FEFPA Summer 2021

Educational Facilities Planning for Emerging Trends in Data Sciences Programs

Provider Number: E212

Course Number: AEI12212015

AEI | Affiliated Engineers

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Course Description

An enlightening and engaging session providing participants with the knowledge required to discern emerging trends in data sciences programs and evaluate the benefits and strategy behind an Intelligent Building and Campus. After an examination of an Intelligent Campus' minimization of natural (water, energy) and human resources to realize significant cost savings; and enhancement of the user experience – from the perspective of both the occupants and the facilities operations team, participants will have the opportunity to ideate in open discussion related to their building or campus.

Learning Objectives

1. Learn how emerging trends in data science in academia is driving programmatic, sustainability and operational requirements for higher education facilities.

2. Understand how the convergence of otherwise disparate systems can save significant operations costs and minimize natural and human resources investments.

3. Learn about the tools and processes that can be utilized to harness the value of data from buildings.

4. Master the Intelligent Building/Campus Concept and develop the business case for its implementation at their institution.

Agenda

- The Growing Prominence of Data Science

- Data Science Programs: Evolution of the Classroom

- Synergy Between Building Systems and Data Science

- Examples

- Conclusion

IoT – The Internet of Things

Vehicle, asset, person & pet monitoring & controlling
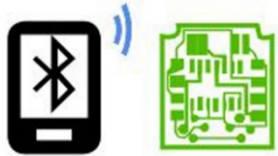
Agriculture automation

Energy consumption

Security & surveillance

Building managment

Embedded Mobile

Everyday things get connected — for smarter tomorrow

Internet of things

M2M & wireless sensor network

Routing node
Sensor

Everyday things

Smart homes & cities

Telemedicine & helthcare

Big Data Driving Business Decisions Across Markets

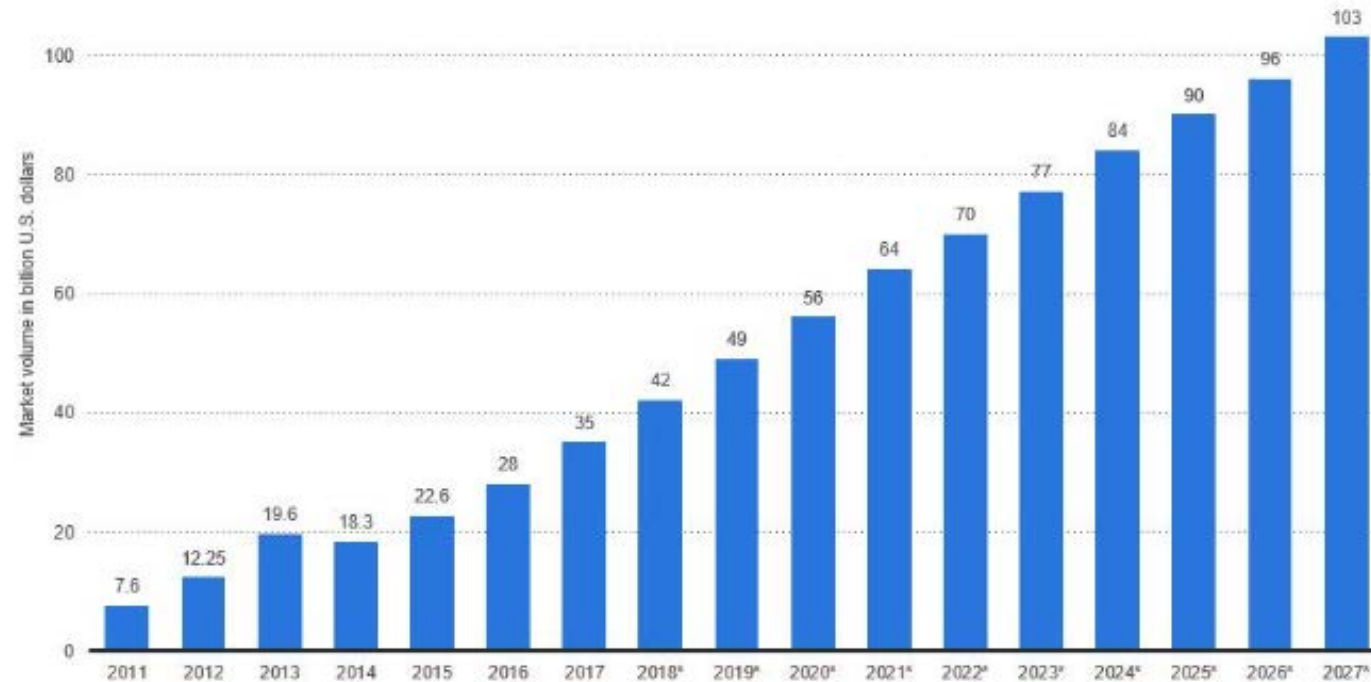# Big Data Driving Business Decisions Across Markets

THE WORLD IS ONE BIG

DATA PROBLEM

ANDREW MCAFEE

Big Data Market Growth

Forecast Revenue Big Data Market Worldwide 2011-2027

Big Data Market Size Revenue Forecast Worldwide From 2011 To 2027 (in billion U.S. dollars)

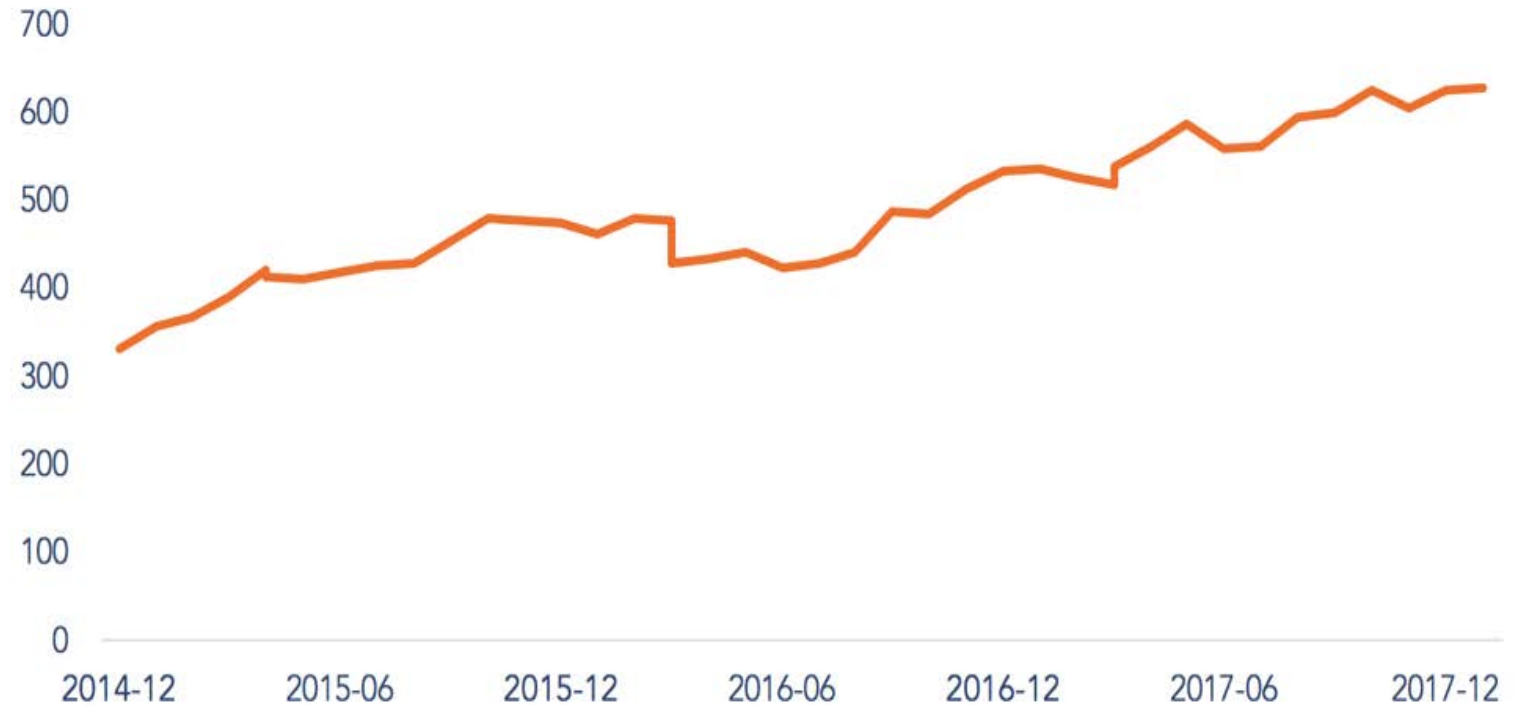DATA SCIENCE

Data Science: Job Market Trends

Percentage of postings for AI, ML, and data mining have almost **doubled in 5 years**.[1]

35% average annual growth for data scientist and data engineer roles.[2]

Top Titles[3]:
    Data Management Analyst
    Data Scientist
    Data Engineers
    Data Architect

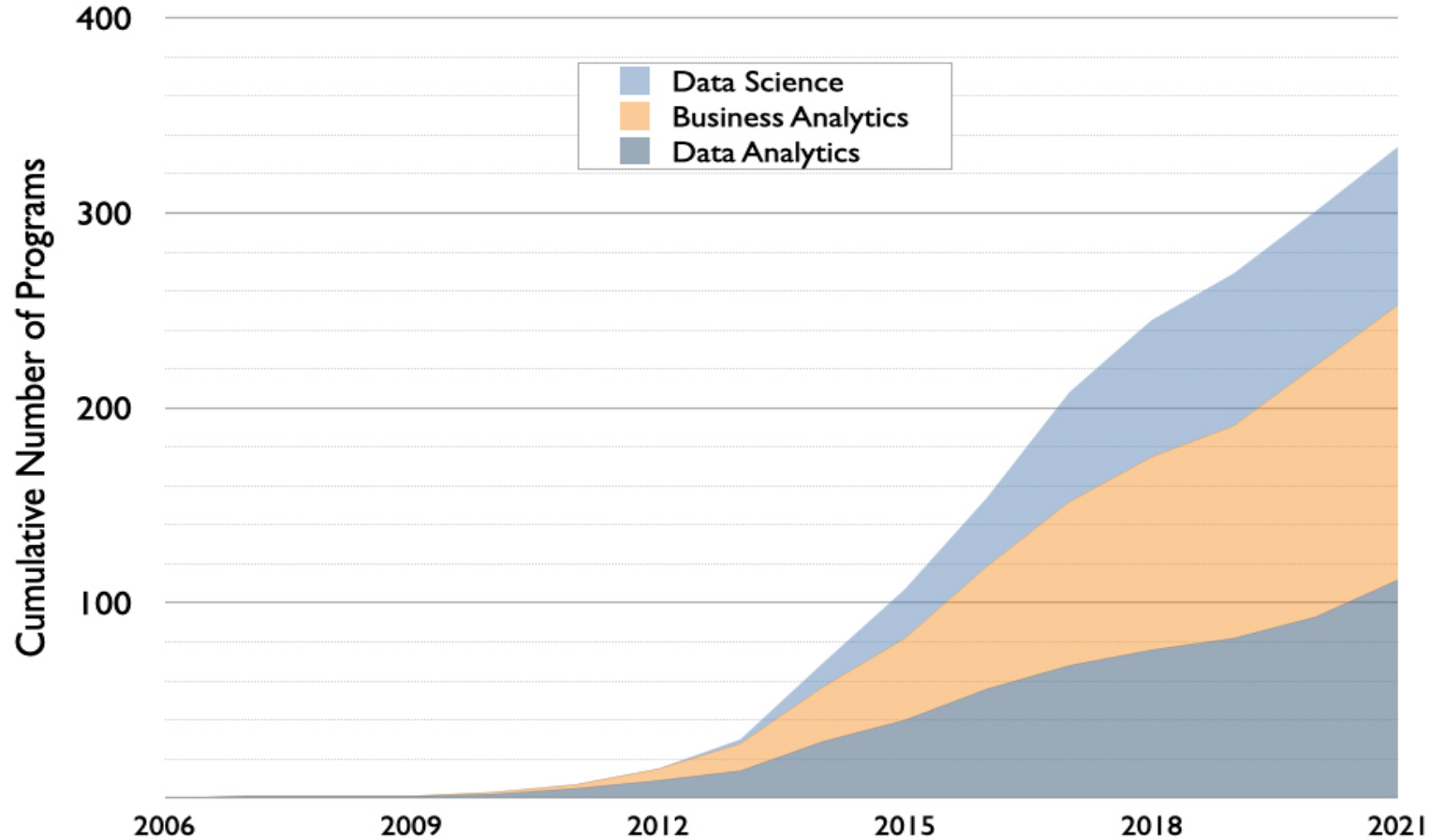Growth in data scientist postings per million postings

indeed

[1] 2019 Worcester Polytechnic Institute study
[2] 2020 US Emerging Jobs Report
[3] https://business.linkedin.com/talent-solutions/resources/talent-acquisition/jobs-on-the-rise-us

Data Science: Academics & Research

The Growth of Analytics and Data Science Master's Degree Programs in the United States

Source: Michael Rappa, Institute for Advanced Analytics   updated May 2021

Data Science Programs: Evolution of the Classroom

FAU Computer Science and Engineering

Living Laboratory that Showcases the Systems, Activities & Programs of **the College**

Programmatic Components:
   Engineering Library with Reading & Study Spaces
   Classrooms with Distance Learning capability
   Engineering Labs for Research and Teaching
   Computer Instrumentation Labs
   Data Center with Support Space
   Administrative Offices and Conference Rooms
   Multi-purpose Room with Catering Kitchen

FAU Computer Science and Engineering

Cost and Energy Metrics
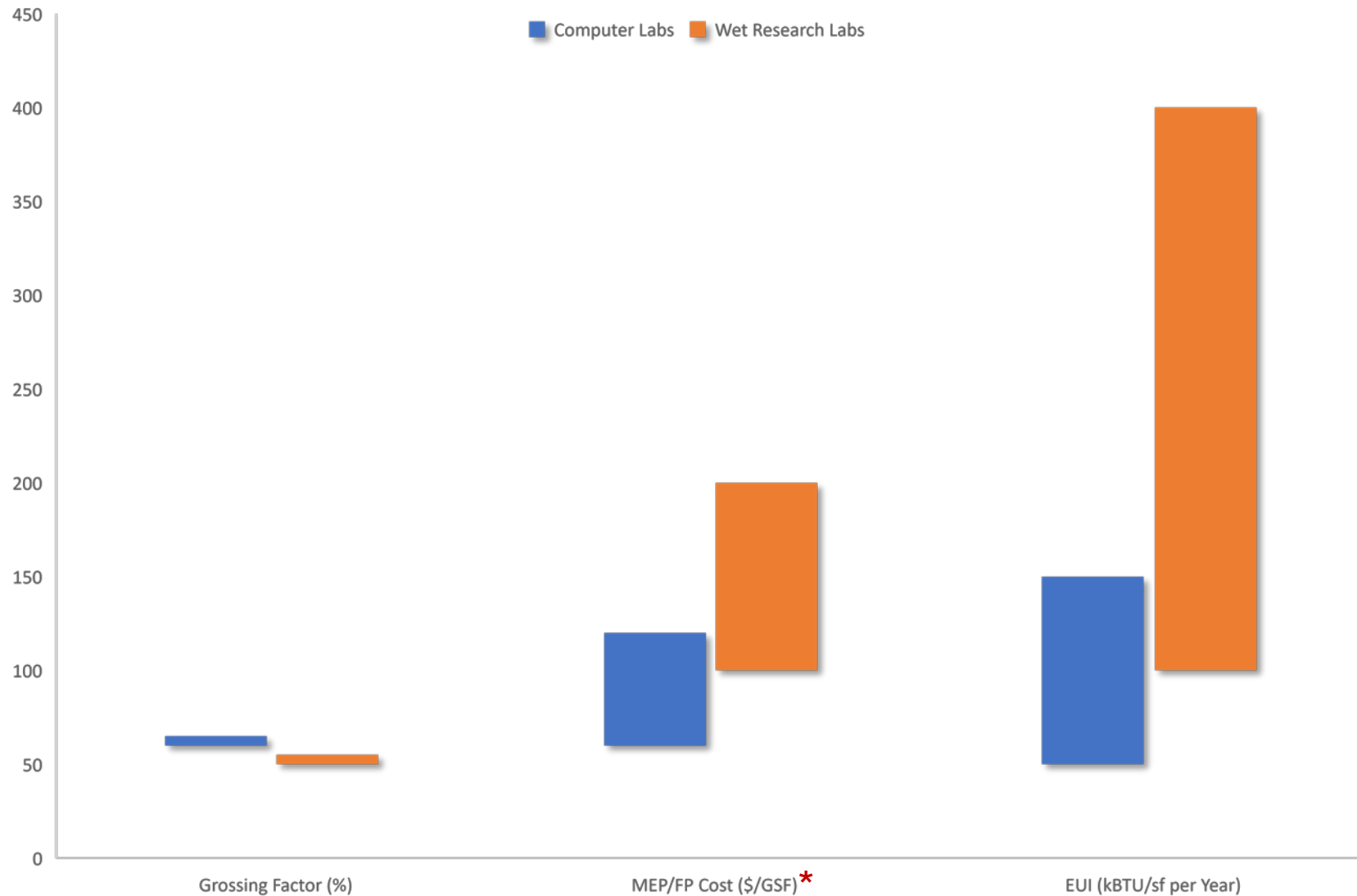   **$105.33/GSF** for MEP/FP (today's dollars)
   EUI = **147 kBTU/sf** per year

Computer Labs or Wet Research Labs?

Computer Labs or Wet Research Labs?

*Doesn't account for current volatility!

Collaboration Between Organizations

- The **Columbia-IBM** Center for Blockchain and Data Transparency will combine cross-disciplinary teams from the academic, scientific, business and government communities[1]

- A new partnership between **Deloitte**'s Artificial Intelligence Institute and the Ted and Karyn Hume Center for National Security and Technology at **Virginia Tech University** has enabled the launch of the Deloitte Graduate Student Research Program on Artificial Intelligence, which aims to prepare graduate students for artificial intelligence careers[2]

- **NVIDIA** is collaborating with biopharmaceutical company **AstraZeneca** and the University of Florida's academic health center, **UF Health**, on new AI research projects using breakthrough transformer neural networks.[3]

[1]https://newsroom.ibm.com/2018-07-17-Columbia-University-and-IBM-Establish-New-Center-to-Accelerate-Innovation-in-Blockchain-and-Data-Transparency
[2]https://vtx.vt.edu/articles/2021/06/deloitte-research-program-on-AI.html
[3]https://blogs.nvidia.com/blog/2021/04/12/ai-drug-discovery-astrazeneca-university-florida-health/

Florida Polytechnic Applied Research Center

Connected, technology-rich, interdisciplinary approach to **research** and **industry collaboration**

Programmatic Components:
   Wet Research Laboratories
   Computer Laboratories
   Data Visualization
   Research Support Offices
   Conference Rooms
   Study Spaces
   Student Support
   Server Room

Collaboration between Business Analytics, CSE, Cybersecurity Data Science, EE, Physics, Environmental, and ME programs

Florida Polytechnic Applied Research Center

Cost and energy metrics
$116.88/GSF for MEP/FP (today's dollars)
EUI = 162 kBTU/sf per year

UF Data Sciences and Information Technology

Iconic **transdisciplinary team hub** to develop and apply **computing, communication, and cyber technologies**

Programmatic components
  Healthcare, Pharmacology, Cybersecurity, Technology Development
  Engineering, Healthcare, and Bioinformatics
  Integration of College of **Engineering**, College of **Medicine**, and College of **Pharmacy**

Remote Data Center(s)

UF Data Sciences and Information Technology

Cost and energy metrics
$117.40/GSF for MEP/FP
EUI = **74 kBTU/sf** per year

FIU Engineering

Enhance **collaboration** between College of Engineering and Computing and Colleges of Medicine, Nursing, and Public Health, with emphasis on interface between **Health Sciences and Engineering/Computer Science**
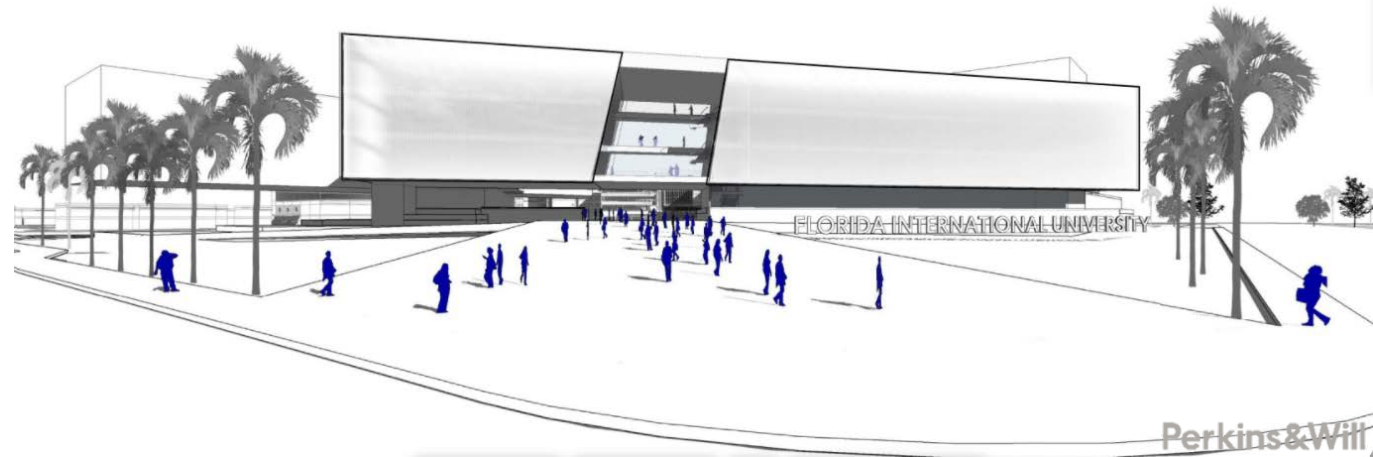
Programmatic Components
- Biomedical Engineering
- **Cybersecurity**
- **IoT**
- Networking
- **Computer Vision**
- Computer Science and Engineering
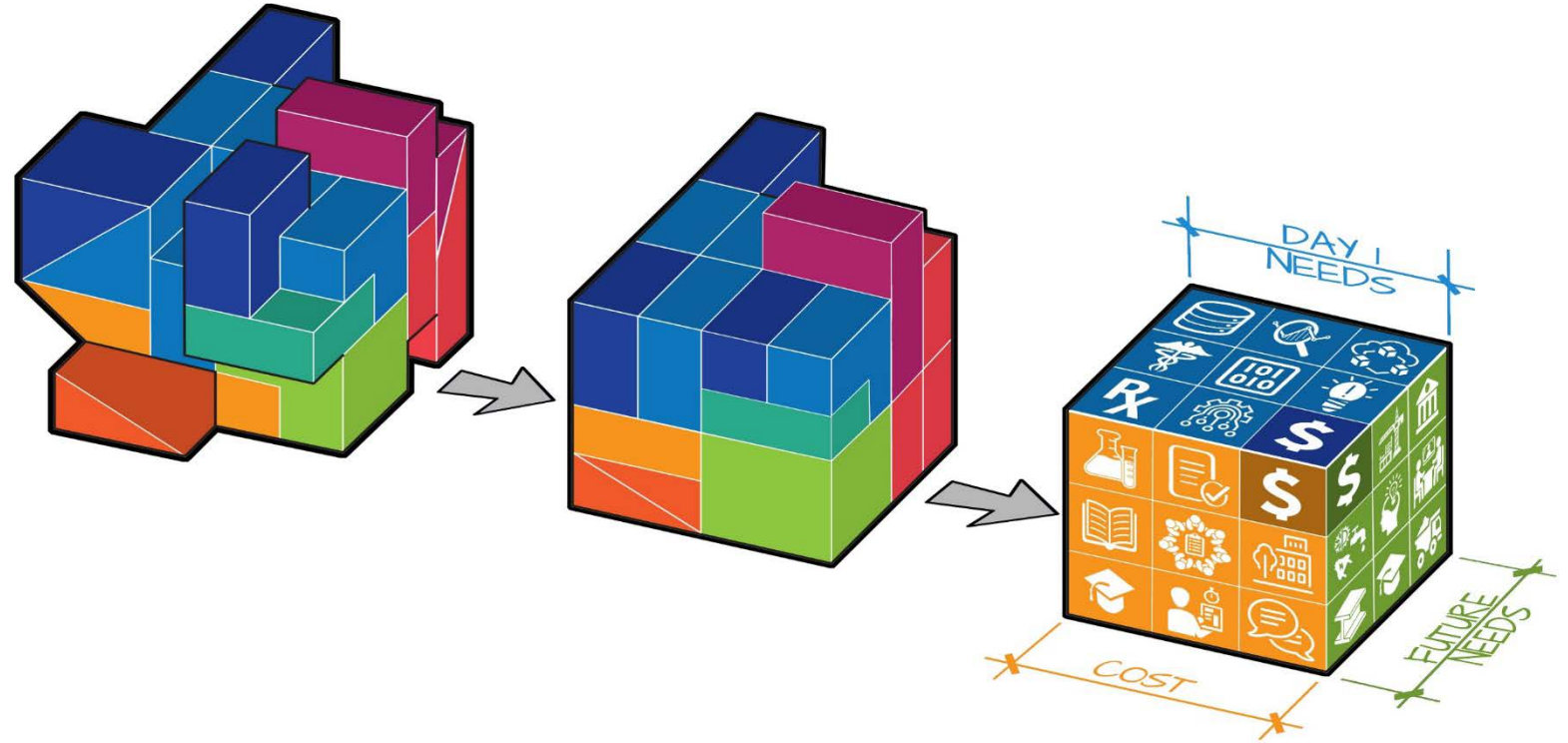
Planned for **Remote Data Center(s)**

Preliminary Concept Vision

Preliminary Concept Vision

FIU Engineering

- Flexible **shell space**

- Plan infrastructure for varied programs in future buildouts

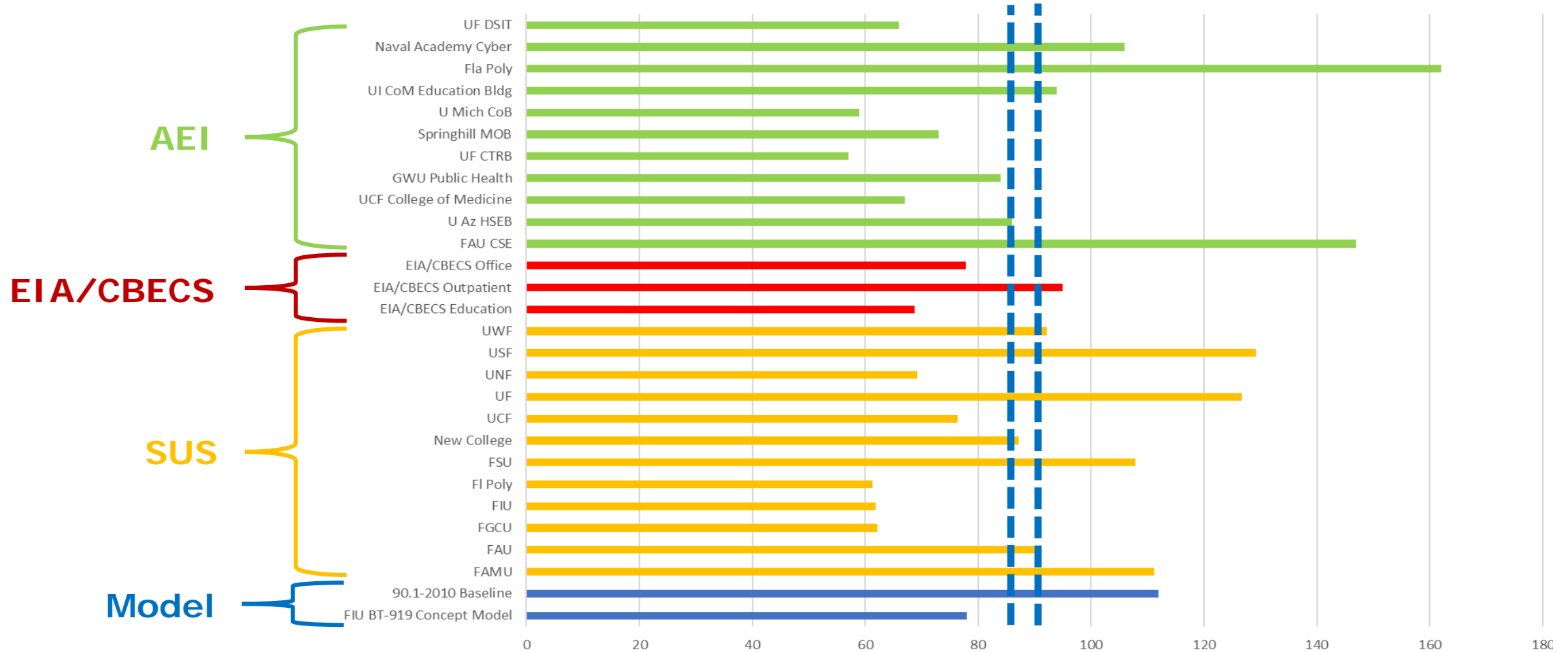- Utilities for **wet research labs**

MEP/FP Cost per GSF

Computer Lab

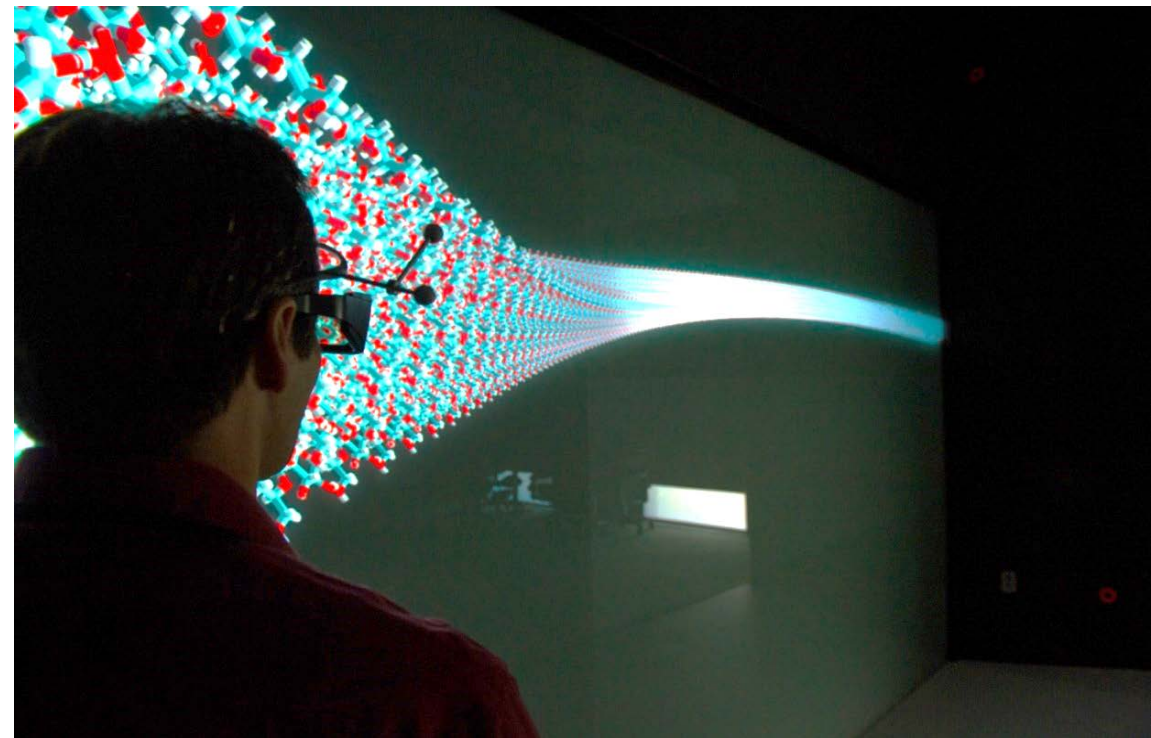$60/GSF

Wet Research

$200/GSF

Looking Forward

Adaptability
- Computer Labs?
- Wet Research Labs?
- Vivarium?
- Hybrids?

Visualizations' Impact on Infrastructure and Floor Space

Pandemic Response
- Remote work
- Distance learning
- Hoteling

Hoteling and Future Work Trends

Over half of employees **[55%]** prefer to work remotely at least three days a week once pandemic concerns recede and claim to be more productive now than before the pandemic **[34% vs. 28%]**.

And over half **[52%]** executives agree that average employee productivity has improved.

Hoteling Example

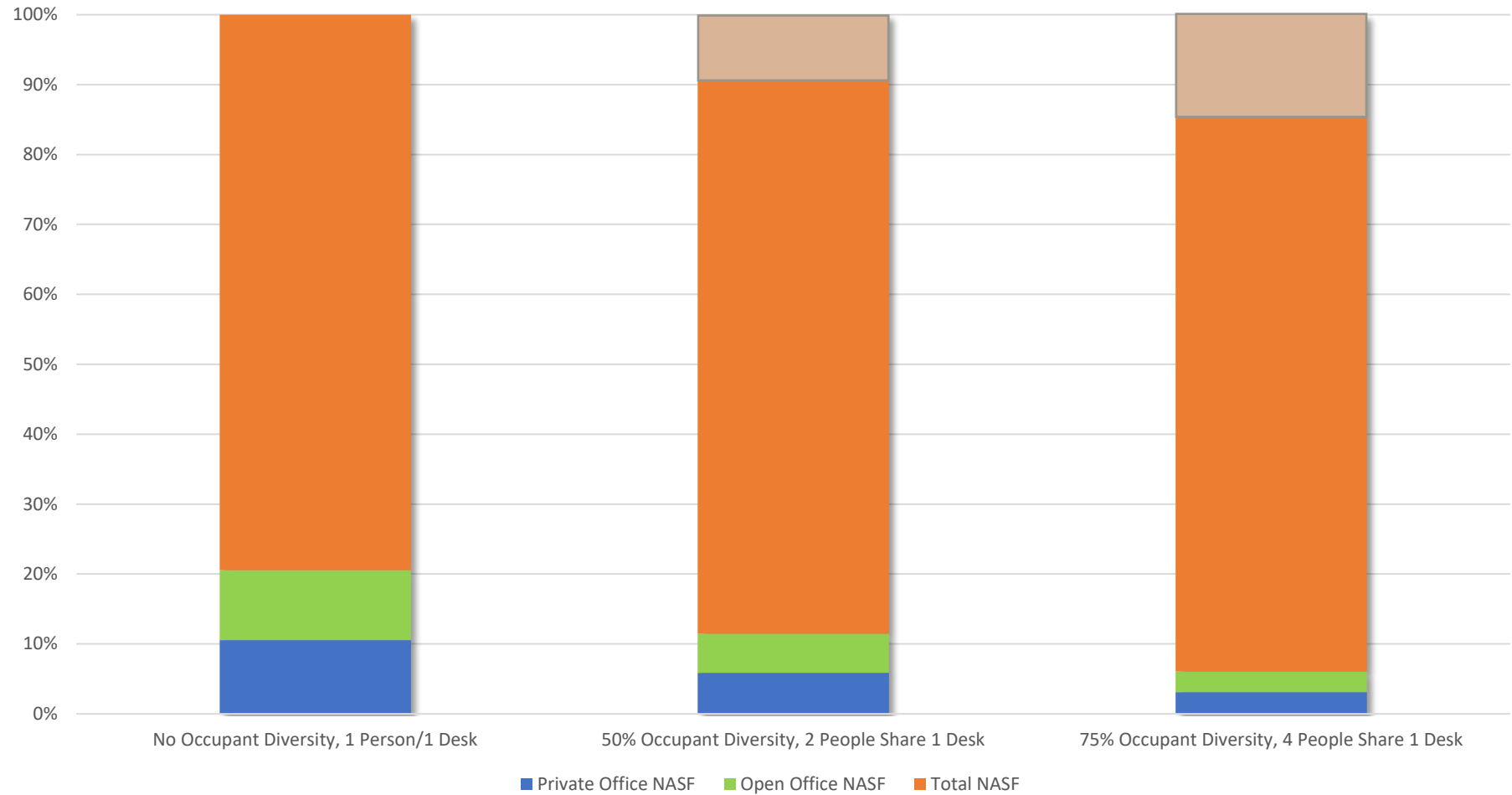150 SF/Person Office Density

50 SF/Person Workstation Density

149,000 NASF Program

132 Faculty

375 Graduate Students

Desks:

Assigned vs. Unassigned

| No Occupant Diversity, 1 Person/1 Desk | 50% Occupant Diversity, 2 People Share 1 Desk | 75% Occupant Diversity, 4 People Share 1 Desk |

■ Private Office NASF ■ Open Office NASF ■ Total NASF
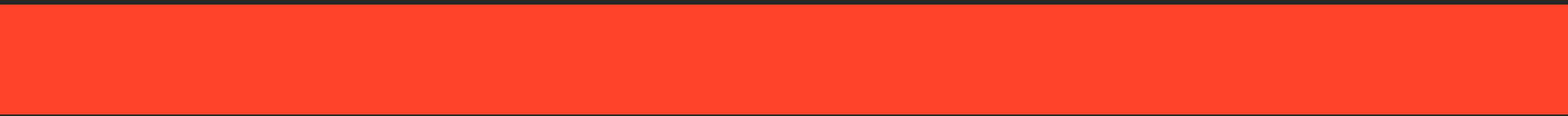
Looking Forward

- Affect on cost, EUI, and campus infrastructure

- Wet lab research can't be done at home

- Data-driven planning for future facilities and renovations

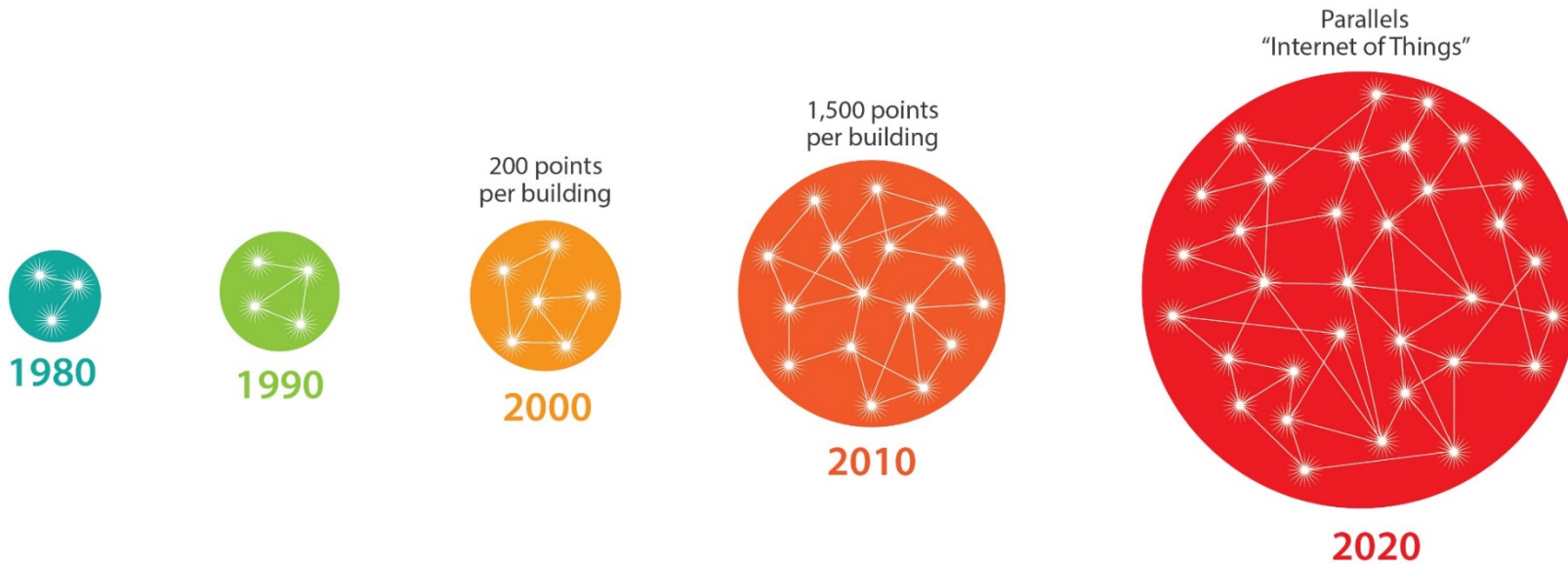**2011:** *"We don't know our staff's work style or when they use their desks"*

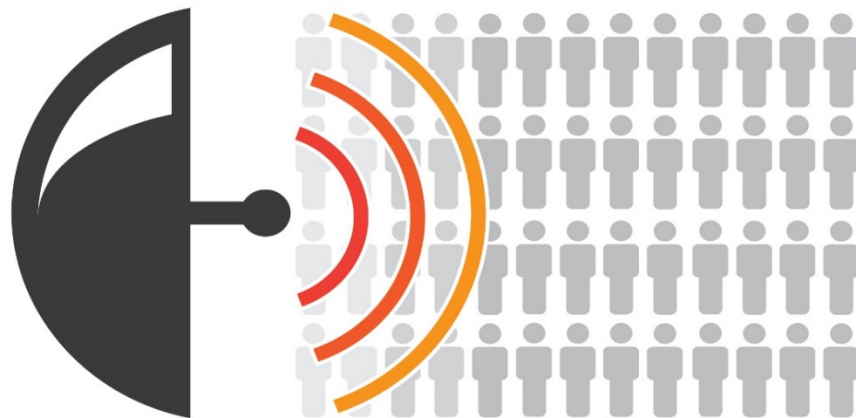**2021:** *"We have **data** to show the occupancy patterns and space utilization."*

Big Data: Evolution of Design + Operations

The Why - Data

Parallels
"Internet of Things"

1,500 points
per building

200 points
per building

1980

1990

2000

2010

2020

BIG
DATA
is here.

40
TRILLION GIGABYTES
Size of digital universe by
2020, up from 130
billion in 2005.

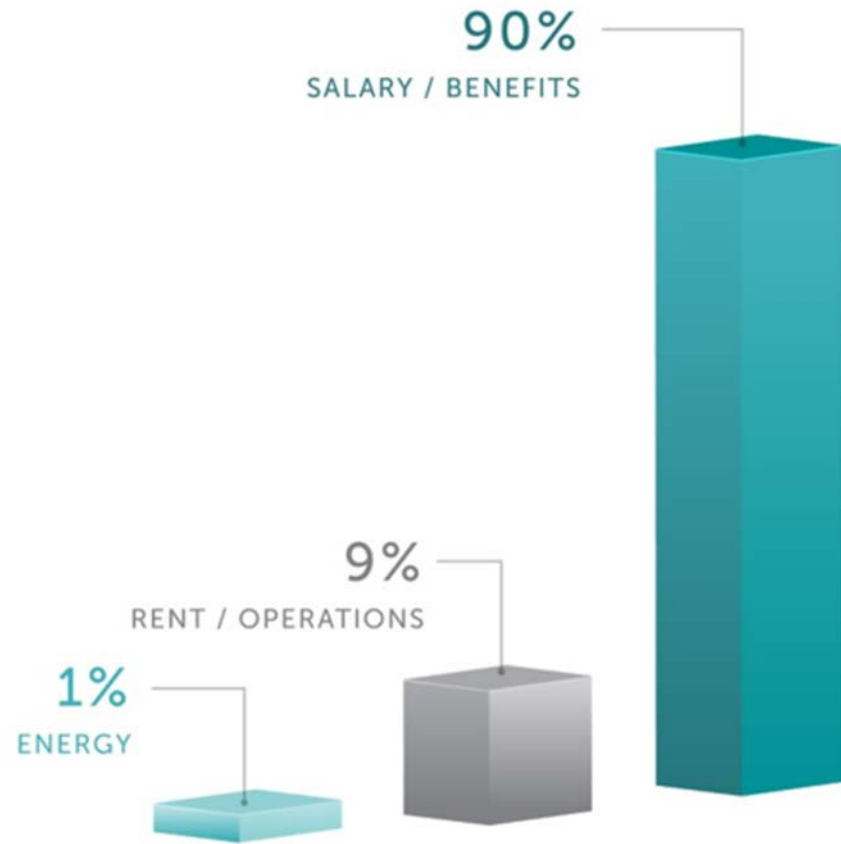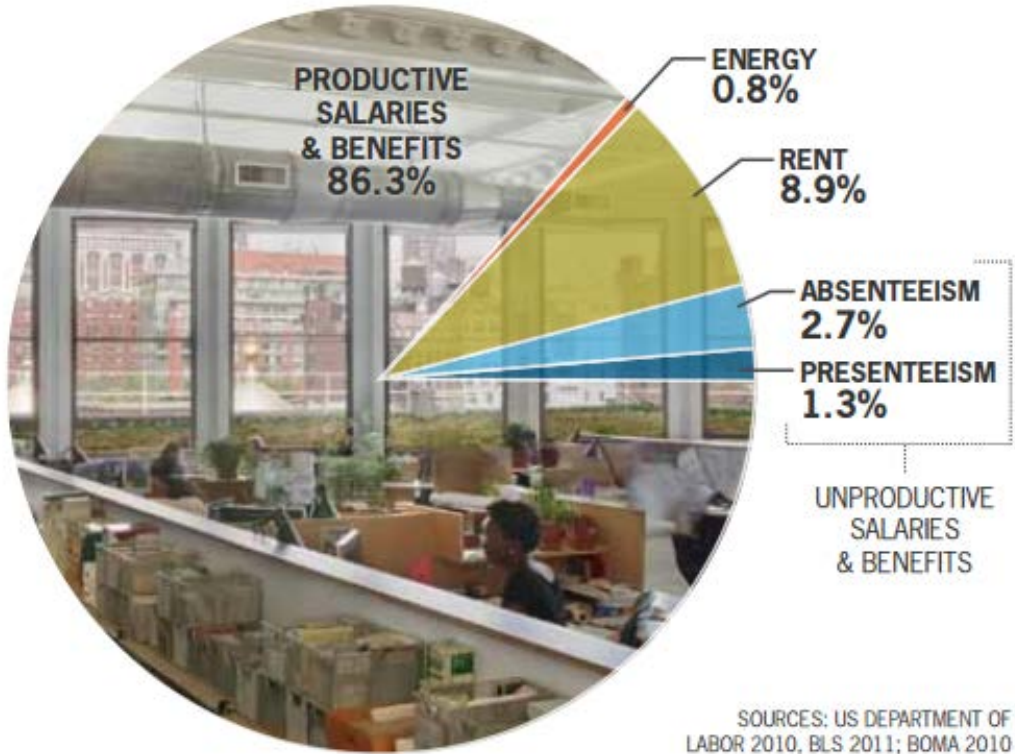Image © AEI/Affiliated Engineers, Inc.

Intelligent Buildings, The What

Smart Buildings are an edge technology integration movement in the built environment that has emerged out of the growing evolution of **cloud computing and data management**.

A **Smart Building** links together multiple data sources, including occupant engagement, into a cloud of useful information that leverages **Artificial Intelligence (AI)** to create **more Efficient, Effective, Engaging & Healthy spaces**.

A **Smart Building is Unique to each Owner.**

Intelligent Buildings, The Why

PRODUCTIVE SALARIES & BENEFITS 86.3%

ENERGY 0.8%

RENT 8.9%

ABSENTEEISM 2.7%

PRESENTEEISM 1.3%

UNPRODUCTIVE SALARIES & BENEFITS

SOURCES: US DEPARTMENT OF LABOR 2010, BLS 2011; BOMA 2010

90% SALARY / BENEFITS

9% RENT / OPERATIONS

1% ENERGY

Data taken from World Green Building Counsel Report "Health Wellbeing & Productivity in Offices" September 2014

Intelligent Buildings, The Why

THE IMPACT OF GREEN BUILDINGS ON
COGNITIVE FUNCTION
STUDY 1: INDOOR ENVIRONMENTAL QUALITY

THE IMPACT OF GREEN BUILDINGS ON
COGNITIVE FUNCTION
STUDY 2: BUILDINGOMICS

THE IMPACT OF GREEN BUILDINGS ON
COGNITIVE FUNCTION
STUDY 3: GLOBAL BUILDINGS

COGNITIVE RESULTS
BY INDOOR ENVIRONMENT

GREEN BUILDINGS
61% HIGHER

ENHANCED GREEN BUILDINGS
101% HIGHER

THE RESULTS ARE IN

26% HIGHER COGNITIVE FUNCTION SCORES

IN **HIGH-PERFORMING**[1], **GREEN-CERTIFIED BUILDINGS** VS. HIGH-PERFORMING NON CERTIFIED BUILDINGS

PARTICIPANTS

Office workers in participating buildings volunteer to take part.

Environmental Monitor

For Health App

68 ACTIVITIES COMPLETED | 520 POINTS EARNED

2200 | 128 | 8.0

81.0

Wearable Monitor

The Why: Data Driven Design

The Why: Data Driven Operations

"A regularly scheduled, or preventive maintenance strategy, in actuality, is one of the worst techniques to keep equipment working properly"

$24 per HP
Preventative Maintenance

$17 per HP + Risk
Run to Failure

$9 per HP
Predictive Maintenance

The Why: Convergence of Sustainability and IB

Sustainable Goals

- Energy Conservation
- Water Conservation
- Air Quality Improvement
- Waste Reduction

Intelligent Methods

- Integrated Systems
- Data Analytics
- Machine Learning
- Augmented Reality
- Predictive Operations
- IT Infrastructure

(Overlap)

- Simplified Operations
- Energy, Water and Air Quality Management
- Space Optimization
- Automatic Measurement and Verification

Profitable Outcomes

- Reduced Operating Costs
- Increased Productivity
- Minimized Consumption of Natural Resources
- Attract & Retain Top Talent
- Enhanced Security

The Why: Low Carbon Future

The How: Stakeholders

Administrative and Institutional Leadership

Facilities Management
- Engineering
- Technicians
- Sustainability

Users
- Faculty and Staff
- Students

Information Technology
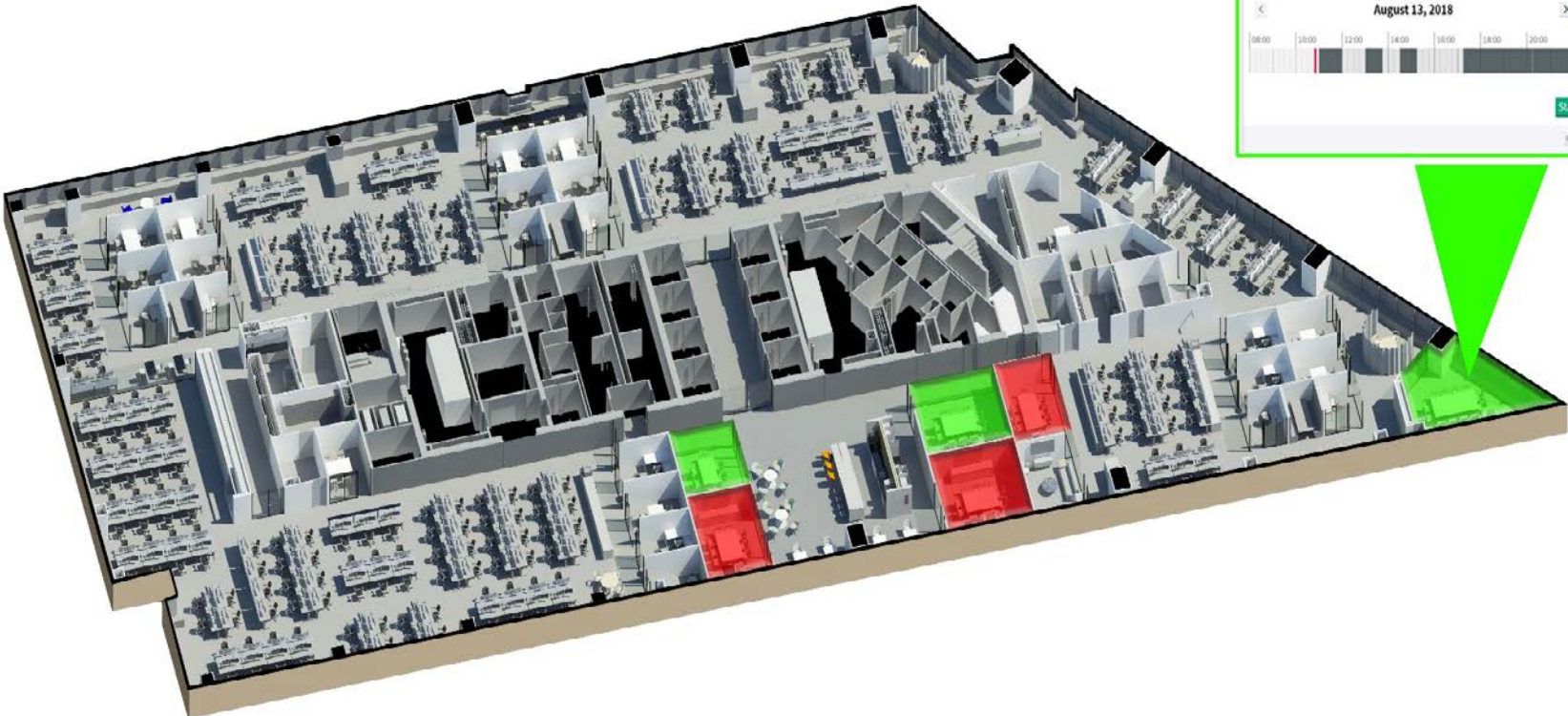- Network Security
- Servers
- Applications

Administration & Institutional Leadership

Users

Information Technology

Facilities Management
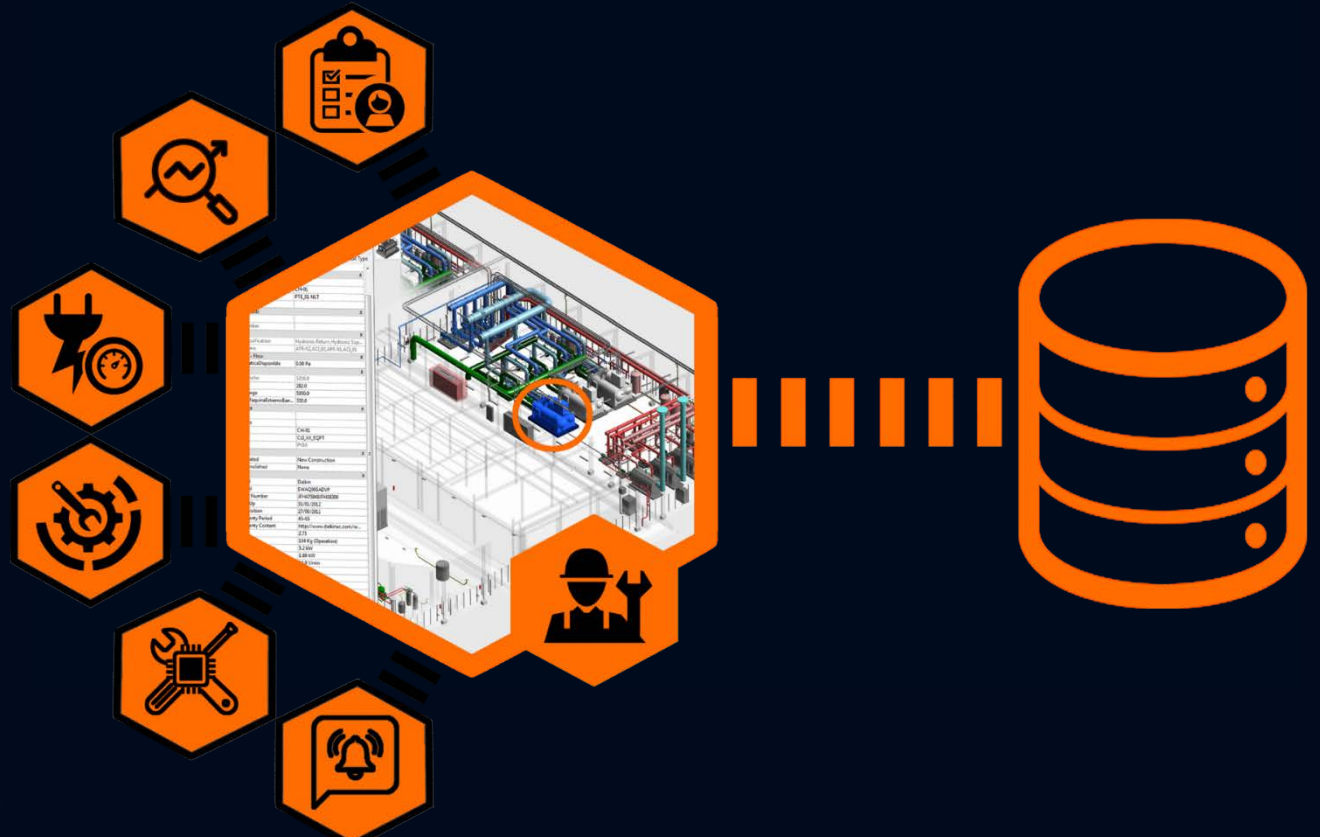
Digital Twin

BIM Integration

Computerized Maintenance Management System Integration
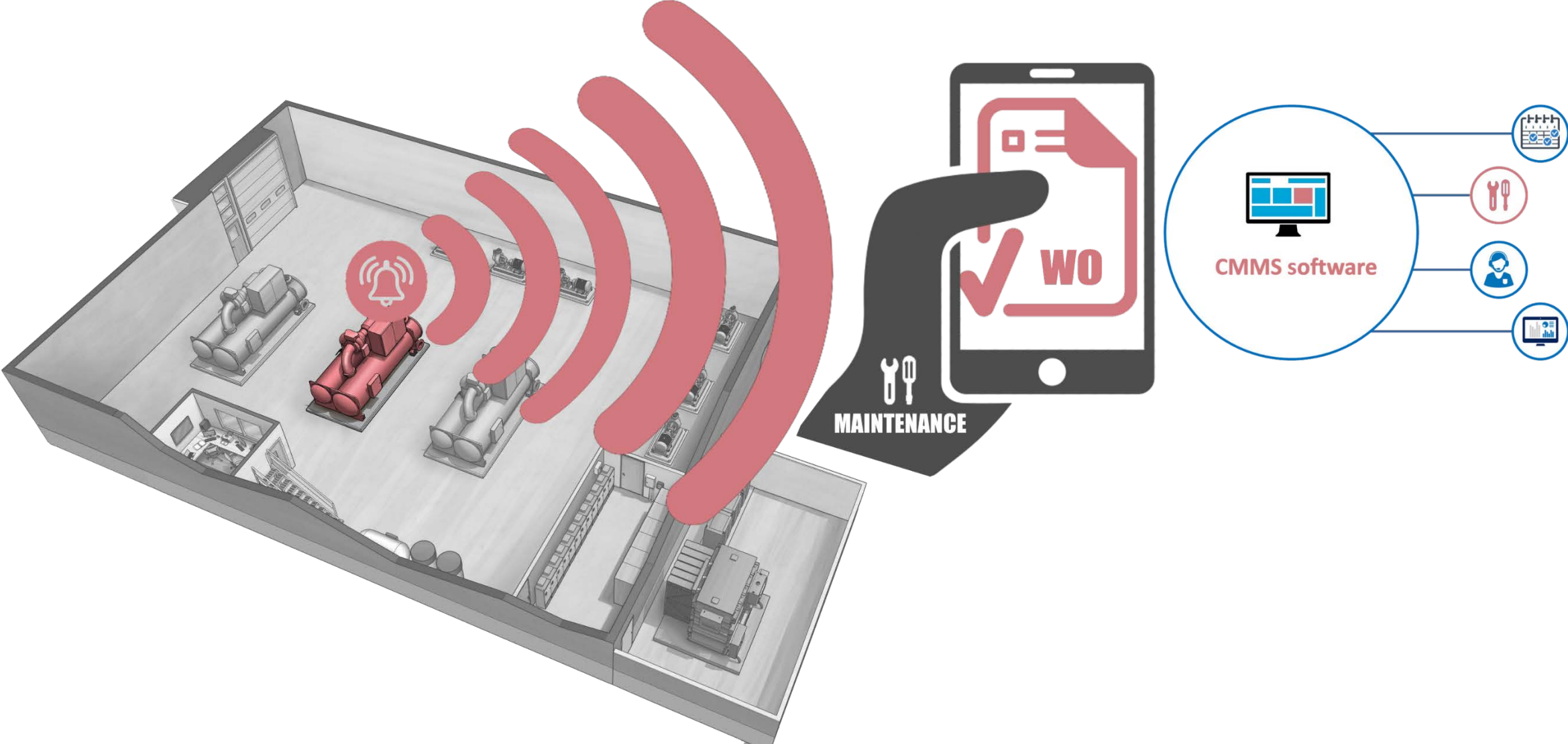
Room Booking Integration & Hoteling
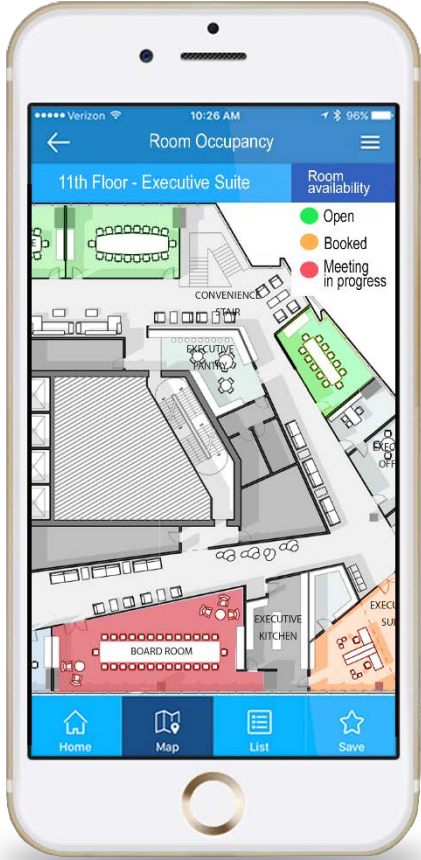
Occupancy Analytics

■ - OCCUPIED WORKSPACES/MEETING ROOMS

■ - AVAILABLE WORKSPACES/MEETING ROOMS

Mobile App

- Students looking for a quiet place to study
- Meeting rooms for student clubs – room booking
- Wayfinding – class schedule integration
- Food & campus services

Holistic Solution – Vendor Neutral | Future Forward

OCCUPANTS
- Occupancy Analytics
- Resource Booking Integration
- Way Finding
- Restroom Service Monitoring
- Visitor Management
- Mobile Building App
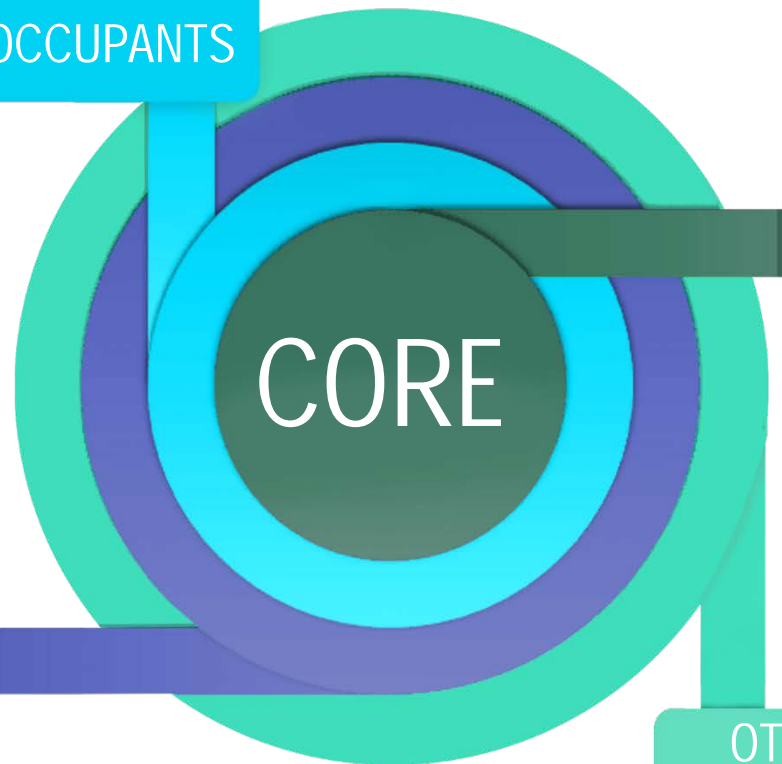
CORE BLDG SYSTEMS
- Emergency Mass Notification
- WiFi
- Electrical Distribution System
- Elevator System
- Enterprise Building Automation
- Lighting System
- Security Systems
- Window Shades
- Critical System Monitoring
- Metering
- Fuel Monitoring
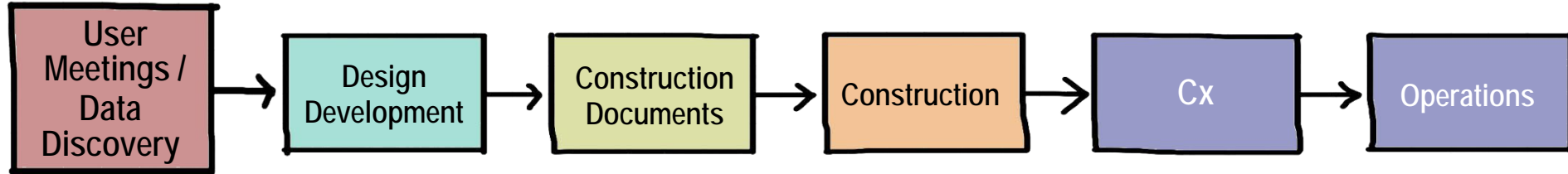- Fire Detection/Suppression

CORE

BRAND SYSTEMS
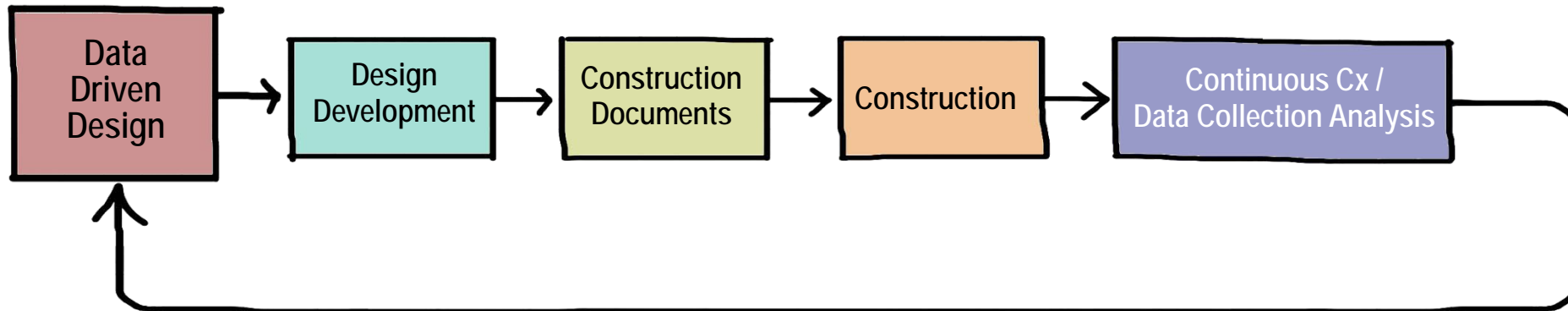- Digital Signage

OTHER SYSTEMS
- CMMS
- Mobile Enhancement Distributed Antenna
- Unified Communications and Telepresence
- RFID/RTLS
- Food Service POS
- Waste Mgmt
- Asset Mgmt
- Plug Load Monitoring
- BIM for FM

Data as a Collaboration Tool

TYPICAL METHOD

User Meetings / Data Discovery → Design Development → Construction Documents → Construction → Cx → Operations

DATA DRIVEN METHOD

Data Driven Design → Design Development → Construction Documents → Construction → Continuous Cx / Data Collection Analysis ⟲ (loops back to Data Driven Design)

Western Carolina University - Goals

Complex Lab Building – Simplify Operations

Integration with Classroom Registration System

Fault Detection Diagnostics

Western Carolina University – Simplified Operations

Key Performance Indicators (Macro)

- Occupant Comfort
- Operational Costs
- Energy
- Work Orders

Key Performance Indicators (Micro)

- kW/Ton
- kW/CFM
- Average Valve Position
- CHW Temp Differential
- Average Sash Position

Western Carolina University – Data Strategy
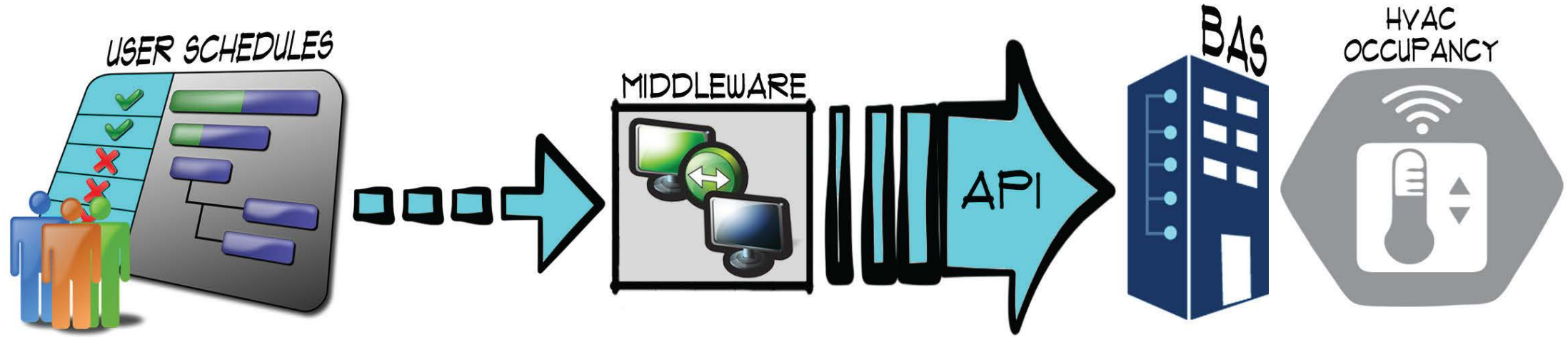
- Visioning Session – Basic Building Blocks of a Data Management Strategy
- Classroom Schedule Integration
- Graphics – KPI's, Summary Dashboard, Pressurization Mapping (Building + Zone)
- FDD – Customized rule set based on actual sequences of operation
- People Strategies – Simplified Operations; Effective Training

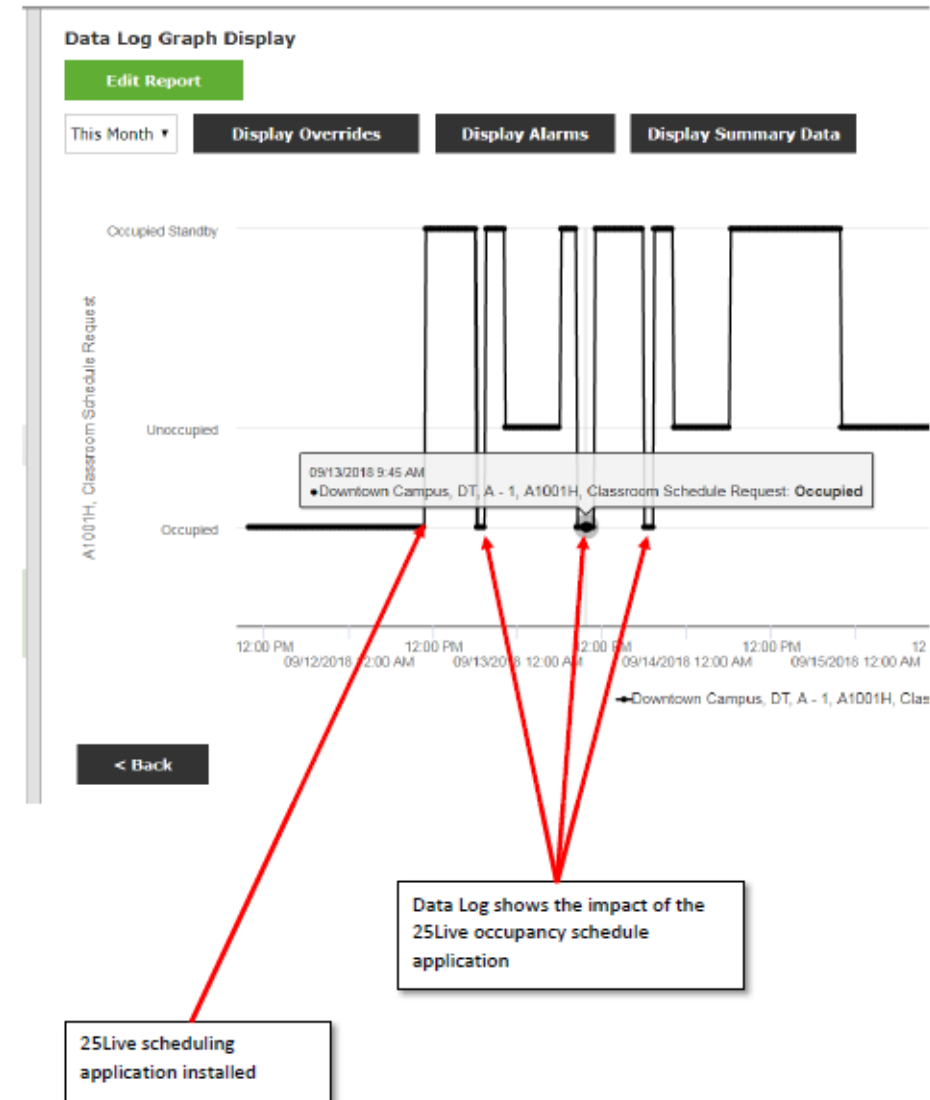# Florida State College Jacksonville - Goals

- Entire Campus Controls Upgrade

- Intelligent Campus

- Focus on Energy Reduction and Student Comfort

Florida State College Jacksonville - Integration

- Standardized hardware & software implementation
- Defined monitoring/control points according to KPI's
- Implemented Skysparks FDD solution
- Integrated CMMS system
- Integrated Energy Cap Utility Analysis software
- Student registration schedule integration (Live365) for HVAC runtime optimization
- Developed BAS Master Plan

Data log view – the occupancy request for each classroom may be trended to show the frequency of the events and time spent in the respective mode.

Florida State College Jacksonville - Fault Detection

Sky Spark Rule Set

AHU OA Damper Stuck Closed
AHU OA Damper Stuck Open
AHU Simultaneous Heating and Cooling
AHU Cooling Coil Valve Stuck Closed
AHU Cooling Coil Valve Stuck Open
AHU Heating Coil Valve Stuck Closed
AHU Heating Coil Valve Stuck Open
AHU Controlled Device Stability
AHU Static Pressure Control
Chiller Design Temperature Delta
Chiller High Pump DP Reset
Cooling Tower Approach Temp
Air Terminal Damper Stuck Closed
Air Terminal Damper Stuck Open
Air Terminal High Reheat Utilization
Equipment Running In Unoccupied Mode
Sensor Point Hung
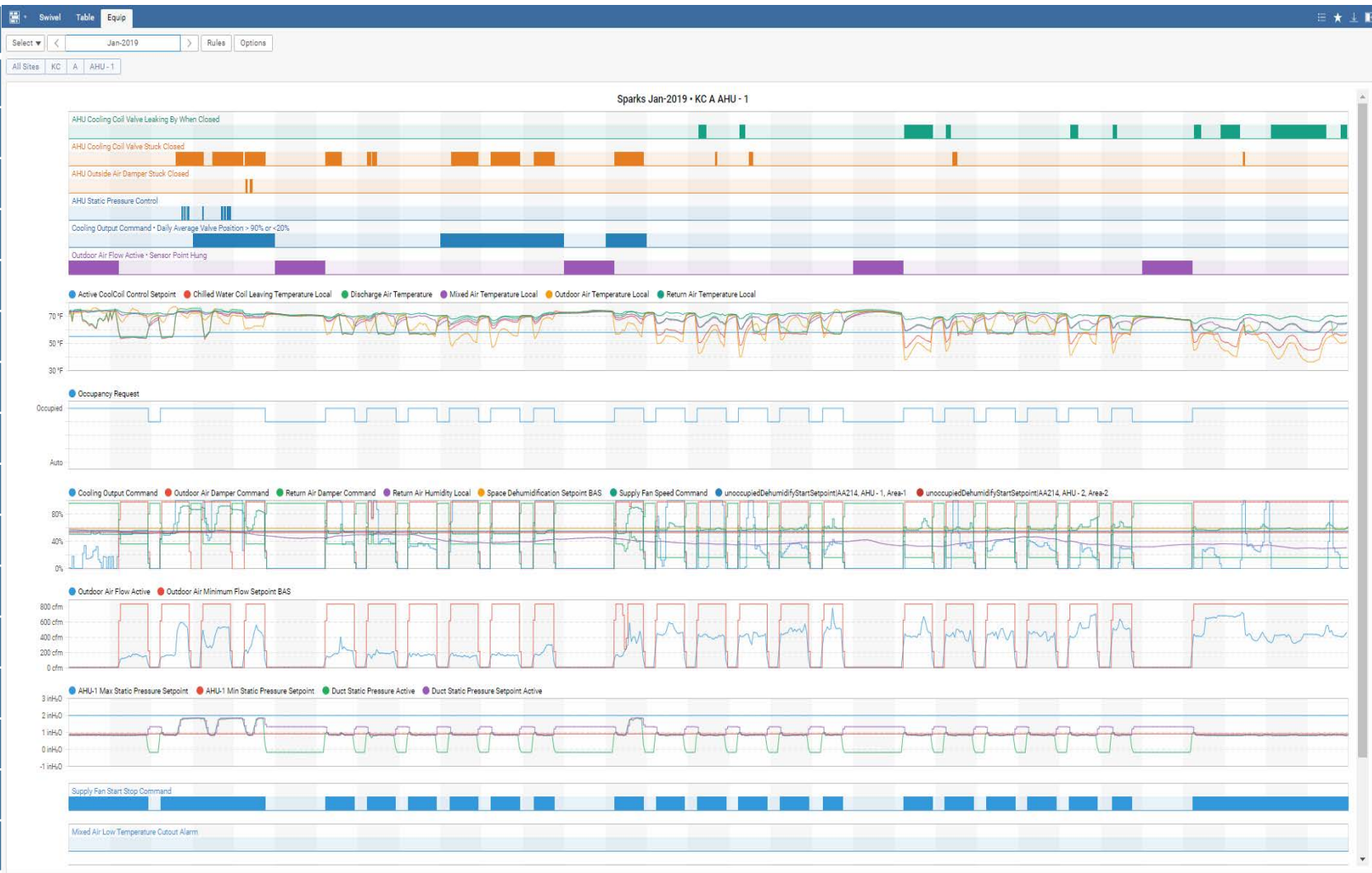
UF Health's Digital Journey

Year	Data Points	Milestones	Strategies
1990's	• 15K	• Introduction to Digital Controls	• All Renovations & Repairs to be DDC
2000's	• 30K	• First Full Digital Buildings: Florida Surgery Center and Cancer Hospital	• From Building Operation Center to and Enterprise Building Operations Center • Data Naming • Fault Detection Diagnostics
2010's	300K	• Data Driven Design: UF Heart & Vascular Neuromedicine Hospital	• Data Driven Design and Operations
2020's	1 Million	• Future Buildings & Renovations	• Predicted Operations: Energy and Equipment Failure • Machine Learning + Artificial Intelligence • Automation of Facility Management Functions

UF Health – Data Strategy

- Building Operations Center
- FDD
- Data Historian
- Asset Naming Standards
- Open Architecture – Competitive Bidding
- 10 years of Data for Analytics and Capital Planning

Outcomes

- $2/SF energy savings; **$5 mil in the past 5 years**

- Alarms **reduced by 80%**

- Occupant satisfaction rating of **96%**

This concludes The American Institute of Architects
Continuing Education Systems Course

Conclusion

Leverage Advancements in **Data Sciences** for the Benefit of the **Built Environment.**

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