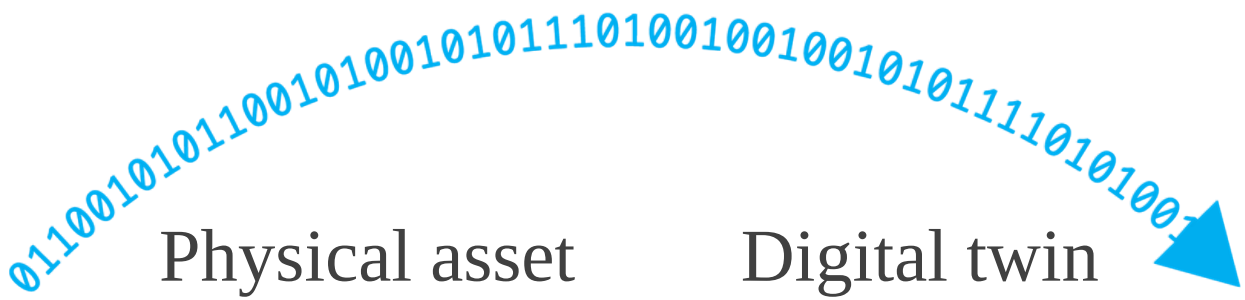
- System of systems
- System of services
- Cyber-physical system
- Sustainable system

Image credits CDBB

The National Digital Twin

ARUP

Data

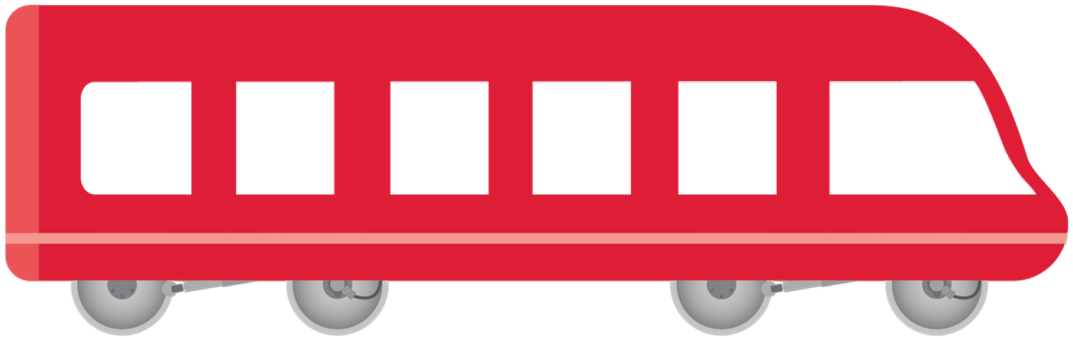


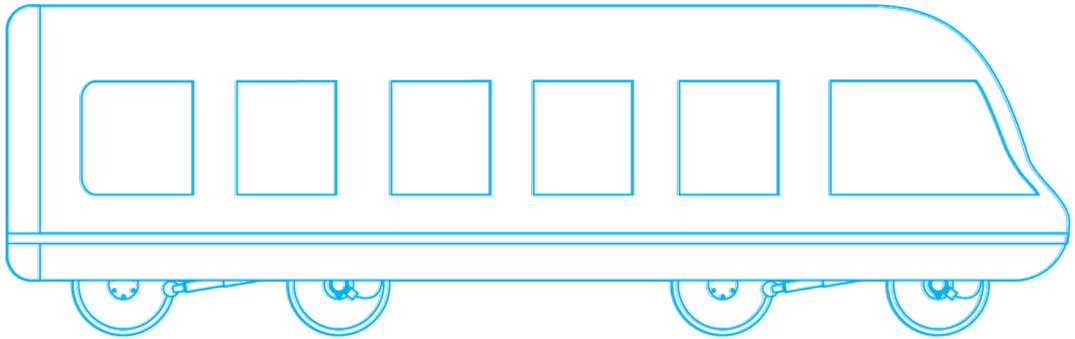
Outcomes

Physical asset

Digital twin

Insights





Decisions

Interventions

Image credits CDBB

ADVANCED DIGITAL ENGINEERING

The National Digital Twin

ARUP

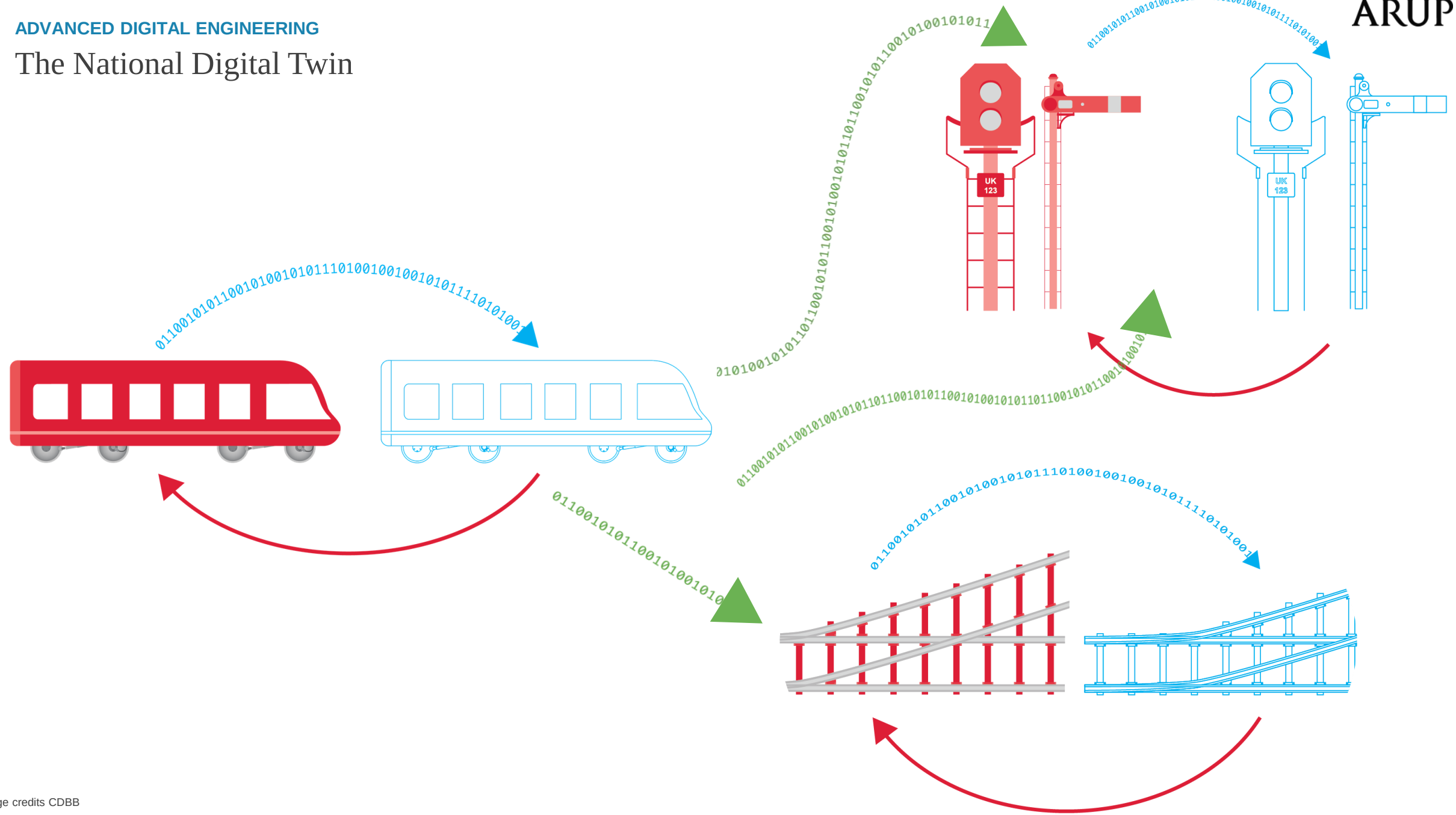
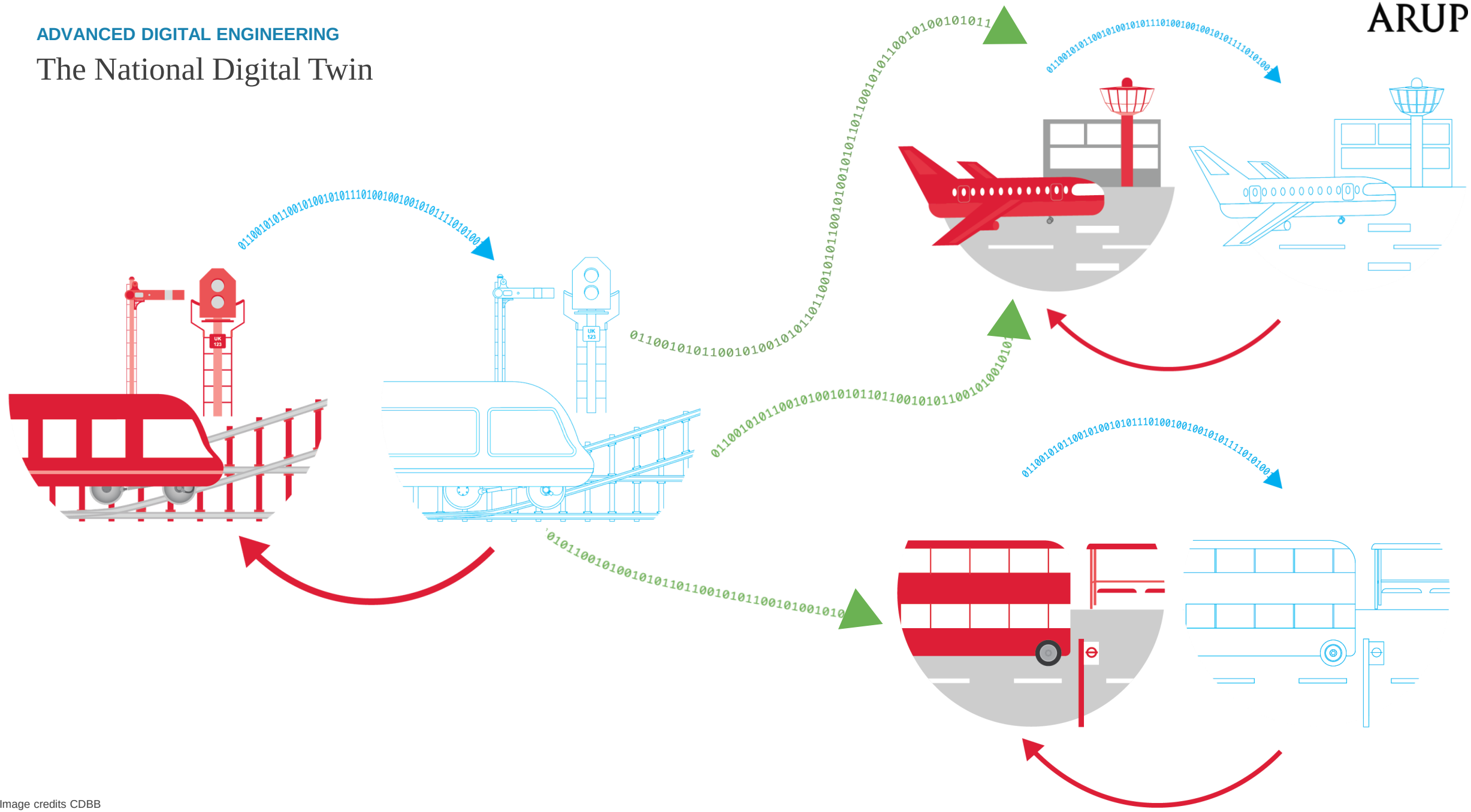


Image credits CDBB

ADVANCED DIGITAL ENGINEERING

The National Digital Twin

ARUP



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ADVANCED DIGITAL ENGINEERING

The National Digital Twin

ARUP

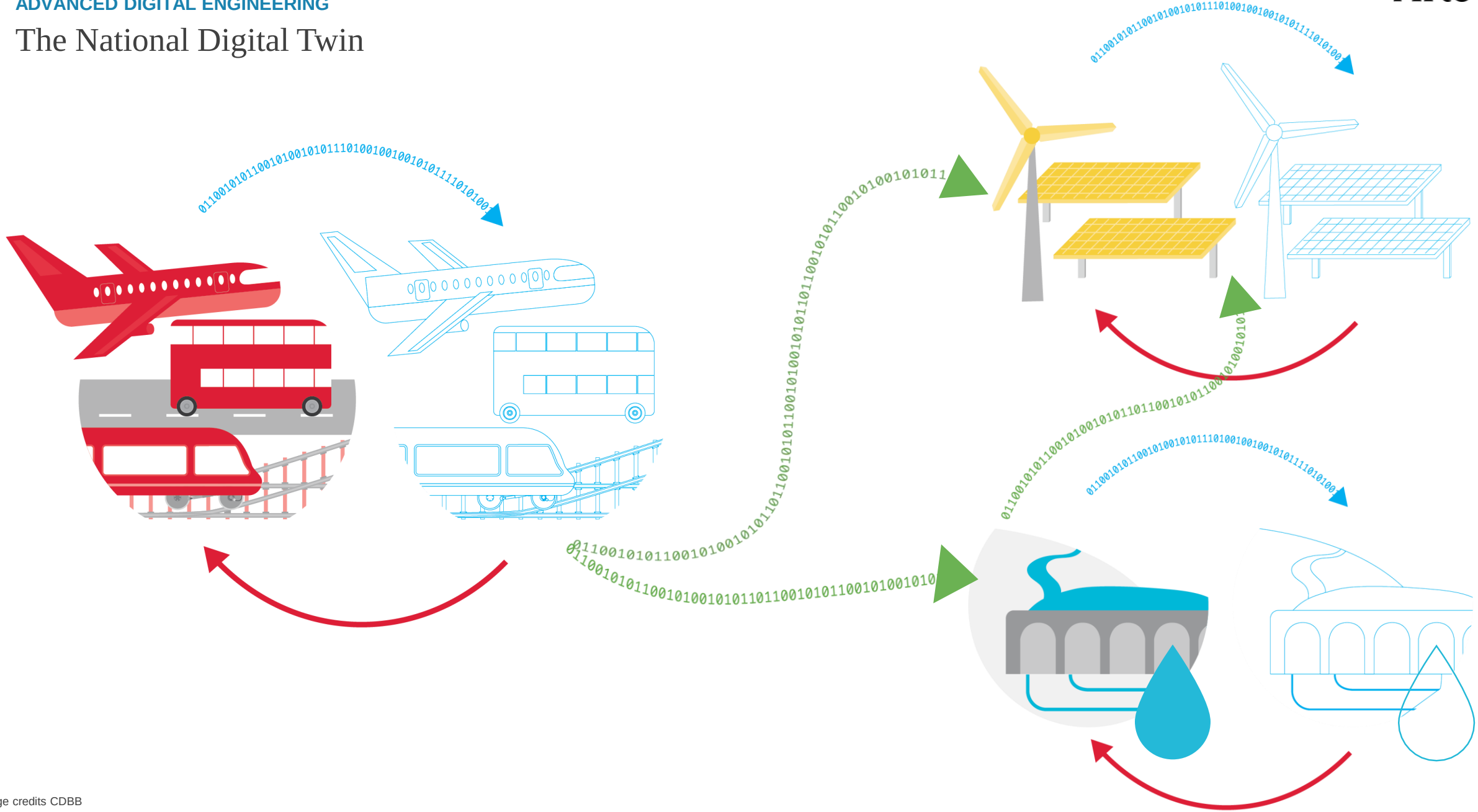
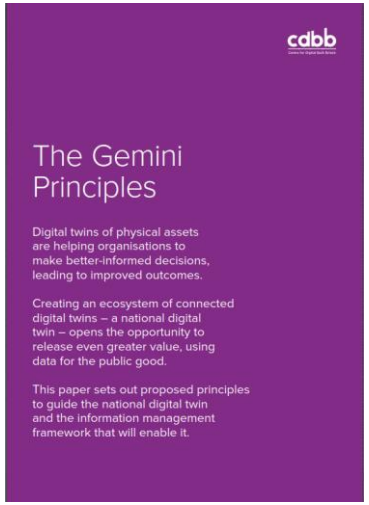


Image credits CDBB

ARUP

The Gemini Principles

- Arup is fully committed to the **Gemini Principles**
- When adopting and implementing a digital twin approach



Purpose: Must have clear purpose	**Public good** Must be used to deliver genuine public benefit in perpetuity	**Value creation** Must enable value creation and performance improvement	**Insight** Must provide determinable insight into the built environment
Trust: Must be trustworthy	**Security** Must enable security and be secure itself	**Openness** Must be as open as possible	**Quality** Must be built on data of an appropriate quality
Function: Must function effectively	**Federation** Must be based on a standard connective environment	**Curation** Must have clear ownership, governance and regulation	**Evolution** Must be able to adapt as technology and society evolve