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SMART BUILDINGS DON'T EXIST WITHOUT DATA & ANALYTICS

Filip Ponulak, PhD
Director of Data Science, Site 1001
www.site1001.com

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ABOUT SITE 1001

Site 1001 is a data and analytics platform for smart buildings

We take regular buildings and convert them into intelligent buildings

SKYLIGHT PLATFORM

- Occupant health/comfort
- Facility management
- Asset/doc. management
- Risk management
- .....

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SMART BUILDINGS

Definition & Value Proposition

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- Buildings equipped with technology and processes used to create indoor environments that are:
  - safe,
  - healthy,
  - comfortable,
  - enable productivity
  - and well-being for its occupants.

- The technology and processes are also used to:
  - optimize building operations,
  - reduce costs / waste and improve sustainability

https://facilityexecutive.com/2016/09/smart-buildings-the-people-inside/

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SO WHAT ABOUT THESE

DATA & ANALYTICS?

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ANALYTICS IS ALWAYS ABOUT ANSWERING SPECIFIC QUESTIONS …

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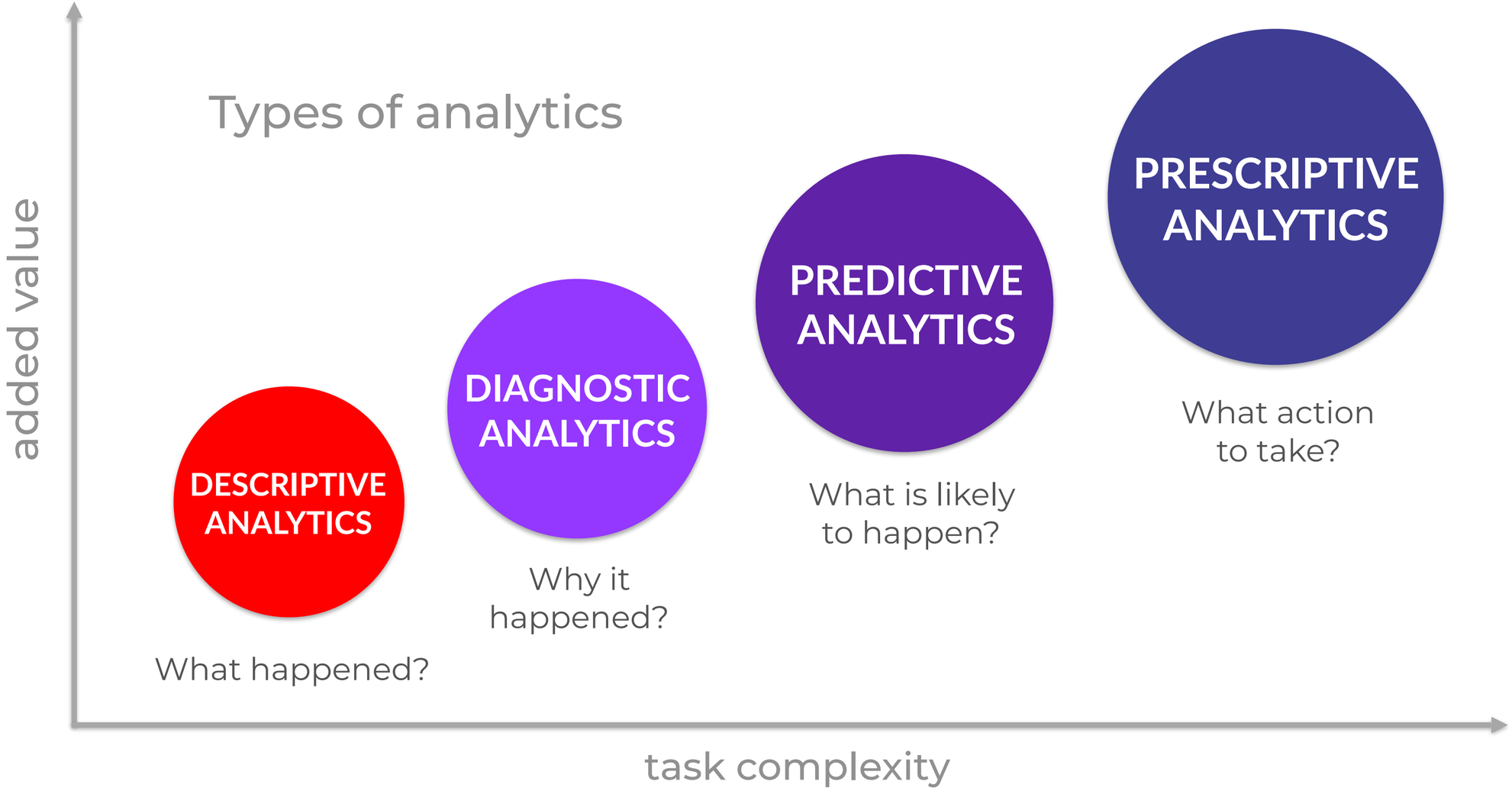

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ANALYTICS IS ALWAYS ABOUT ANSWERING SPECIFIC QUESTIONS …

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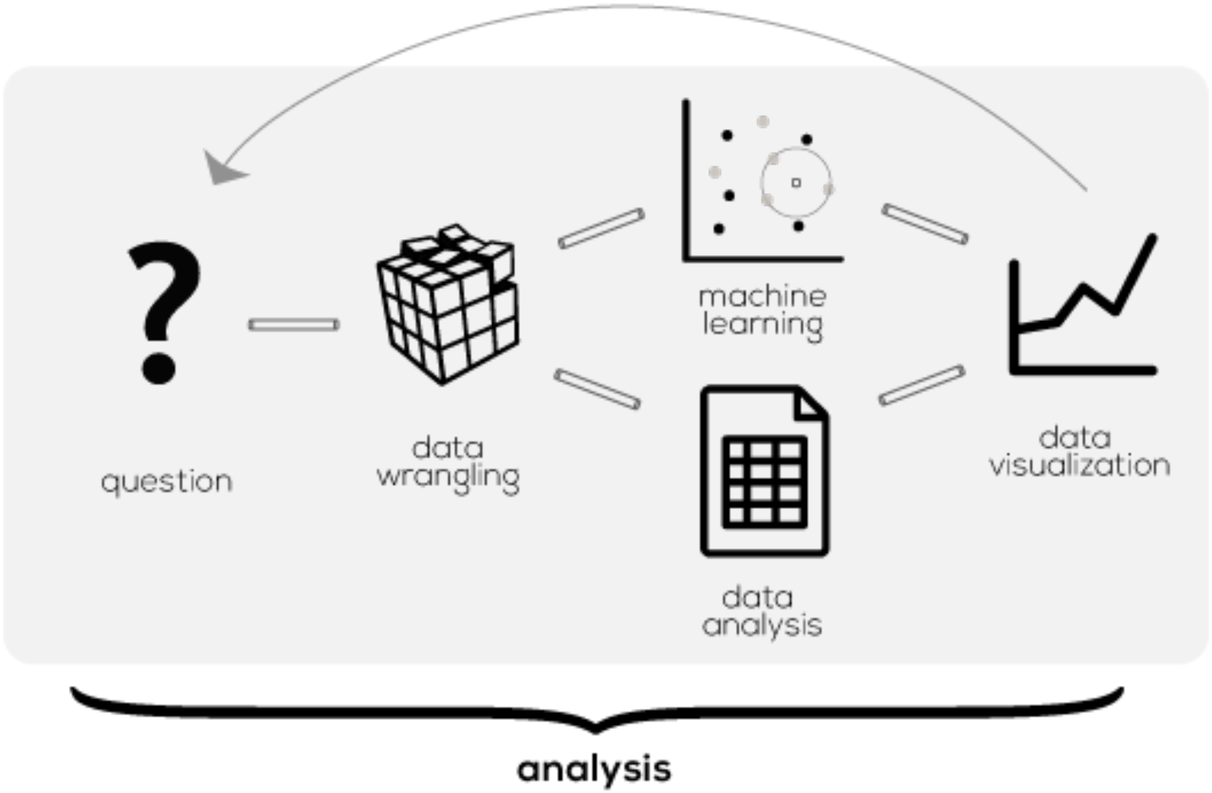
Questions about buildings:

- Is building performing optimally?
- Are resources used efficiently (e.g. energy, space, assets)
- How to improve occupant comfort or productivity?
- …..



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DATA ANALYTICS PIPELINE

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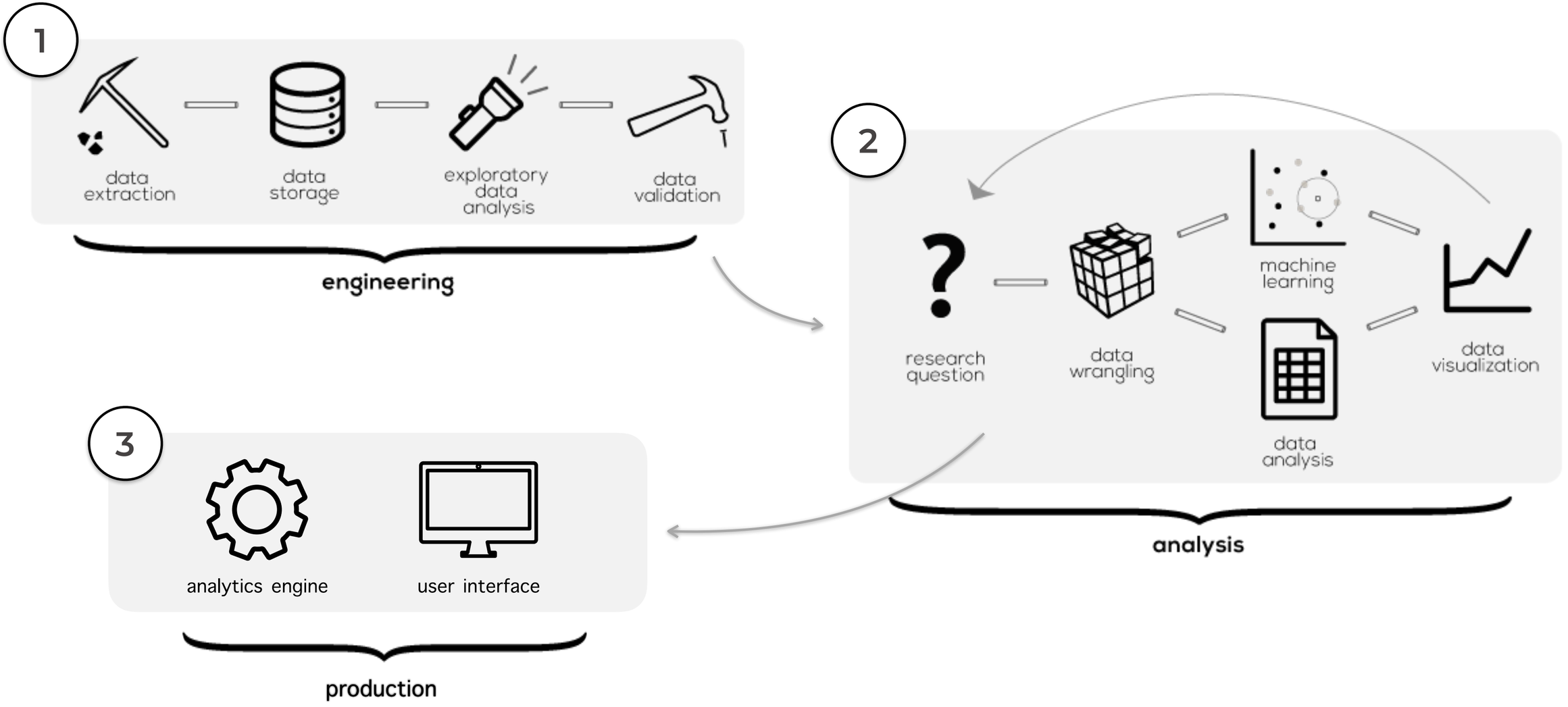
Typical process / steps



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DATA SOURCES FOR SMART BUILDINGS

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BUILDING & ASSET INFORMATION

SENSORY DATA (BMS, IoT)

WORK ORDERS

3RD PARTY DATA SOURCES

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A PRACTICAL
EXAMPLE

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ASSET MANAGEMENT

Capturing granular asset details

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Home | BMS | Locations | Assets | Work Orders | Inventory | Reports | Admin | System

ASSETS | Edit | Add New Asset | Add Work Order | More

Asset: A-135

Details | Work Orders 0 | Custom 0 | Monitors 0

Name	A-135
Serial Number	[None]
Warranty Status	Out of Warranty
Quantity	1
Installed Date	[None]
Notes	[None]
Warranty Length	365
Warranty Days Remaining	0
SpecSheet	

Asset Groups HQ Lighting

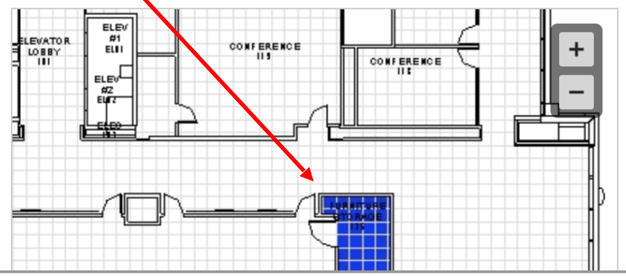
Asset Type

Category	Light Fixture
Code	A
Make	Williams
Model	Series 81, 8'

View full Asset Type details

Location

Building	KC HQ
Area	LEVEL 1
Room	135 FURNITURE STORAGE



Home | BMS | Locations | Assets | Work

ASSET TYPES

Asset Type: Light Fixture - (A) - Series 81, 8'

Details | Parts List 1 | Vendor | Subcontractor

Make	Williams
Model	Series 81, 8'
Category	Light Fixture
Description	4 bulbs
Notes	[None]
Warranty (Days)	365
Expected Life (yrs.)	5
Replacement Cost	$95.00
Spec Sheet	

Home | BMS | Locations | Assets | Work

ASSET TYPES

Asset Type: Light Fixture - (A) - Series 81, 8

Details | Parts List 1 | Vendor | Subcontractor

Name	Mark One Electric
Web Site	www.markone.com
Trade	[None]
Client ID	[None]
Email	[None]
Phone	816-842-7023
Fax	816-842-8955
Address	909 Troost Ave. Kansas City Missouri 64106 Map

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INPUT DATA: BUILDINGS & ASSETS

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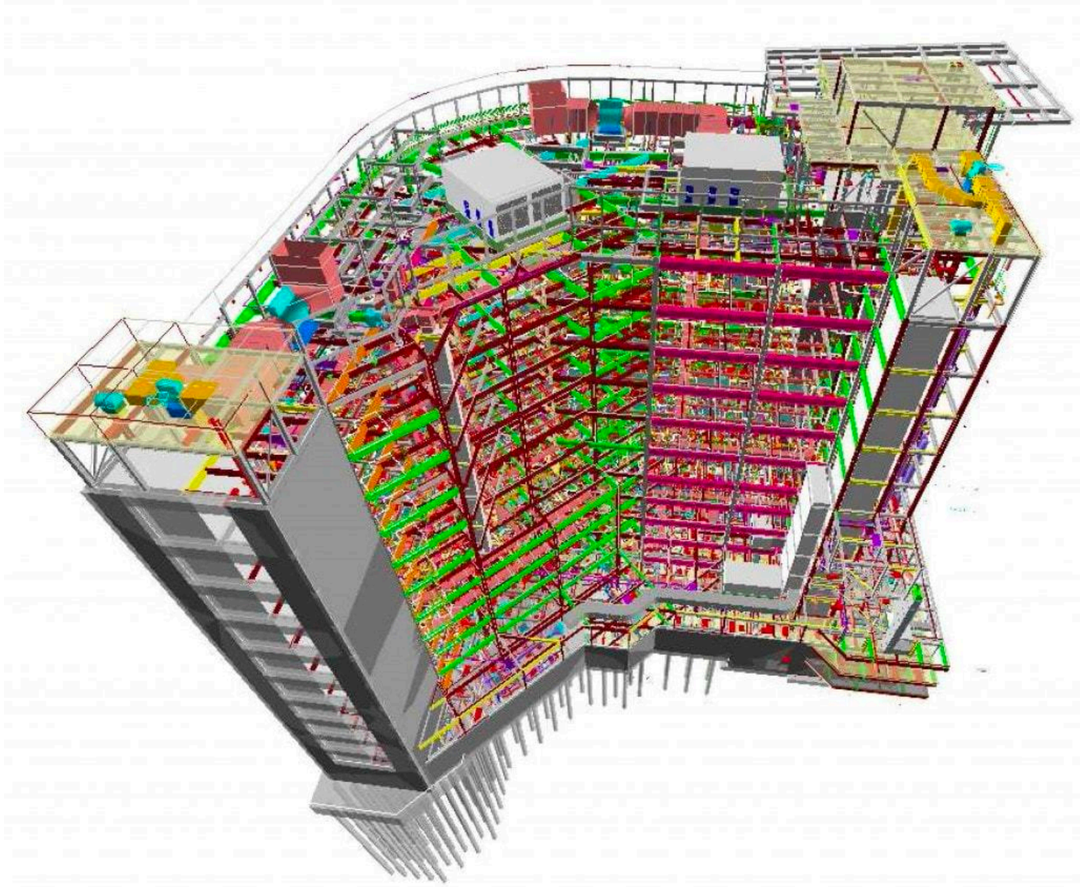
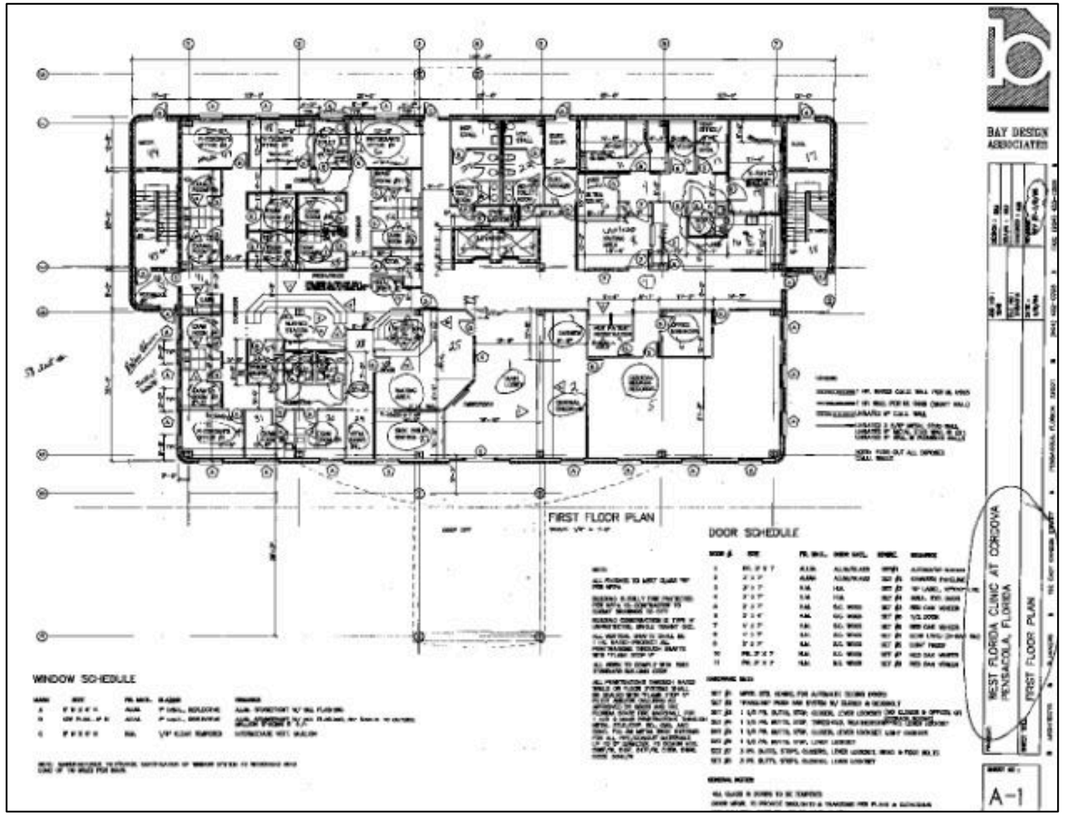
Reality check

New buildings - BIM



The majority of existing buildings



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INPUT DATA: BUILDINGS & ASSETS

Acquiring & organizing data is not trivial

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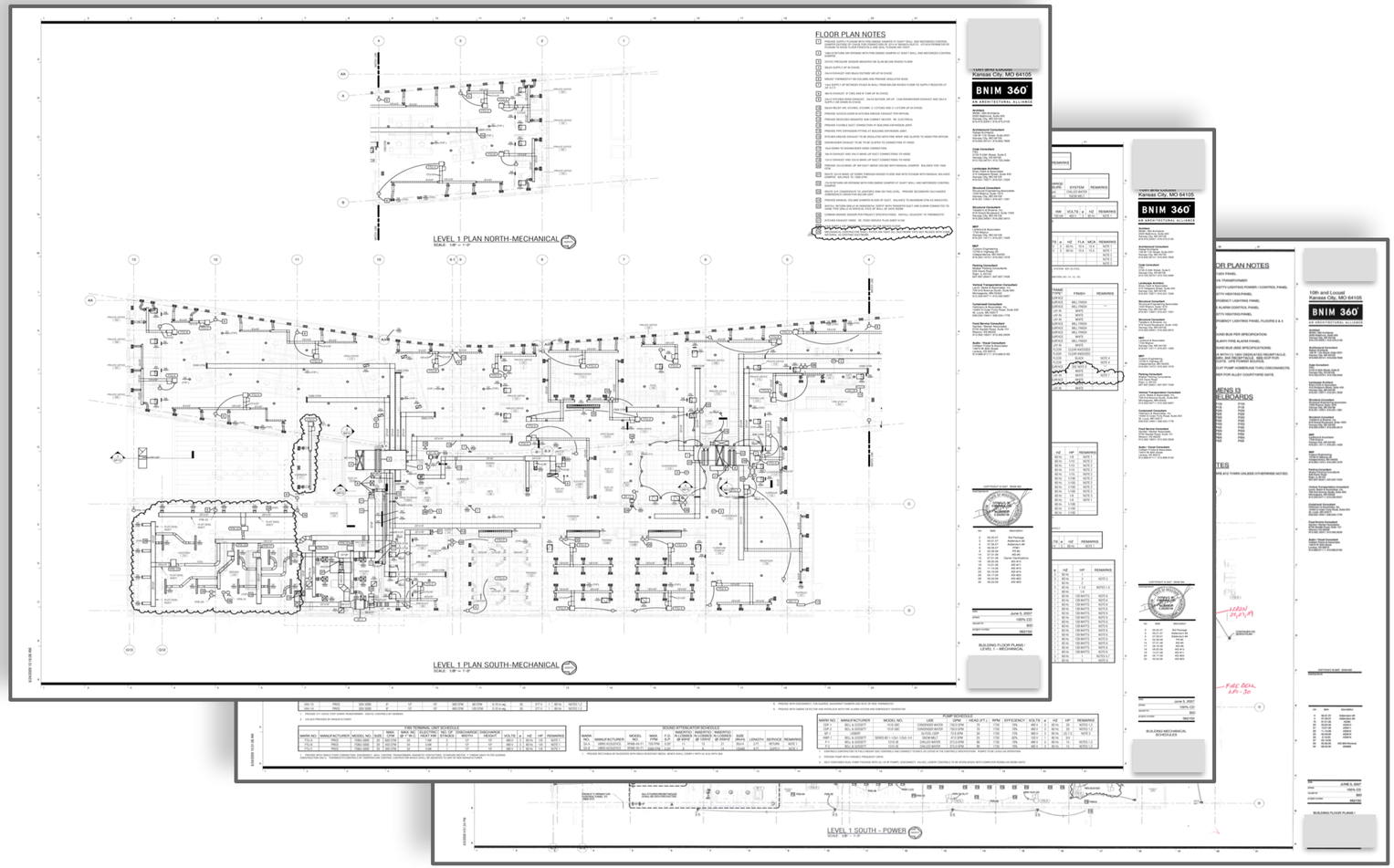
Typical documents from customers:

- single, multipage PDF (often 100s of pages),
- drawings,
- schedules,
- annotations (handwritten)



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DATA PROCESSING - STEPS

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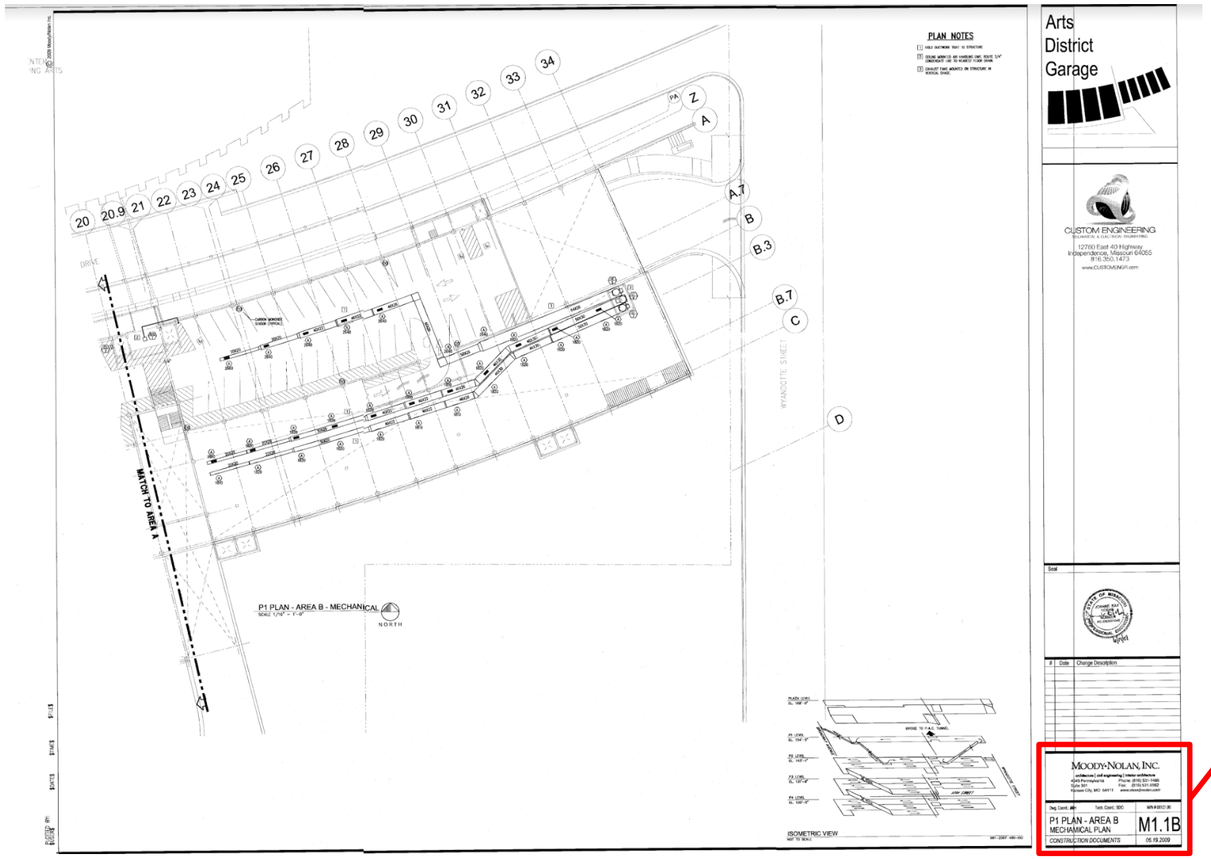
Step 1: Extracting and classifying key information



Automated extraction (OCR)
of page codes and titles

(e.g. with tools like PlanGrid)

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DATA PROCESSING - STEPS

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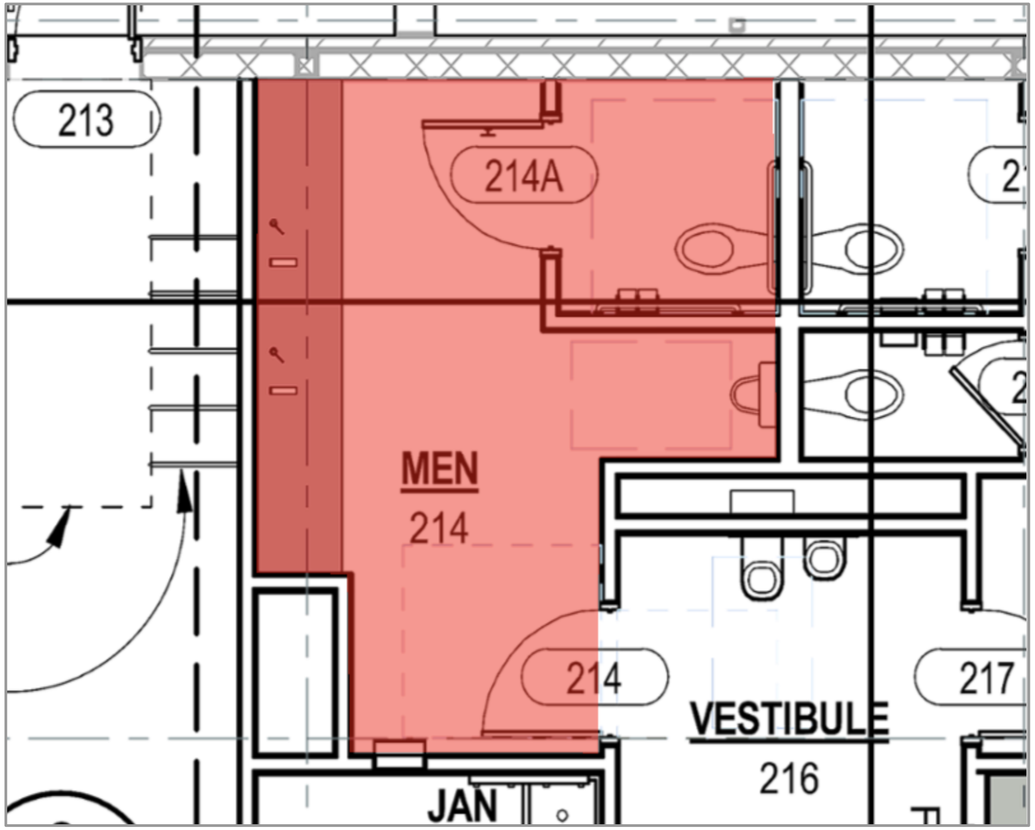
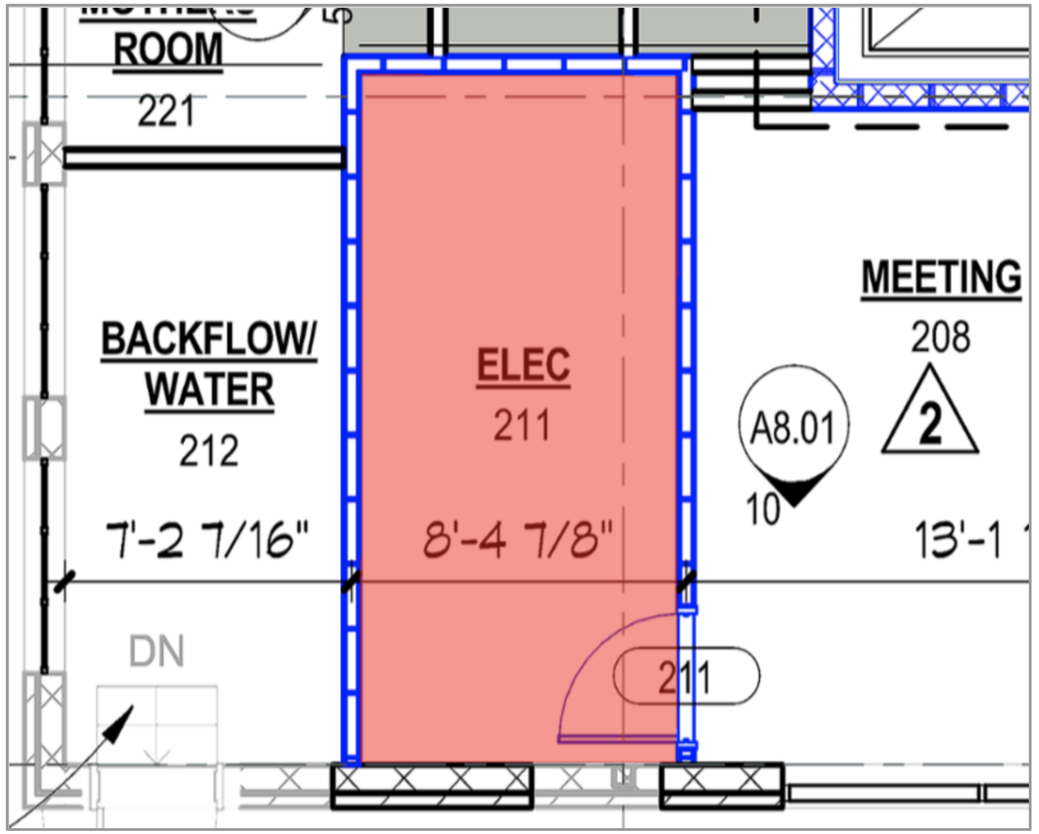
Step 2: Identifying rooms and areas





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DATA PROCESSING - STEPS

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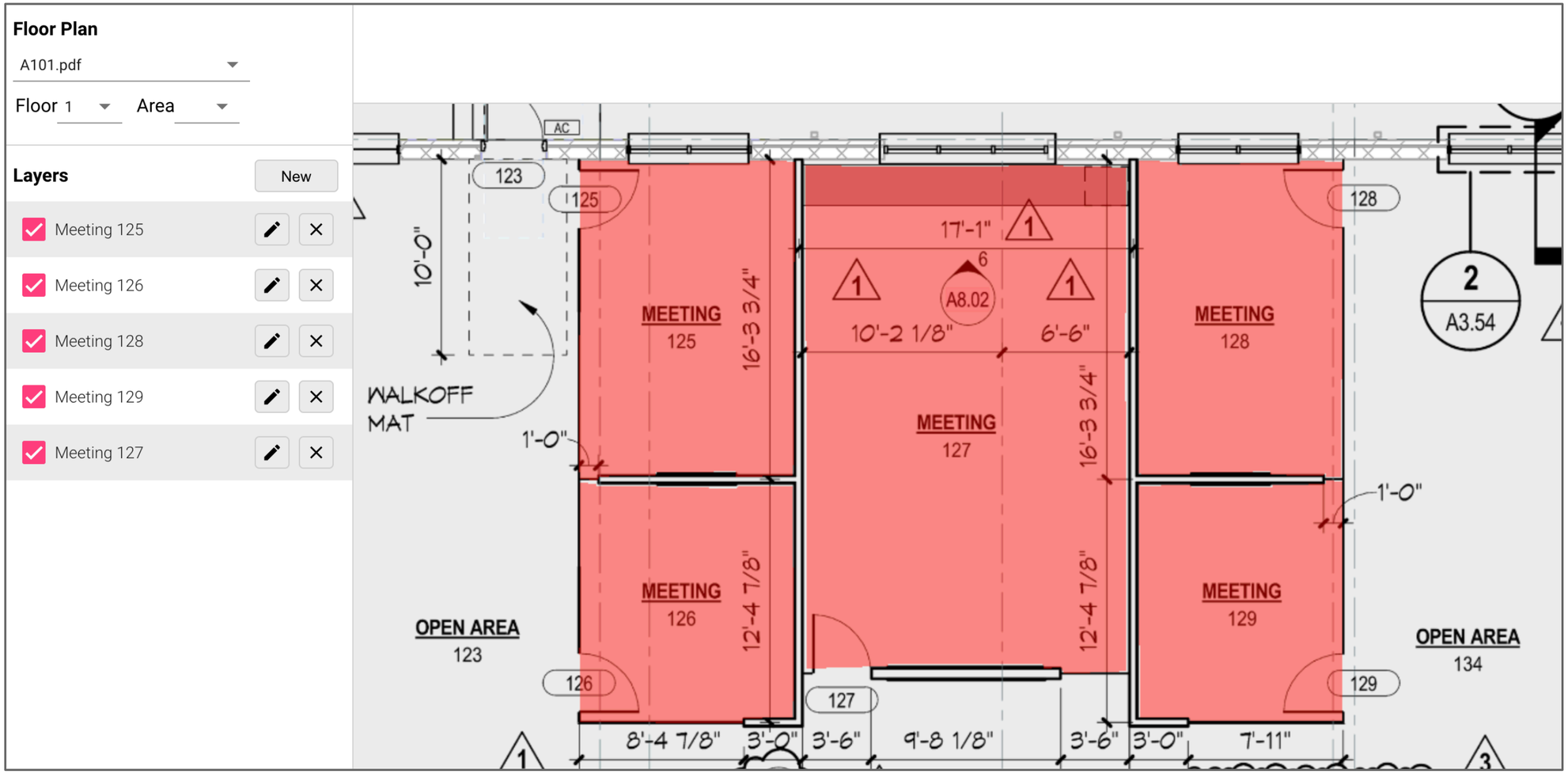
At Site 1001 we are using a proprietary tool to define rooms and areas



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DATA PROCESSING - STEPS

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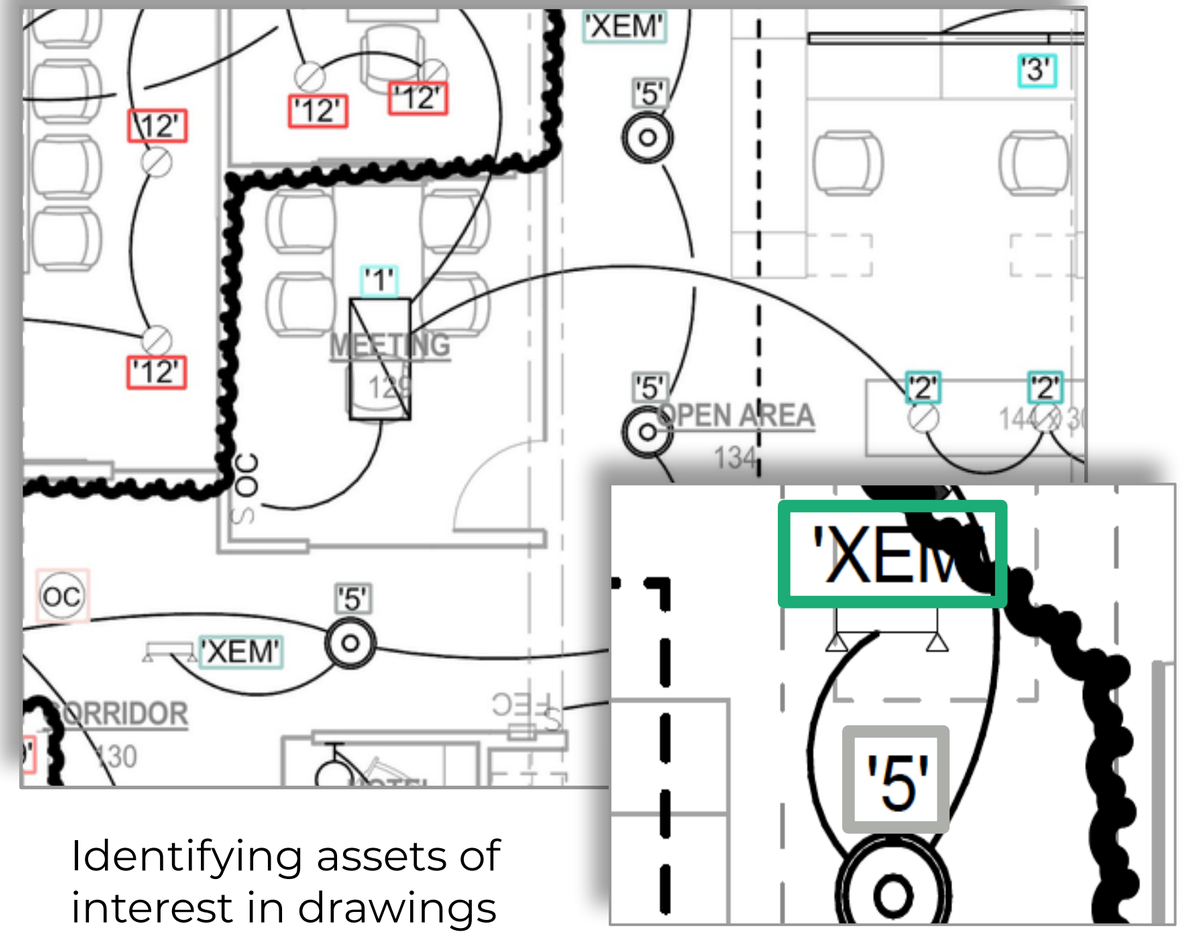
Identifying and localizing assets

Lighting Fixture Schedule

Type	Manufacturer	Model	Lamp	Description
1	WILLIAMS	LT-24-L52/835-AF-DIM-UNV	37W LED	RECESSED 2'x4'
2	GREEN CREATIVE	97763-12DL4DIM/930	12W LED	RECESSED DOWNLIGHT
3	WILLIAMS	LLM-XX-L41/835-X-SQ-DIM-UNV, BLACK	33W LED	SUSPENDED LINEAR
4	RESTORATION HARDWARE	MODERN PICTURE LIGHT - 24" SCONCE - POLISHED NICKEL	9W LED	LIGHT SCONCE
5	HI-LITE MFG	H-16114-91/X-91/XX-91/XX-X-120V	14W LED	PENDANT
6	HI-LITE MFG	H-15116-91-B-1-91-SGU-CLR-DCC,BLACK	14W LED	SURFACE
7	RESTORATION HARDWARE	20TH C. TORPEDO SCONCE-AGED STEEL	9W LED	LIGHT SCONCE
8	HI-LITE MFG	H-16008-91-ALUM606-91CORD	14W LED	PENDANT IN MEETING
9	RESTORATION HARDWARE	VARICK CHANDELIER-54" PENDANT - VINTAGE BRONZE	9W LED	PENDANT
10	RESTORATION HARDWARE	VARICK CHANDELIER-31" PENDANT - POLISHED BRONZE	9W LED	LOUNGE PENDANT
11	GREEN CREATIVE	58029-11.6DLNC6DIM/830	11.6W LED	SHOWER DOWNLIGHT
12	GREEN CREATIVE	58029-11.6DLNC6DIM/830	11.6W LED	RECESSED DOWNLIGHT
13	HE WILLIAMS	76-4-L53-DRV-UNV	28W LED	4' STRIP FIXTURE
14	LUMINII	LL18-35K-X-X-XX	1.5W LED	TAPE LIGHT
15	HE WILLIAMS	96-2-L29-HIAFR-DRV-UNV	27W LED	PIT LIGHT
16	V2 LIGHTING	Q3LU-RN1W-XX35X-XX35X-BLK	47W LED	EXTERIOR WALLPACK
17	TBD	TBD	LED	LOBBY PENDANT
18	GREEN CREATIVE	58029-11.6DLNC6DIM/830/BLK	11.6W LED	EXTERIOR DOWNLIGHT
19	INTENSE	L1-358-X-B-C-X	13W LED	PENDANT
20	HI-LITE MFG	H-15106-B-91	14W LED	LOCKER ROOM WALL SCONCE
21	ENTERPRISE	DECORATIVE SO SOCKET/BLK	9W LED	CORD PENDANT
22	TBD	TBD	LED	TRACK LIGHT
23	WILLIAMS	LT-22-L52/835-AF-DIM-UNV	37W LED	RECESSED DIMMABLE 2'x2'
A	VISIONAIRE	VMX-TX-64LC-7-4K-AM-XX140 WATTS	140W LED	POLE LIGHT - 2 HEADS
X	BEGHELLI	CRV-SA-LR-X-M-S-AL	LED	EXIT SIGN
XEM	BEGHELLI	PEH-1-X	LED	EMERGENCY LIGHT

Extracting information about assets from schedules



Identifying assets of interest in drawings

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HOW CAN WE USE THE COLLECTED DATA?

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Asset management (location info, asset info at instance level, ...)

Home | BMS | Locations | Assets | Work Orders | Inventory | Reports | Admin | System

ASSETS | Edit | Add New Asset | Add Work Order | More

Asset: A-135

Details | Work Orders 0 | Custom 0 | Monitors 0

Name	A-135
Serial Number	[None]
Warranty Status	Out of Warranty
Quantity	1
Installed Date	[None]
Notes	[None]
Warranty Length	365
Warranty Days Remaining	0
SpecSheet	

Asset Groups HQ Lighting

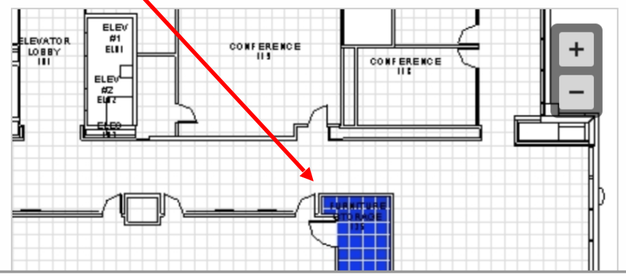
Asset Type

Category	Light Fixture
Code	A
Make	Williams
Model	Series 81, 8'

View full Asset Type details

Location

Building	KC HQ
Area	LEVEL 1
Room	135 FURNITURE STORAGE



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Details | Parts List 1 | Vendor | Subcontractor

Name	Mark One Electric
Web Site	www.markone.com
Trade	[None]
Client ID	[None]
Email	[None]
Phone	816-842-7023
Fax	816-842-8955
Address	909 Troost Ave. Kansas City Missouri 64106 Map

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HOW CAN WE USE THE COLLECTED DATA?

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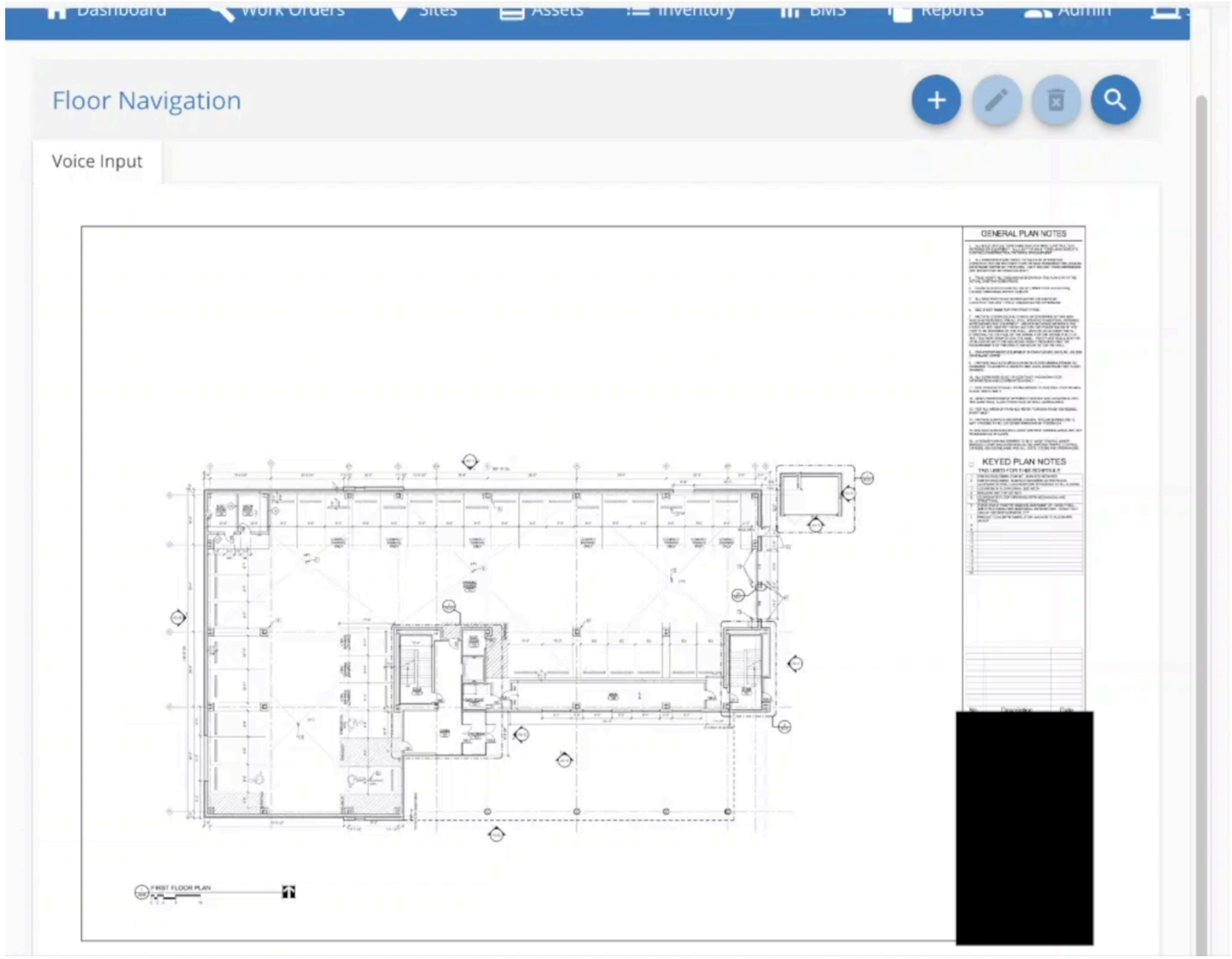
"Hands-free navigation"

- CARL - intelligent assistant for building management
- Using collected info about floor plans, rooms, assets & our virtual assistant CARL one can do better asset & facility management.



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HOW CAN WE USE THE COLLECTED DATA?

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"Smart work requests"

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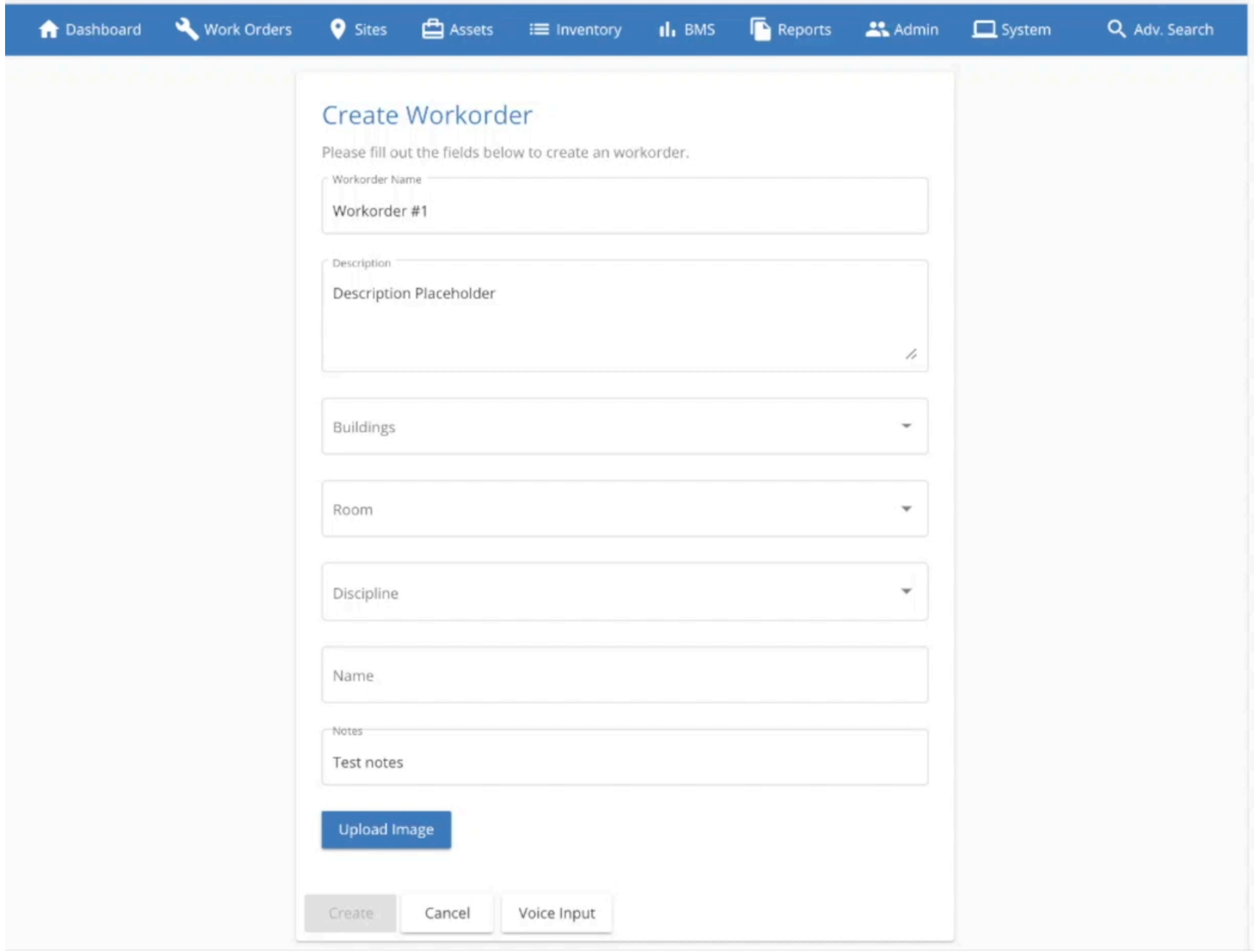

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INTEGRATION OF SENSORY DATA

Moving towards Smart Buildings with BMS/IoT integration

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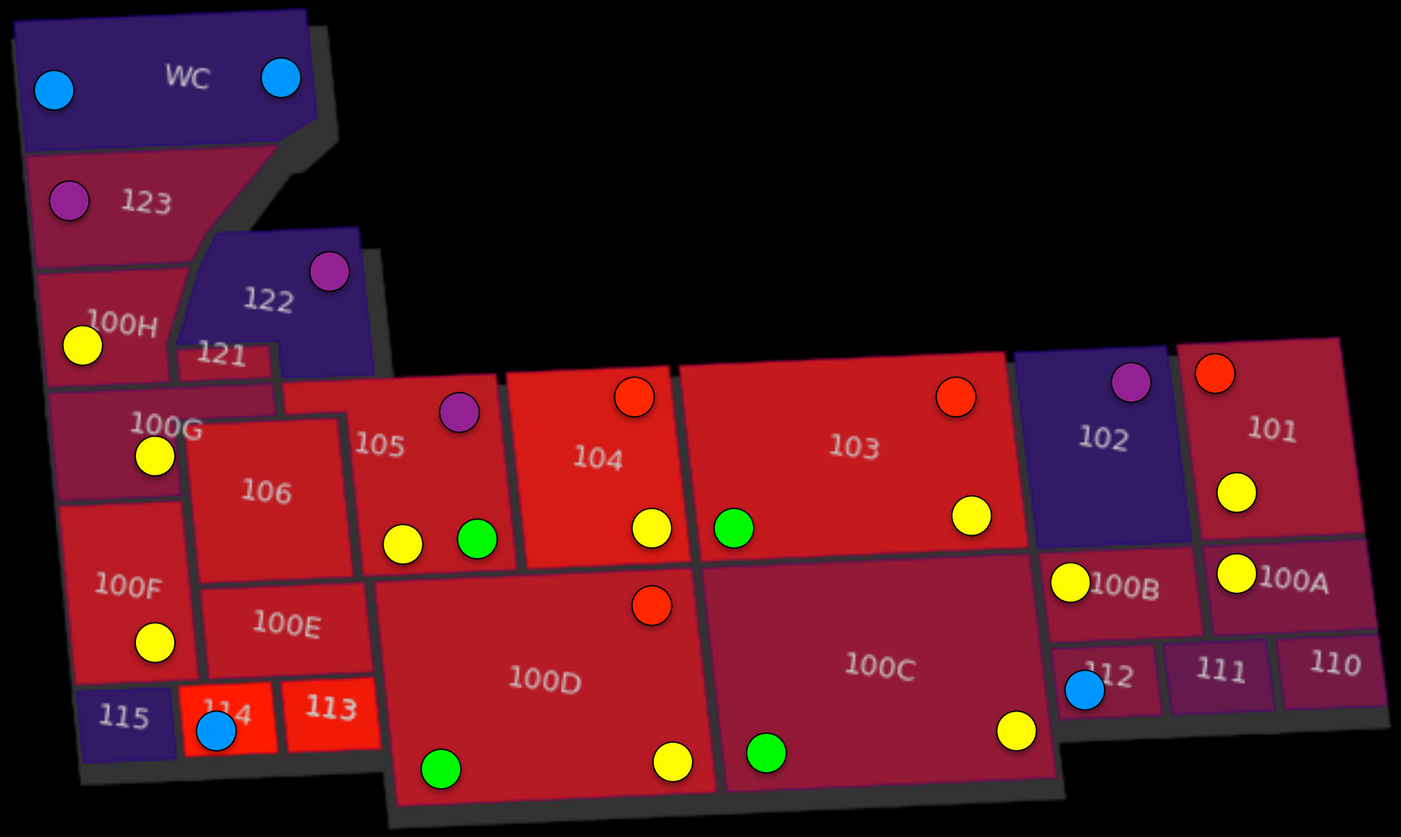

TYPICAL IOT SENSORS

- TEMPERATURE & HUMIDITY
- INDOOR AIR QUALITY
- WATER LEAK DETECTION
- OCCUPANCY
- NOISE LEVEL

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OCCUPANT COMFORT & PRODUCTIVITY

HEAT INDEX (PERCEIVED COMFORT LEVEL)

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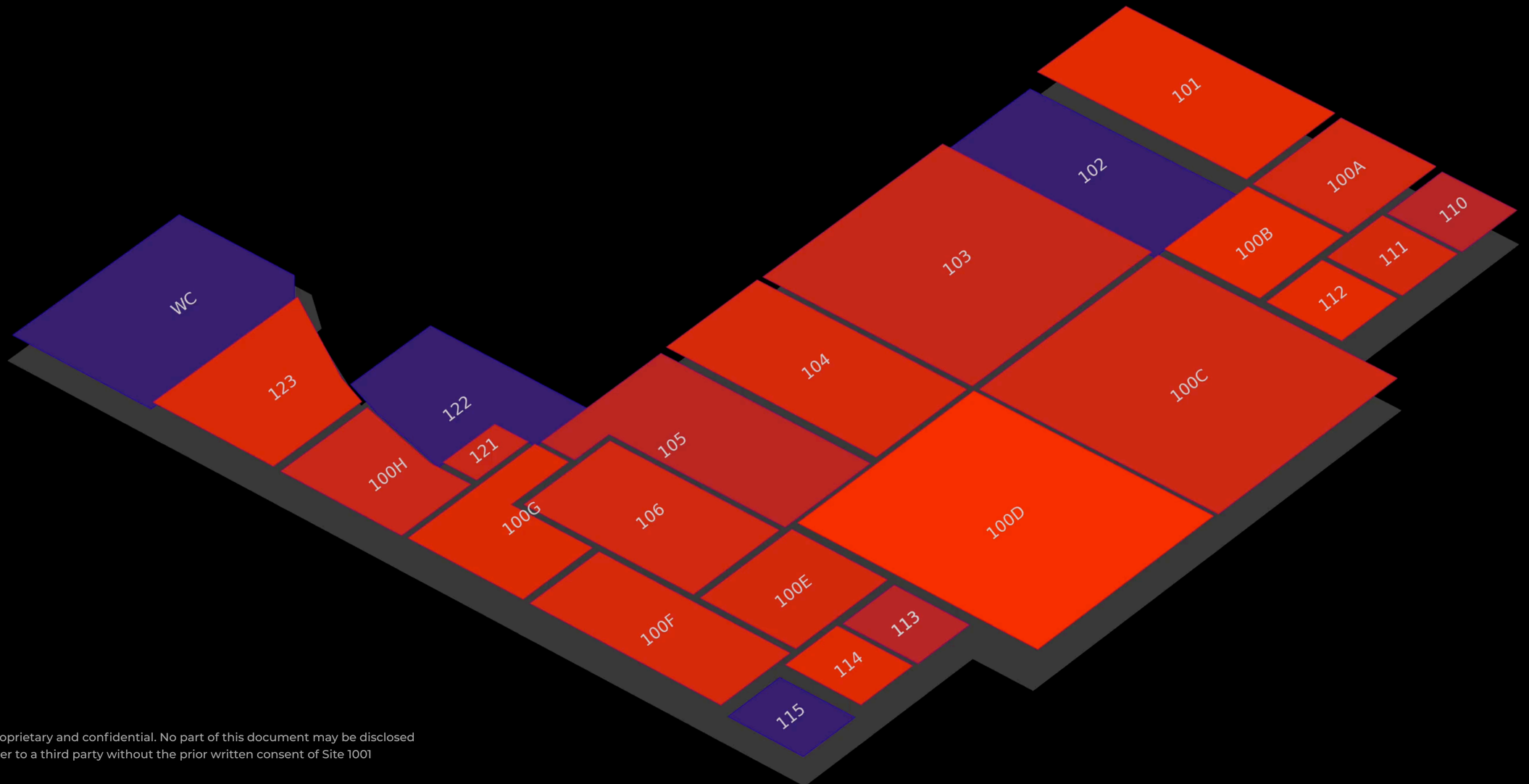

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OCCUPANT COMFORT & PRODUCTIVITY

HEAT INDEX (PERCEIVED COMFORT LEVEL)

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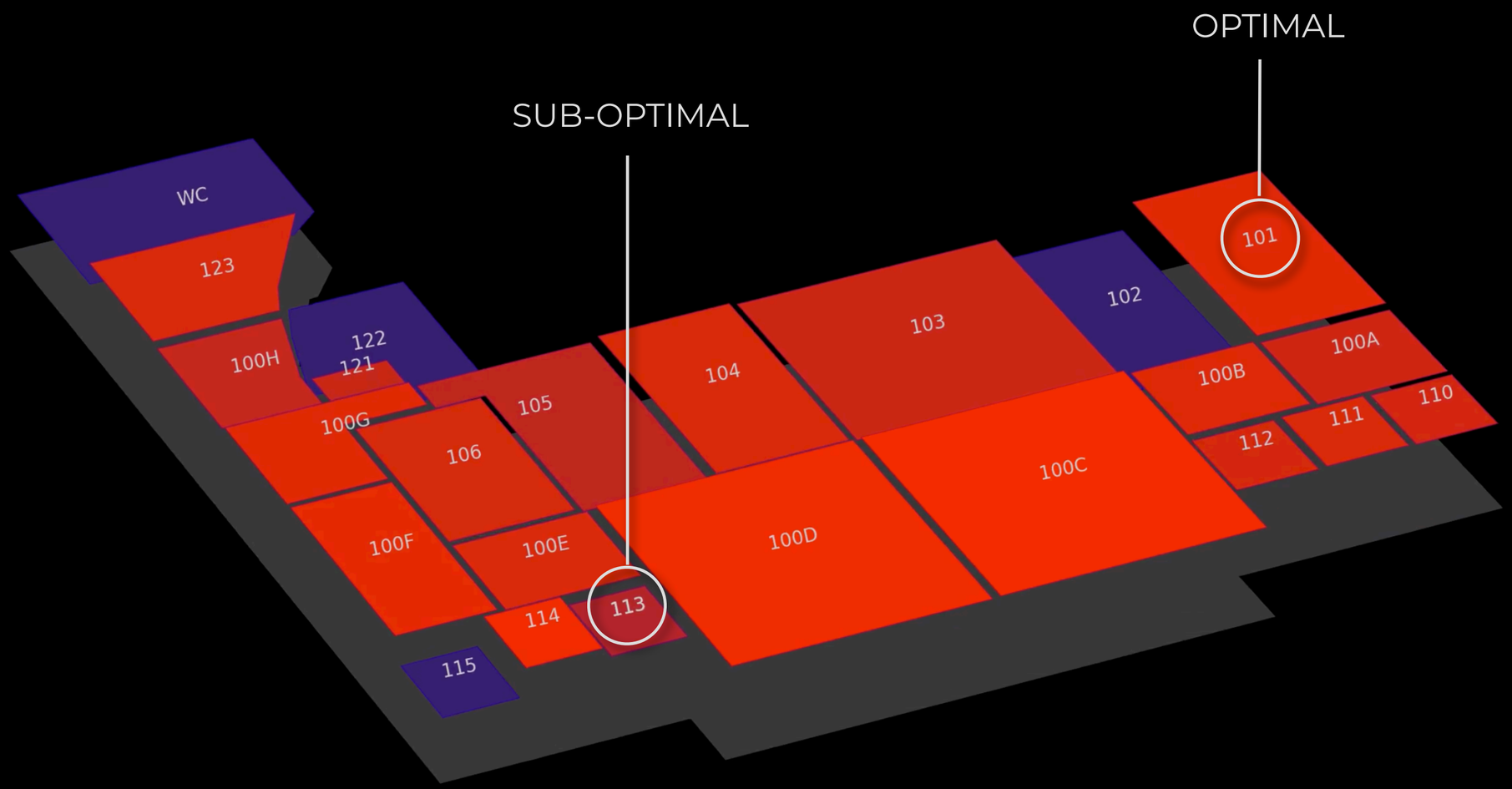

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INDOOR ENVIRONMENT QUALITY

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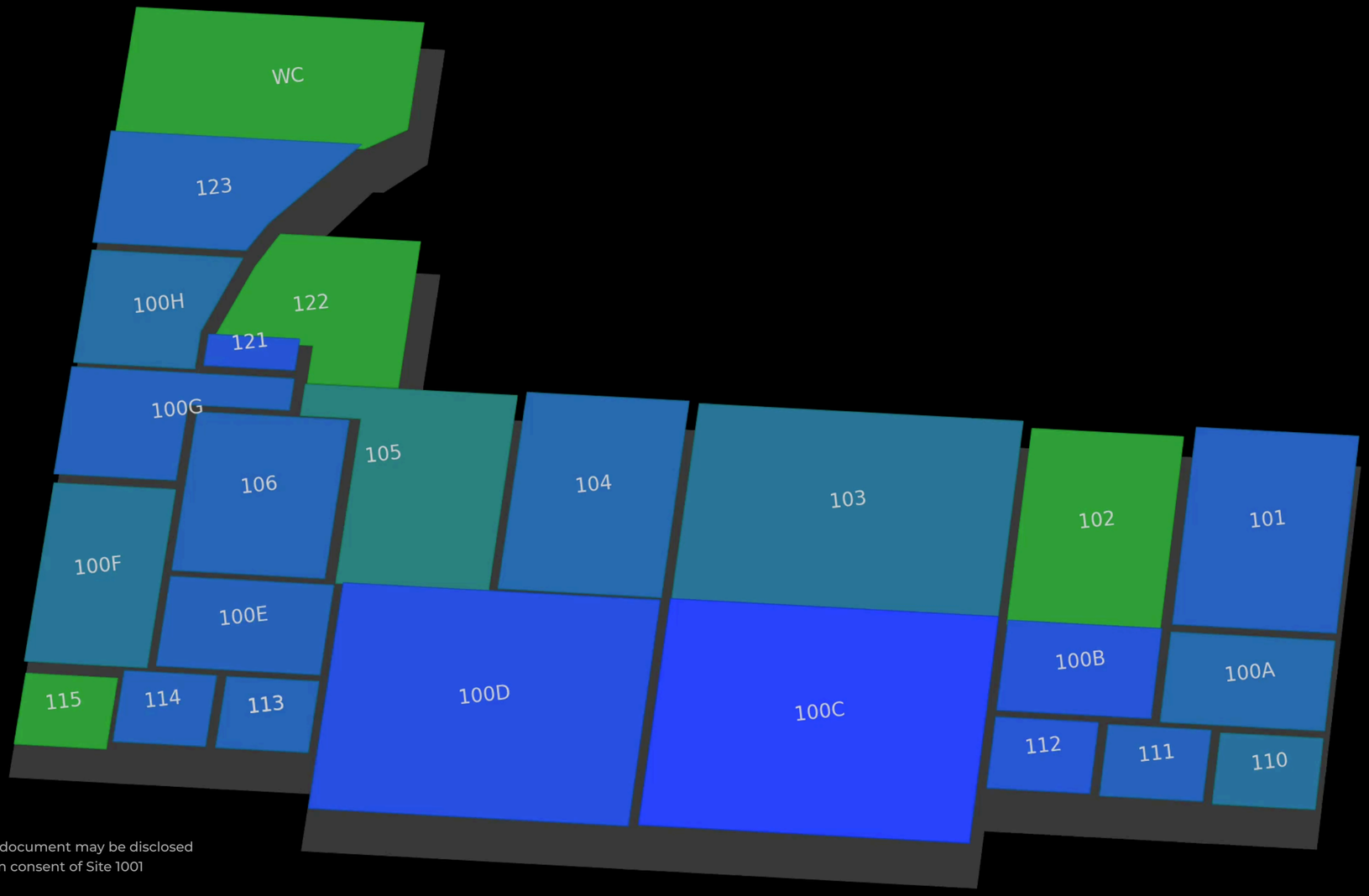
MATERIAL CORROSION/DECAY RISK



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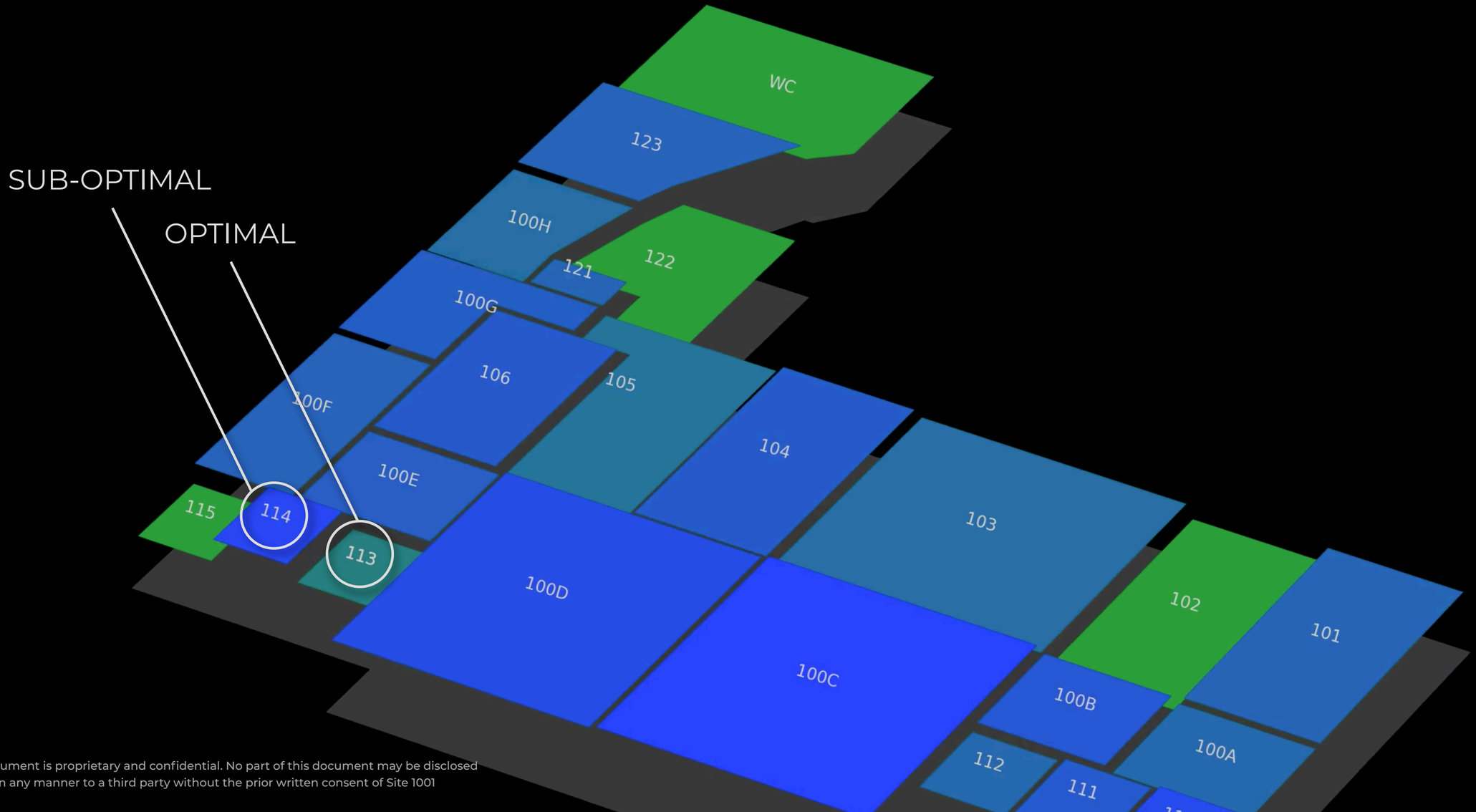
INDOOR ENVIRONMENT QUALITY

MATERIAL CORROSION/DECAY RISK



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SPACE UTILIZATION

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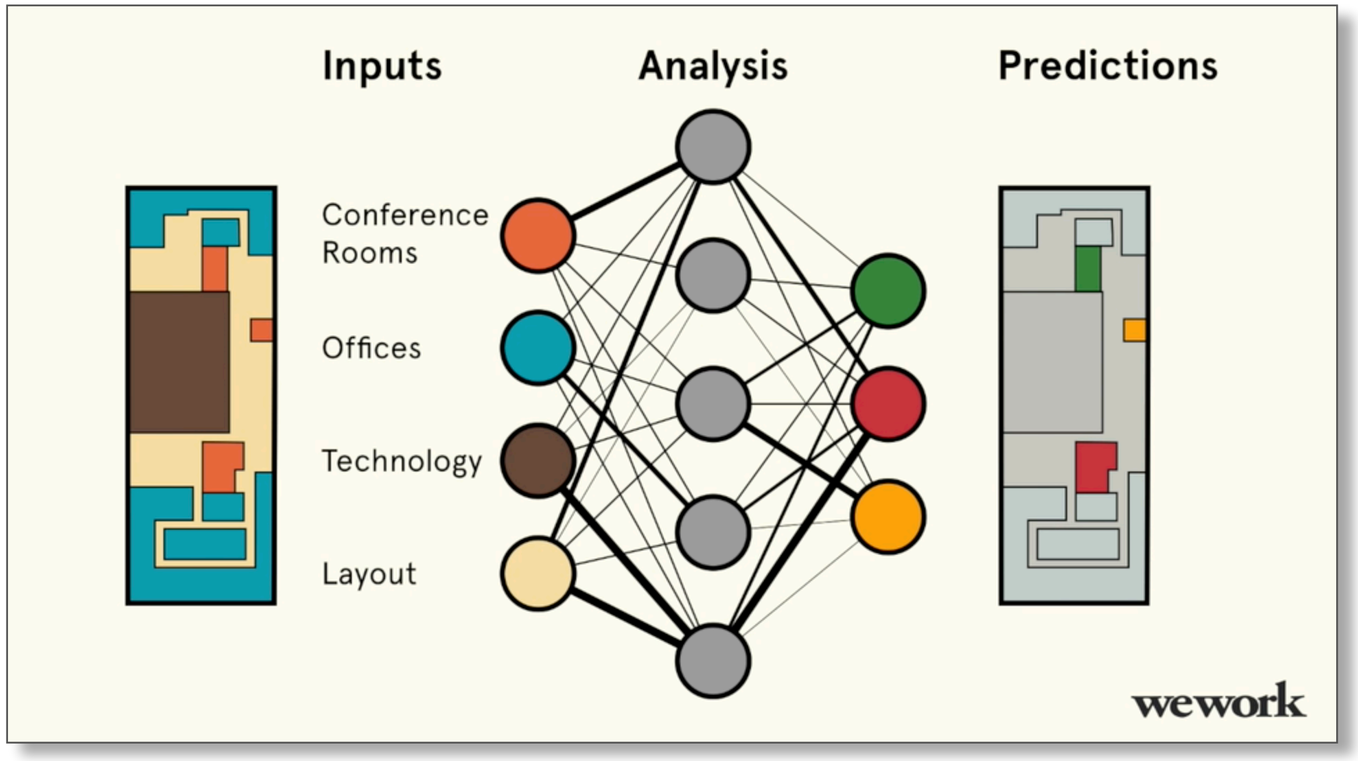
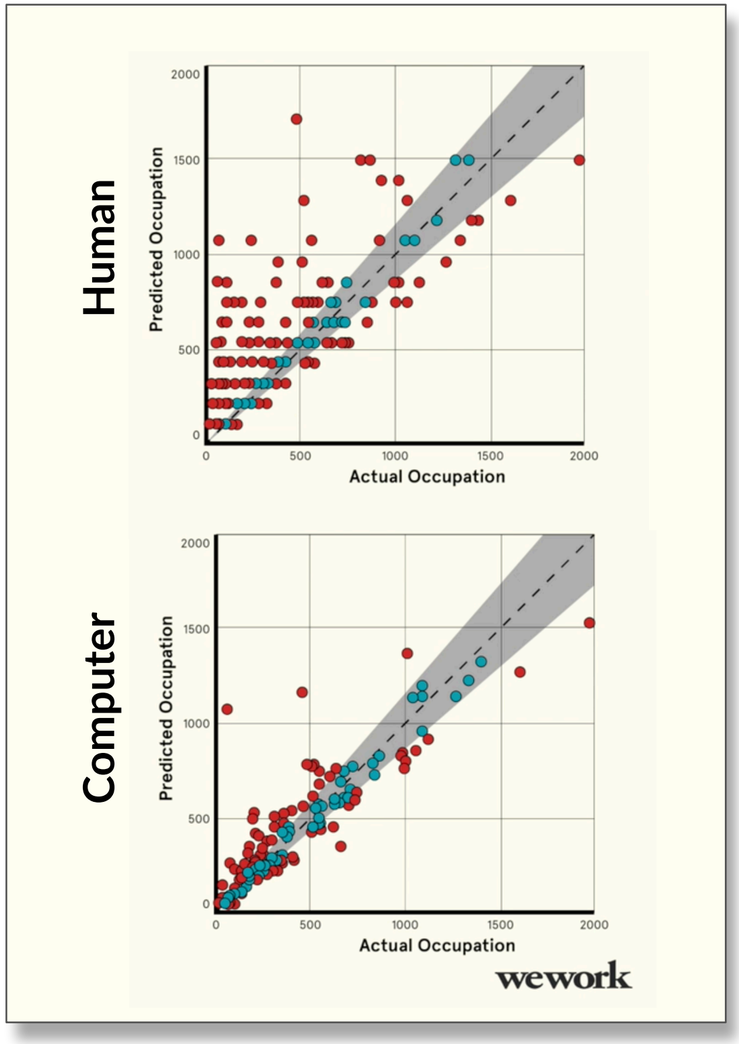
Using occupancy sensors & ML to optimize use of space





Based on the talk by Daniel Davis, PhD, Director of Product Research at WeWork, Accelerate Live Conference, Chicago, 2017

source: https://www.bdcnetwork.com/accelerate-live-talk-applying-machine-learning-building-design-daniel-davis-wework

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SMART BUILDINGS

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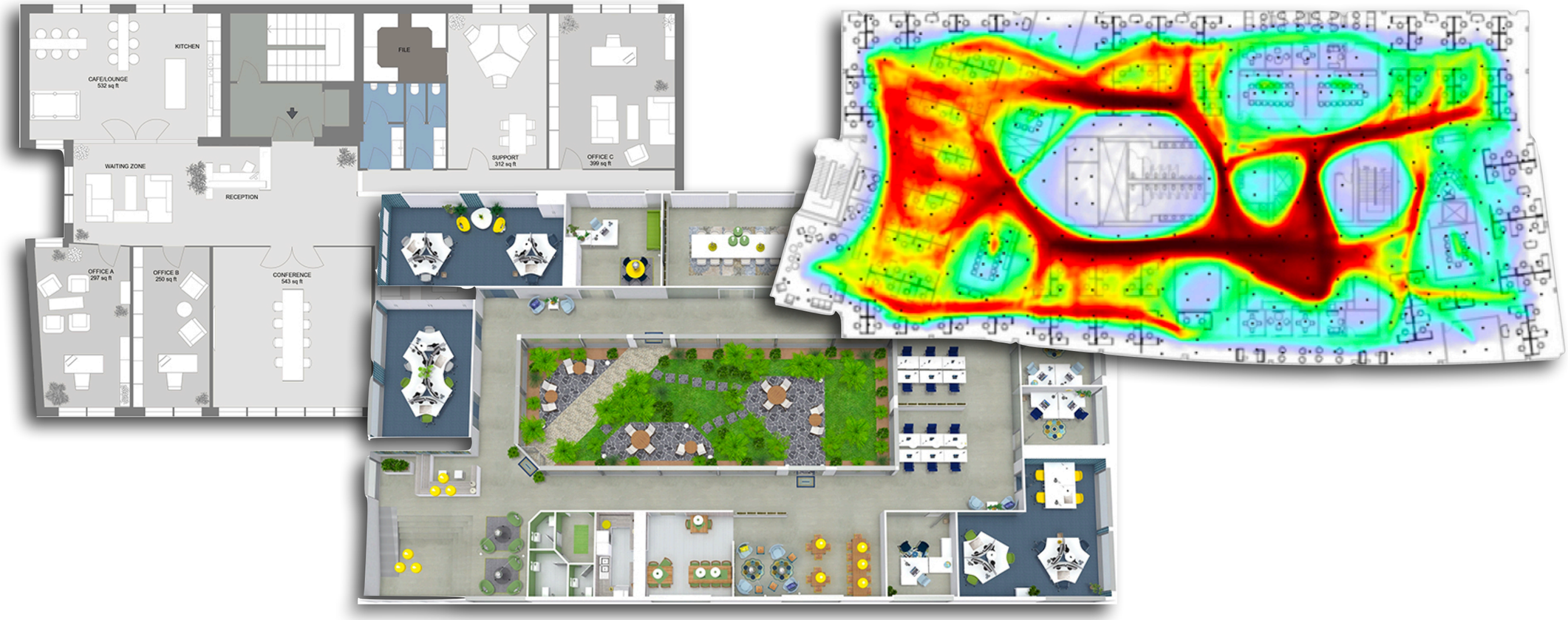
With the presented process we can do more effective
asset & facility management, monitor indoor environment
for occupant health, comfort, and thus make buildings smarter



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