

DESIGNING FOR BUILDING OPERATORS

EXPLORING SOCIO-
TECHNICAL ASPECTS OF
BUILDING DATA ANALYTICS

BY: CONNOR BRACKLEY



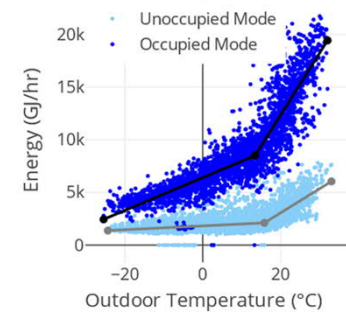
About me



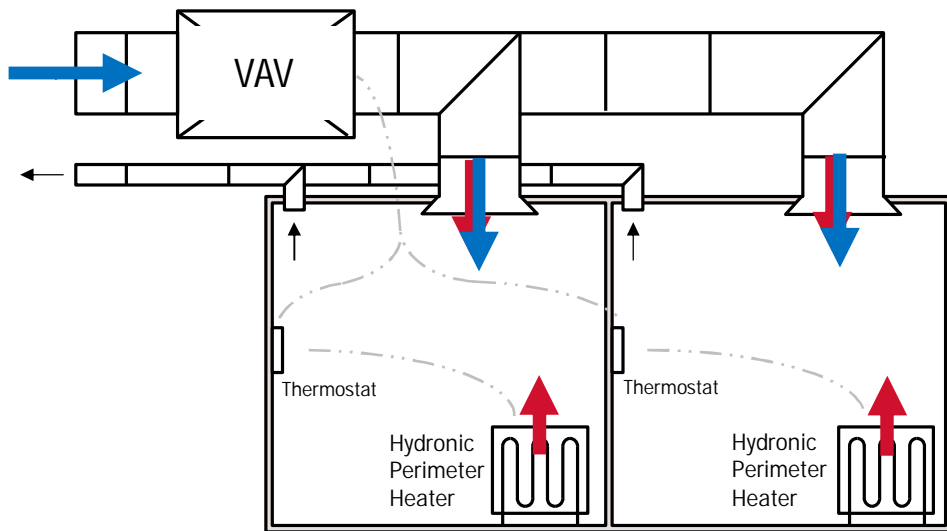
Masters of Applied Science
Human Factor Approach's to
Perceived Control of Thermostats



PhD Student
Technology Acceptance Approach's to
Building Performance Data Analytics



Master's Research



HVAC Systems are some of the **most complex** building systems people interact with

Typical thermostats **do not reflect the complexity** of the system

Master's Research



Time to setpoint



Zoning Info



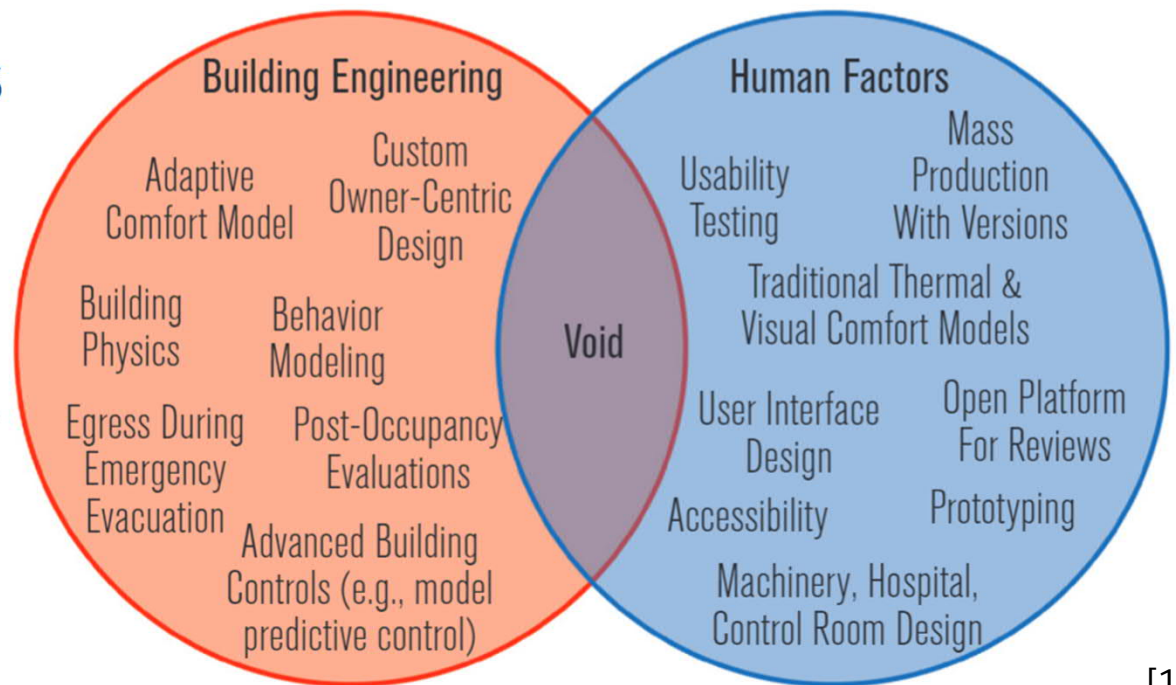
Schedule Info

The Human Factors Gap

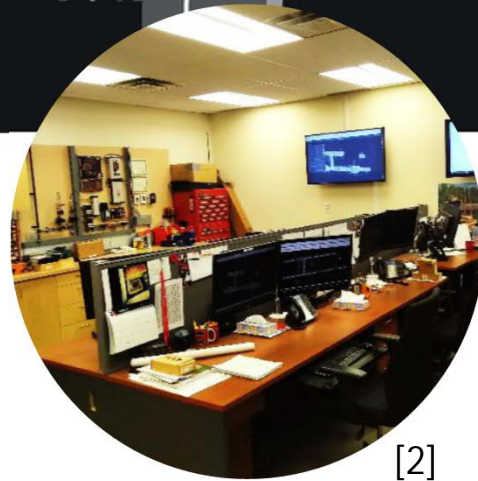
How Building Interfaces Affect Occupant Experience

BY WILLIAM O'BRIEN, PH.D., P.E.N.G., ASSOCIATE MEMBER ASHRAE; JULIA DAY, PH.D., MEMBER ASHRAE; CONNOR BRACKLEY, STUDENT MEMBER ASHRAE

Building interfaces—from simple levers and knobs to Internet-connected, voice-activated smart thermostats—represent the critical link between people and buildings. They are often the cause of major occupant-related discrepancies between expected and real building performance (the “performance gap”). Yet building interfaces have received disproportionately little attention in design practice and research.



[1]



[2]

Background

BUILDING OPERATION:
THE CURRENT STATE,
WHY IT'S IMPORTANT,
AND HOW ITS MANAGED.

Impact of Operational Decisions

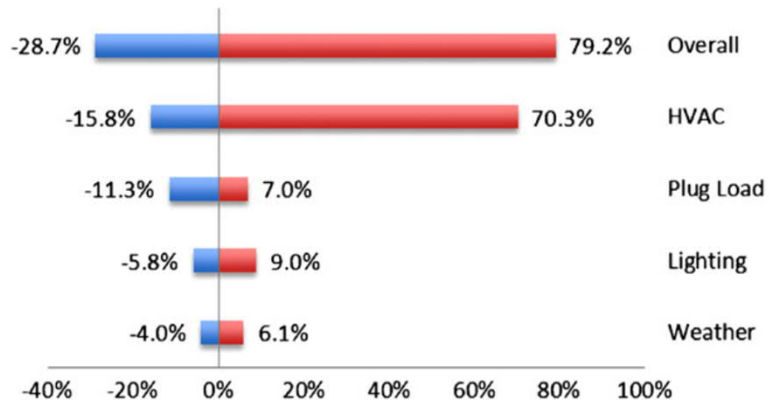
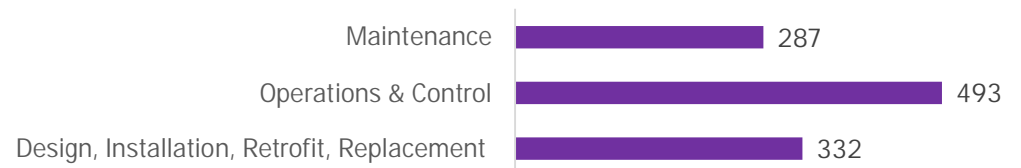


Fig. 9. Uncertainties in annual site energy consumption by category.

[3]

Frequency of Recommended Measures (Existing Buildings, N=1606)



Modified from [4]

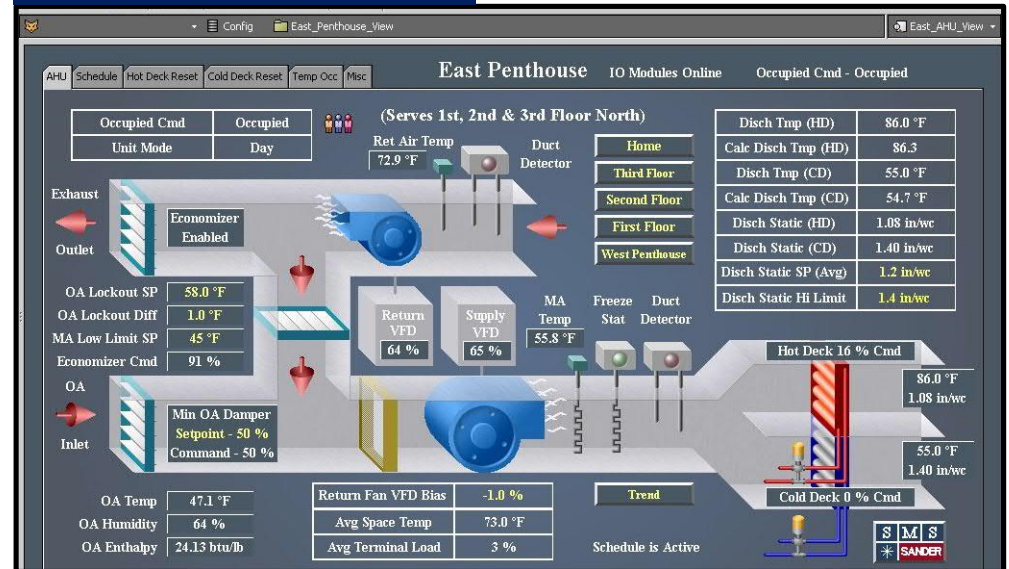
Energy Management Tools

Benchmarking



[5]

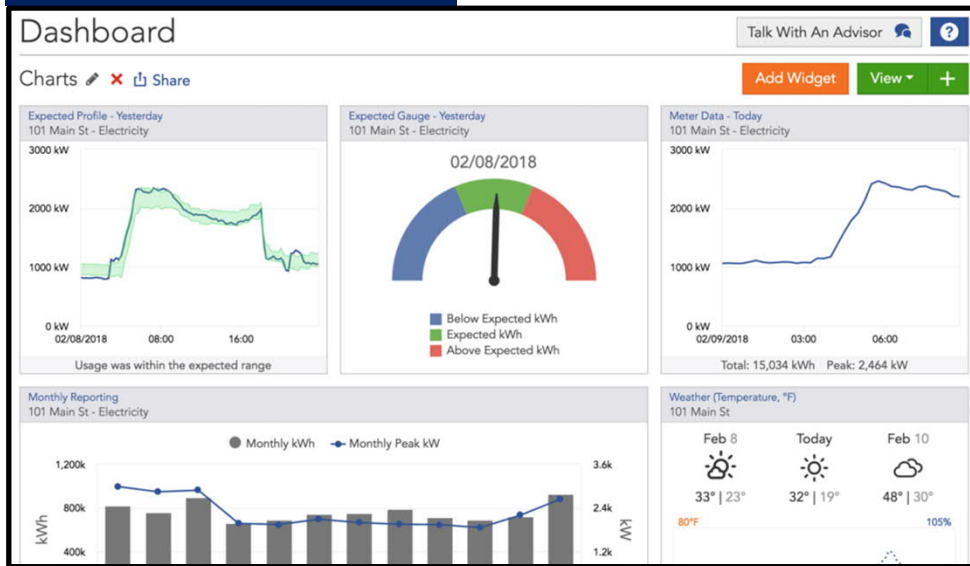
Building automation systems



[6]

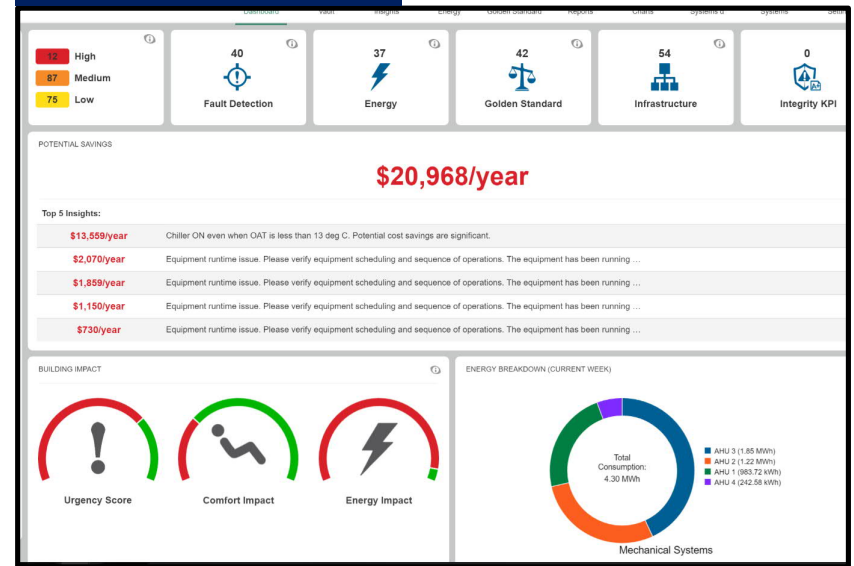
Energy Management Tools

Energy information systems



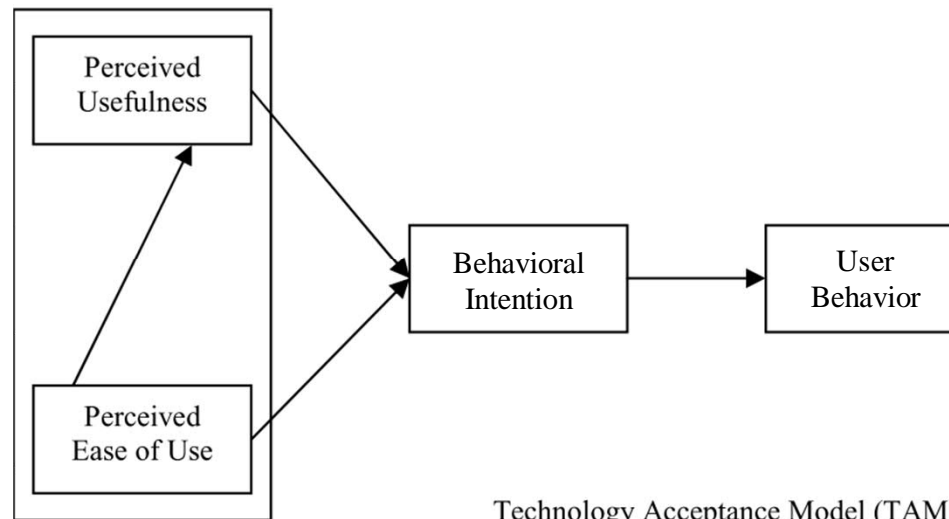
[7]

Fault detection systems



[8]

Technology Acceptance Model



Technology Acceptance Model (TAM)

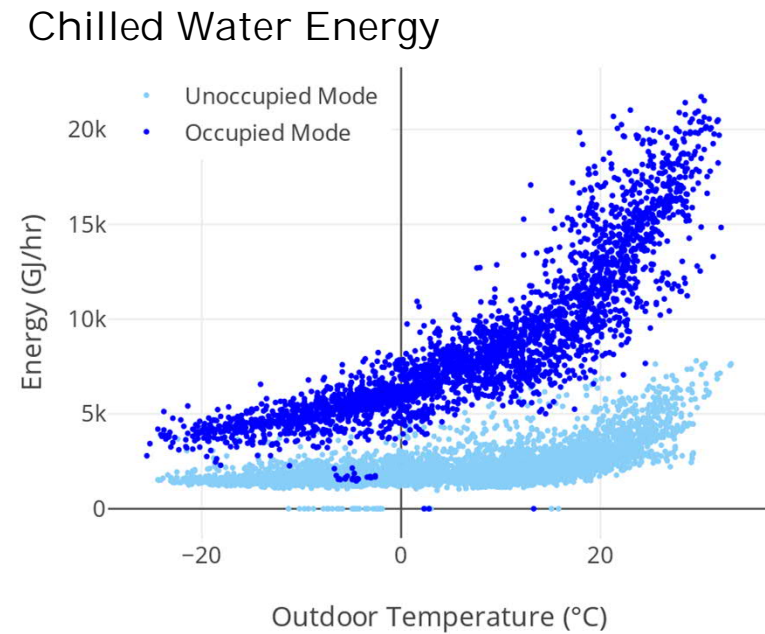
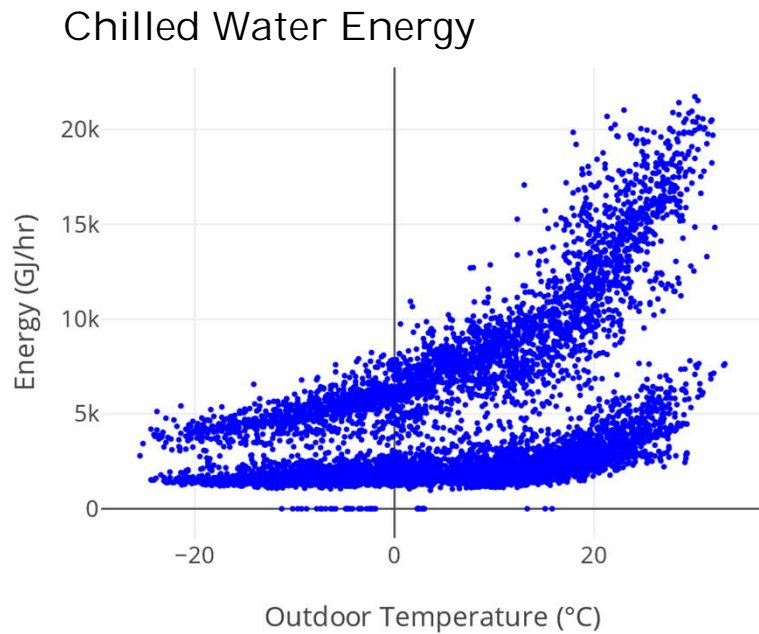
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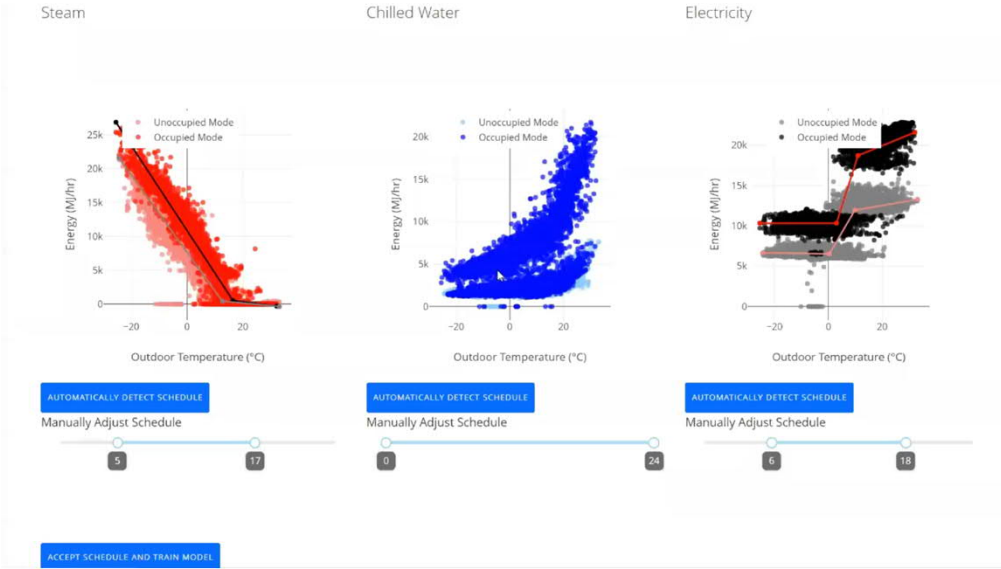
Current Work

TOOL PROTOTYPING AND
SOCIO-TECHNICAL
BARRIERS TO EFFICIENT
OPERATION

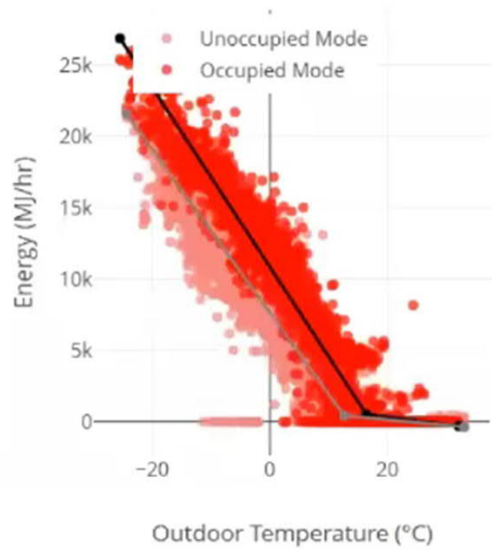
Prototyping - Equipment Schedule



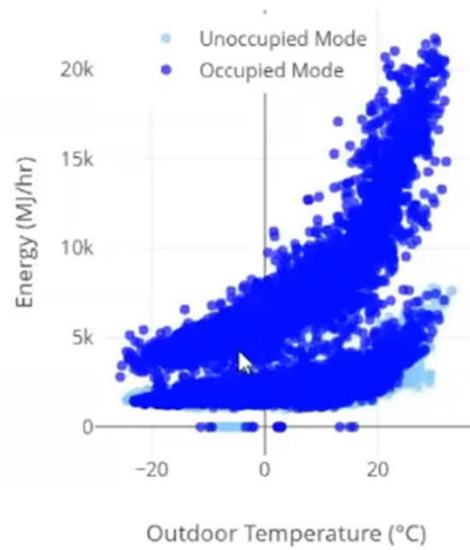
Rapid Prototyping



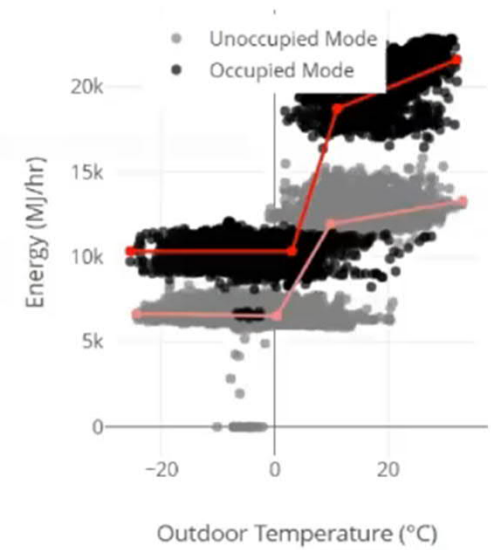
Steam



Chilled Water



Electricity



AUTOMATICALLY DETECT SCHEDULE

Manually Adjust Schedule



AUTOMATICALLY DETECT SCHEDULE

Manually Adjust Schedule



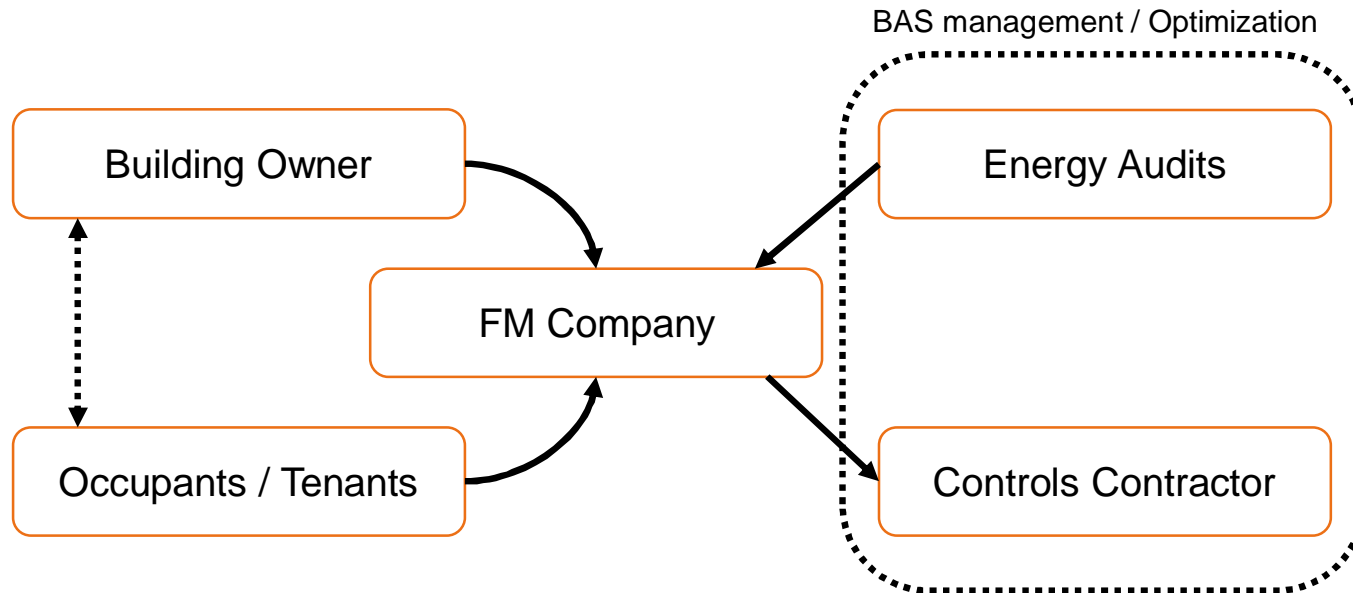
AUTOMATICALLY DETECT SCHEDULE

Manually Adjust Schedule

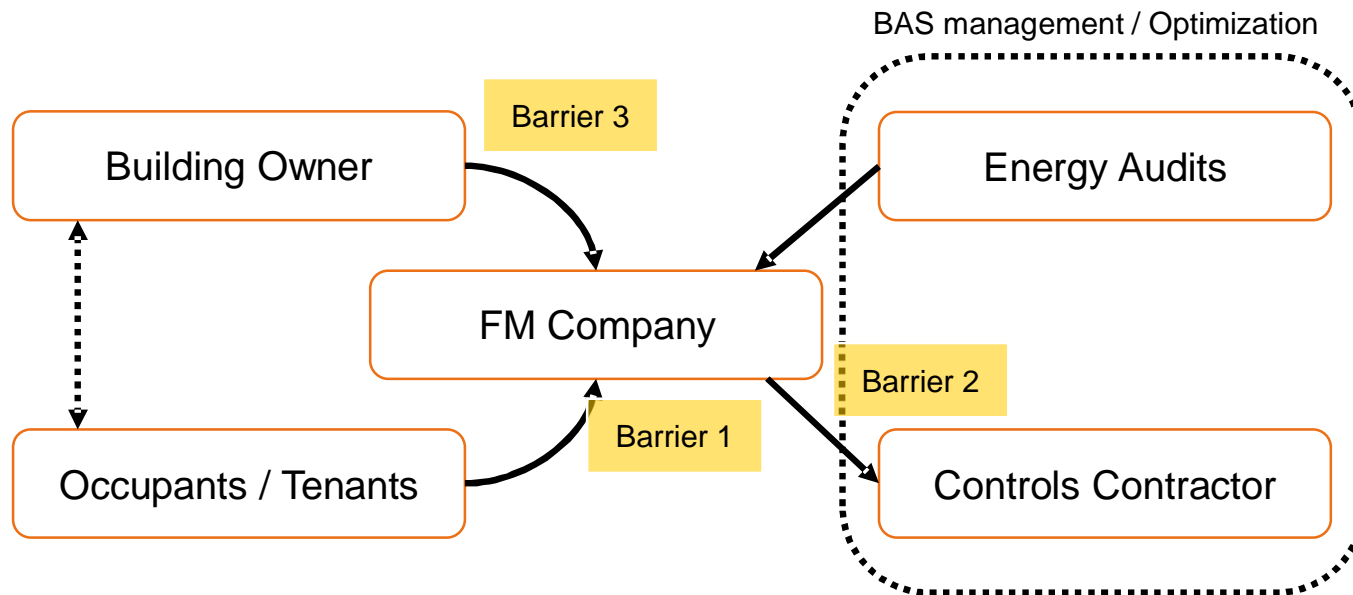


ACCEPT SCHEDULE AND TRAIN MODEL

Interviews with FM companies



Socio-Technical Barriers

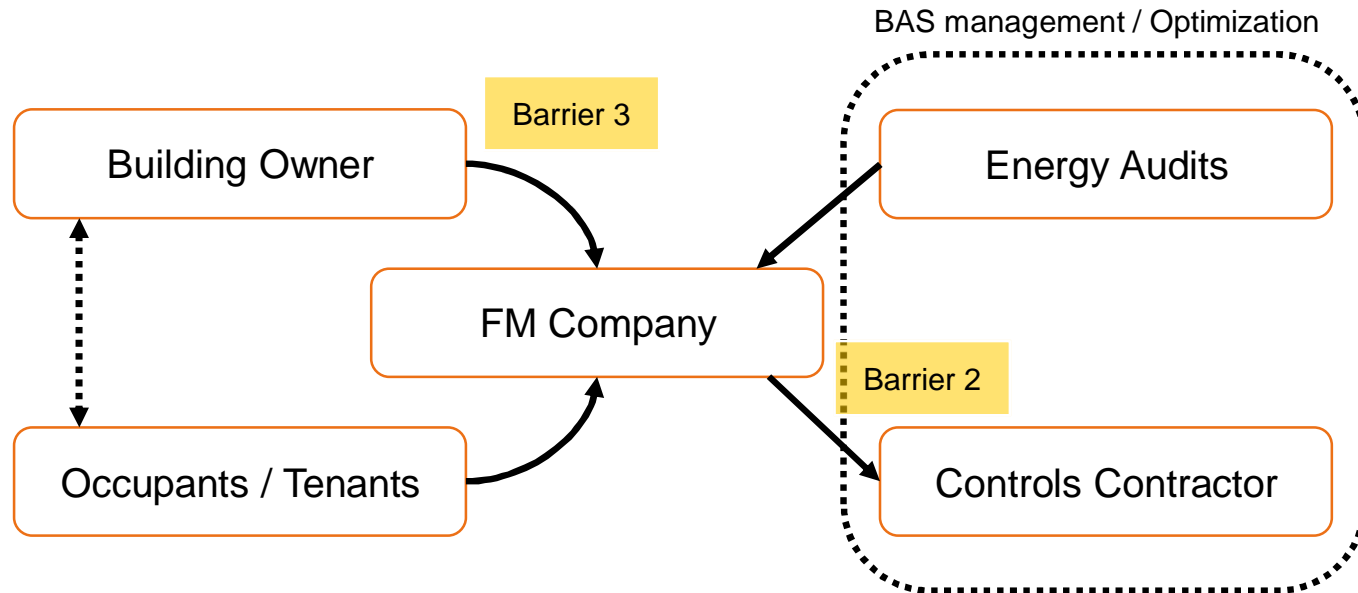


Socio-Technical Barriers

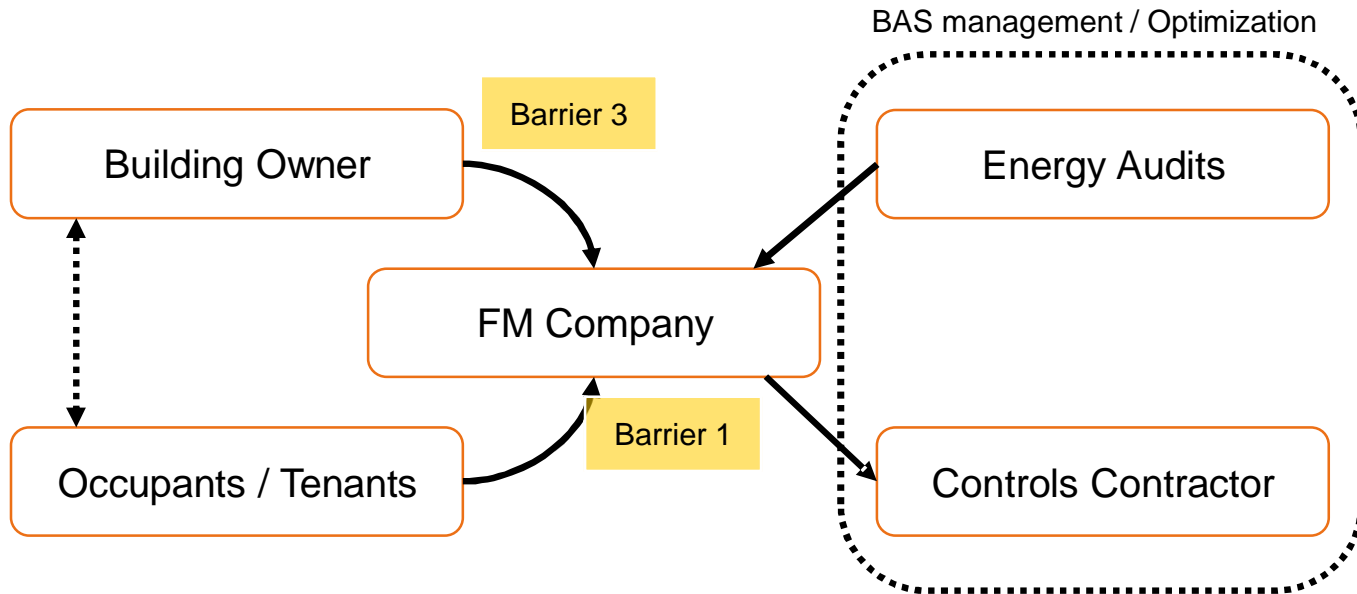
Barrier 1

Lack of building-specific short-term energy targets

"I don't want my team sitting and looking at real-time data, I want them doing projects which will reduce their energy and GHG consumption"



Socio-Technical Barriers



Barrier 2

BAS management is nearly entirely contracted out

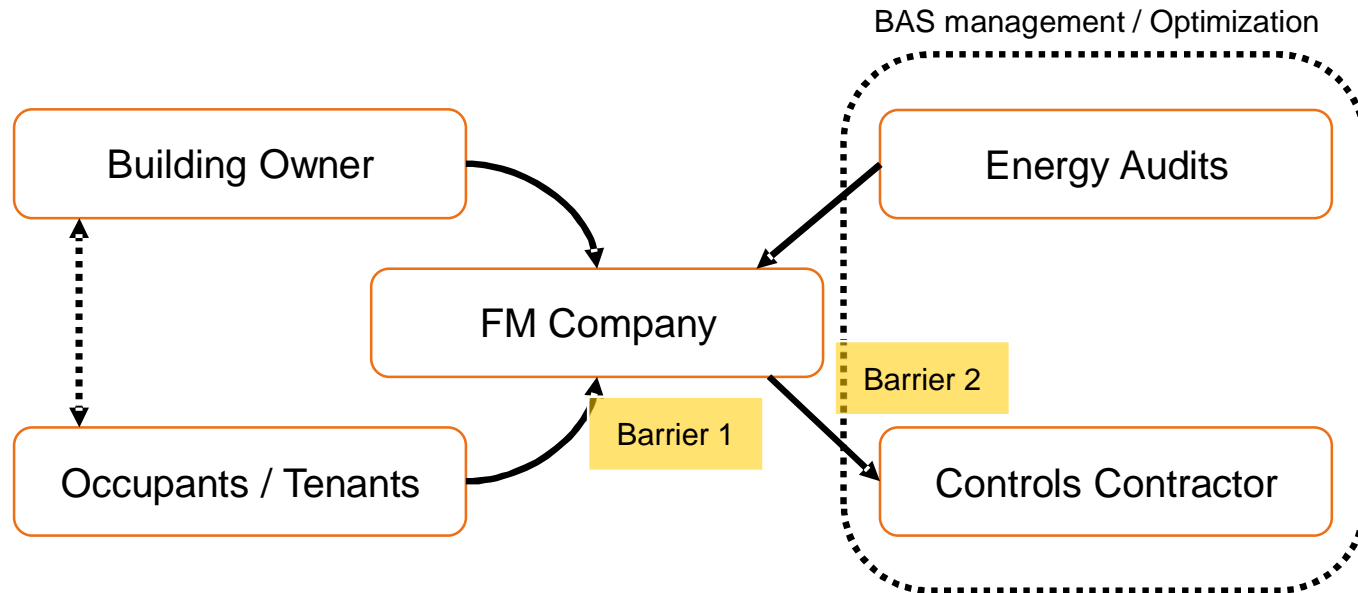
“Our controls providers are extremely reactive ... it’s pretty rare that they are coming to us with ideas and strategies.”

Socio-Technical Barriers

Barrier 3

FM-client contracts can disincentivize focus on operation

“we’re bound to the constraints of [our clients] direction and what they’ll approve”



Next Steps

1

Develop prototypes for a suite of **user focused** data analysis tools that fits within organizations **work flows and targets**

2

Iteratively test prototypes with **real users**

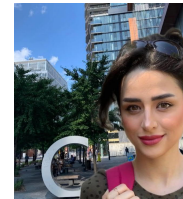
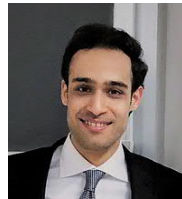
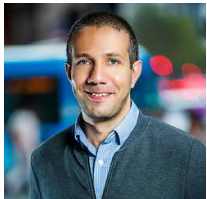
3

Develop **generalizable frameworks and recommendations** for tool development specific for the building industry



Intelligent Buildings and Cities Lab

We develop data-driven solutions to optimize occupants' interactions with the built environment and improve energy efficiency



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- [3] L. Wang, P. Mathew, and X. Pang, "Uncertainties in energy consumption introduced by building operations and weather for a medium-size office building," *Energy Build.*, vol. 53, pp. 152–158, 2012.
- [4] E. Mills et al., "THE COST-EFFECTIVENESS OF COMMERCIAL-BUILDINGS COMMISSIONING A Meta-Analysis of Energy and Non-Energy Impacts in Existing Buildings and New Construction in the United States," *Lbnl – 56637*, p. 99, 2004. [Online]. Available: <http://eetd.lbl.gov/emills/PUBS/Cx-Costs-Benefits.html>
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