# Harnessing Data Relationships with a Digital Twin

Chris McClurg, PE

BuildingIQ Snapshot

- Building optimization company
  - Establishing the future of how AI interacts with buildings
  - Making buildings smarter to achieve lower operating cost and energy optimization
  - Cloud-based technology-enabled services delivered from a common platform

- 120+ million ft^2 serviced with REITs, government, utilities, and enterprises in North American, Middle East, Australia, SE Asia

- Since 2009
  - ASX:BIQ since January 2016
  - ~45 people
  - Operations in United States, Australia, Philippines, and Singapore
  - 24/7 Network Operation Center
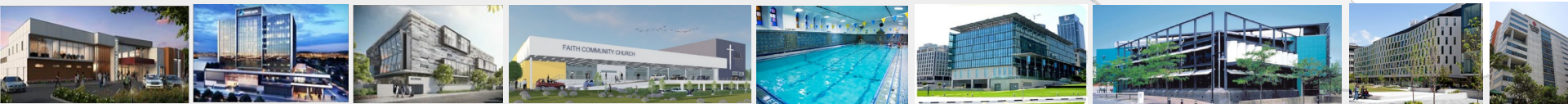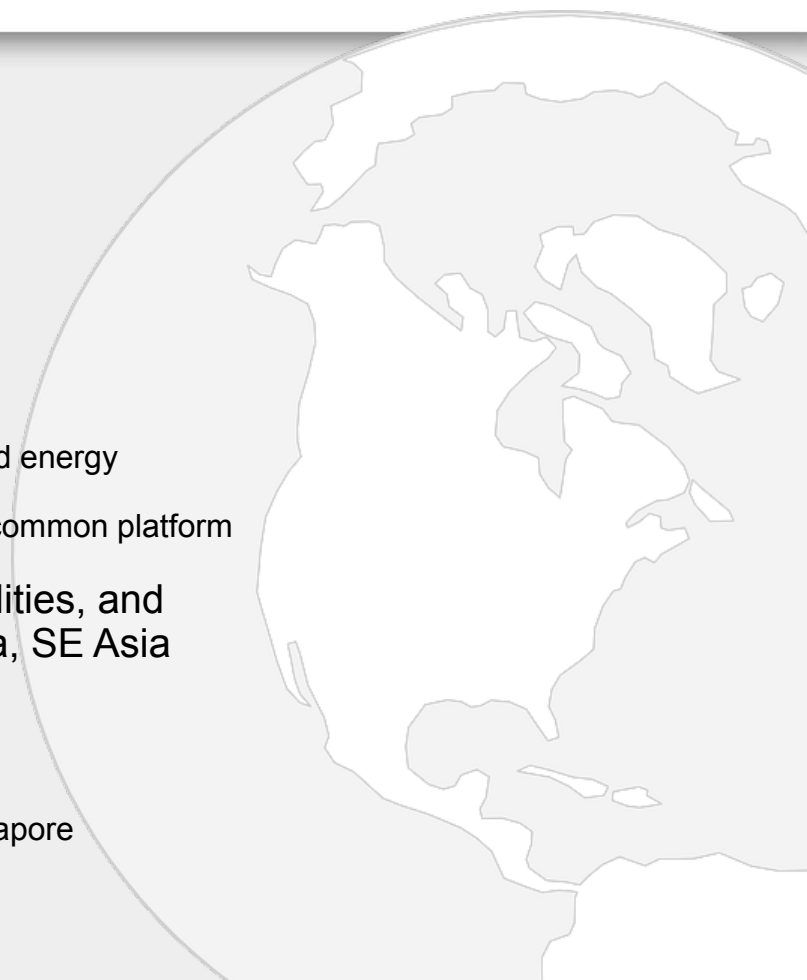
Buildings Have a Problem
Carbon Trust Research

Figure 2 *A comparison between actual regulated energy consumption and the output of modelling, used to generate the EPC rating for five case study buildings*

5 times design!*

*CarbonBuzz
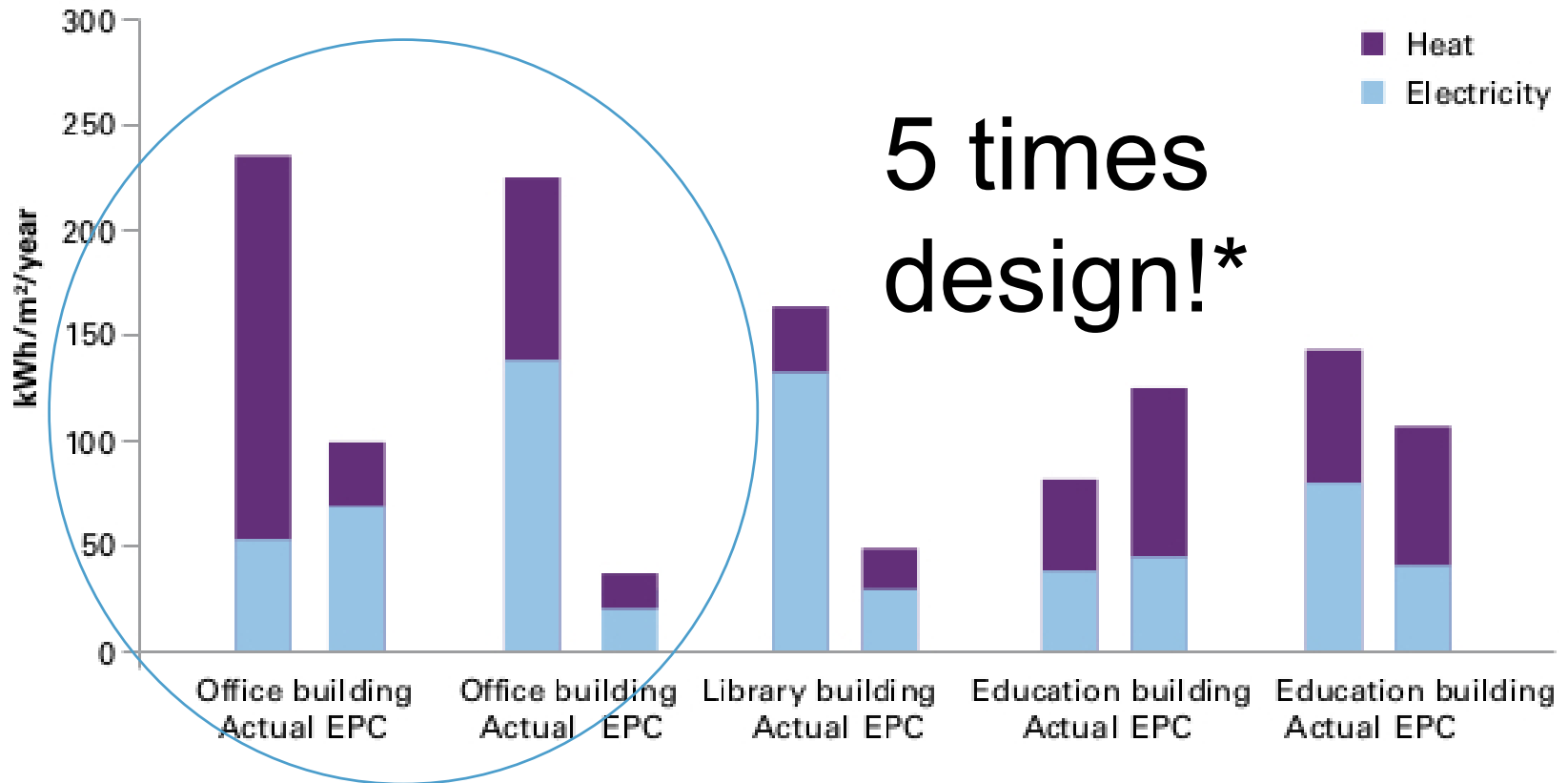
LAB026 - The noise cancelling foam tiles on the ceiling outside lecture theatre LAB026 **are coming away from the ceiling and may fall to the floor soon**. Please can this be fixed. Thanks

The pump on the econet unit for AHU 4 serving LAB 003 has failed. It is **supplying air at 10 deg and the room is 17 deg**. This is an urgent issue, the room is in use and is severaly below temperature. I have turned off teh AHU to stop more cold air.

LAB- 026 - grd Floor fire escape Door- Door closer in serious need of work as the **slightest breeze from adjacent by parting entrance door will blow exit door open** - Adjust asap

The cooling system in LAB seems particularly ineffective. Is it just not turned on or **must we deal with stifling airless corridors and rooms for the rest of eternity**

LAB- Every morning this week the iCentre office has been really cold to the extent we have borrowed a small heater from another Department. Can something be done where we get heat first thing in the morning. **We seem to constantly have a freezing cold office or the temperature of the tropics!** A balanced heat would be gratefully appreciated.

LAB- 027- Room is very hot and stuffy and there appears to be no working ventilation, **Room is full of international students from hot countries who are used to heat however they are finding it unbearable**. please advise

More Data Is Not the Answer

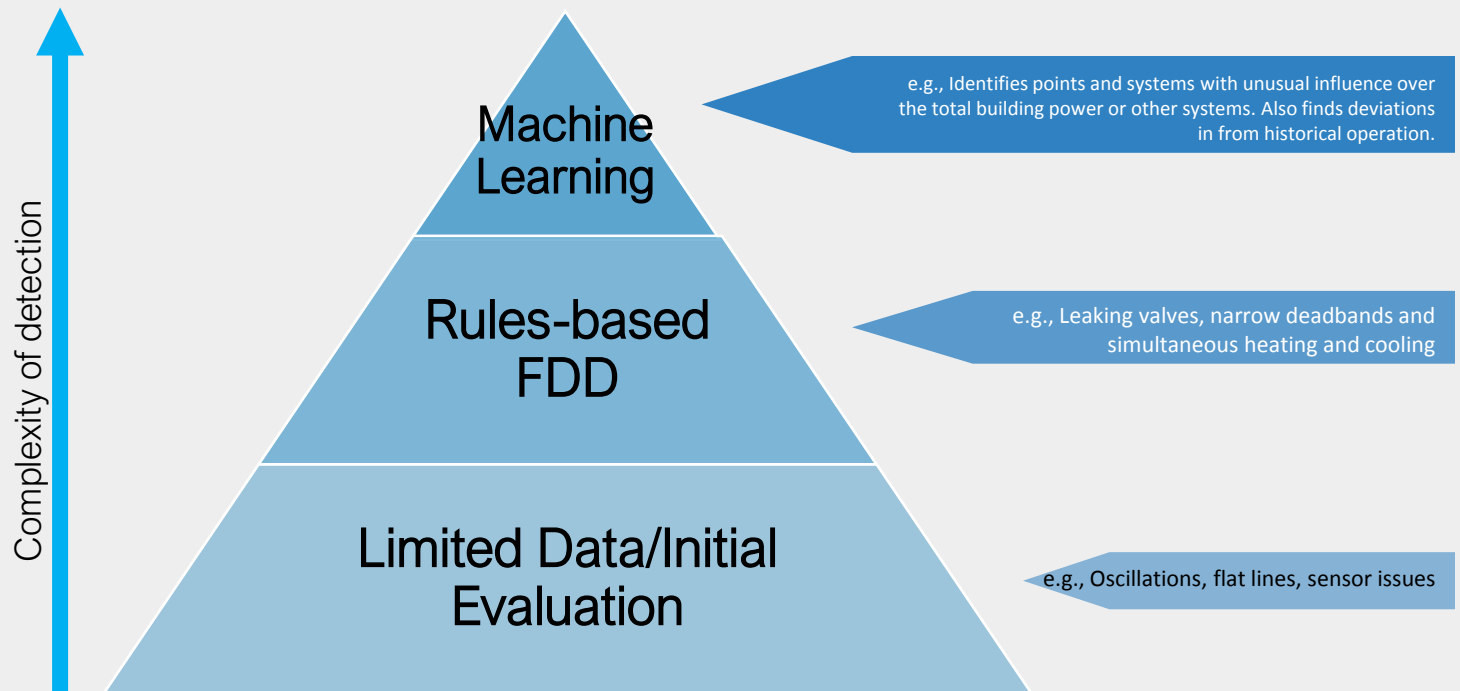# Outcome-based Fault Detection Service
Changing the FDD Game

- Partner for entire process for fault remediation: fault detection, diagnosis, prioritization, and validation service

- OFD uses a layered approach of human expertise, rules-based discovery and artificial intelligence to transform the noise of hundreds of detected daily faults into a set of prioritized, and justified, actions

- Uncovers the deeper dynamics of building systems and builds the deep knowledge base about the building to protect you

OFD Discovery & Diagnosis Hierarchy
*From One Building to Entire Portfolios*

Complexity of detection

Machine Learning

e.g., Identifies points and systems with unusual influence over the total building power or other systems. Also finds deviations in from historical operation.

Rules-based FDD

e.g., Leaking valves, narrow deadbands and simultaneous heating and cooling

Limited Data/Initial Evaluation

e.g., Oscillations, flat lines, sensor issues

OFD is Powered by AI

Influence Heatmap

- What points are driving whole building power?

- What points are influencing each other?

- Most effective demand response strategy?

- Where to invest limited resources?

BuildingIQ Influence "Heatmap" Low Level Tool

Correlation Engine
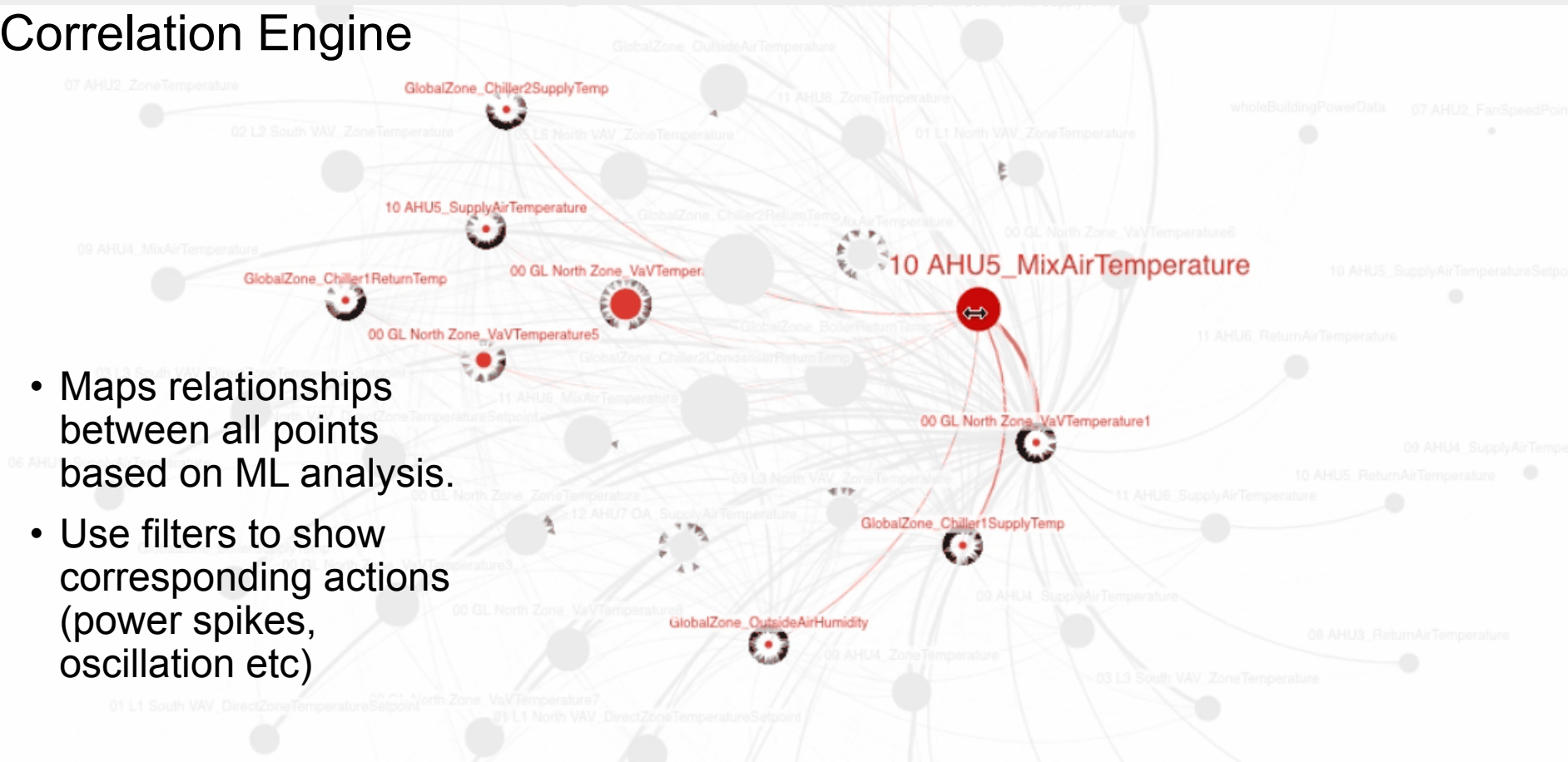
- Maps relationships between all points based on ML analysis.

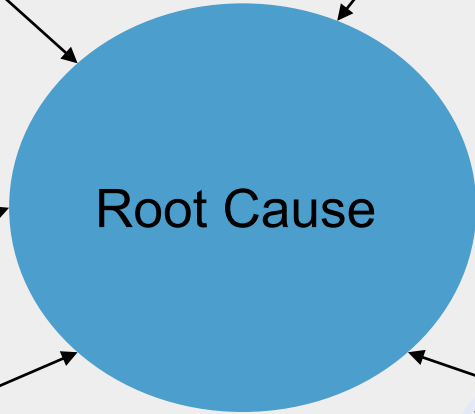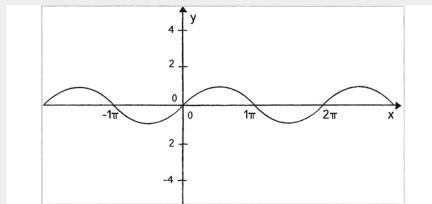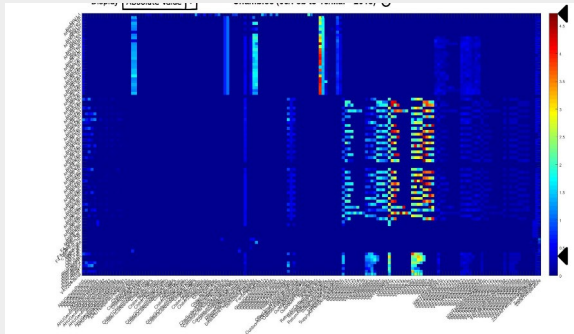- Use filters to show corresponding actions (power spikes, oscillation etc)

Finding the root cause
Translating analytics to actionable insights
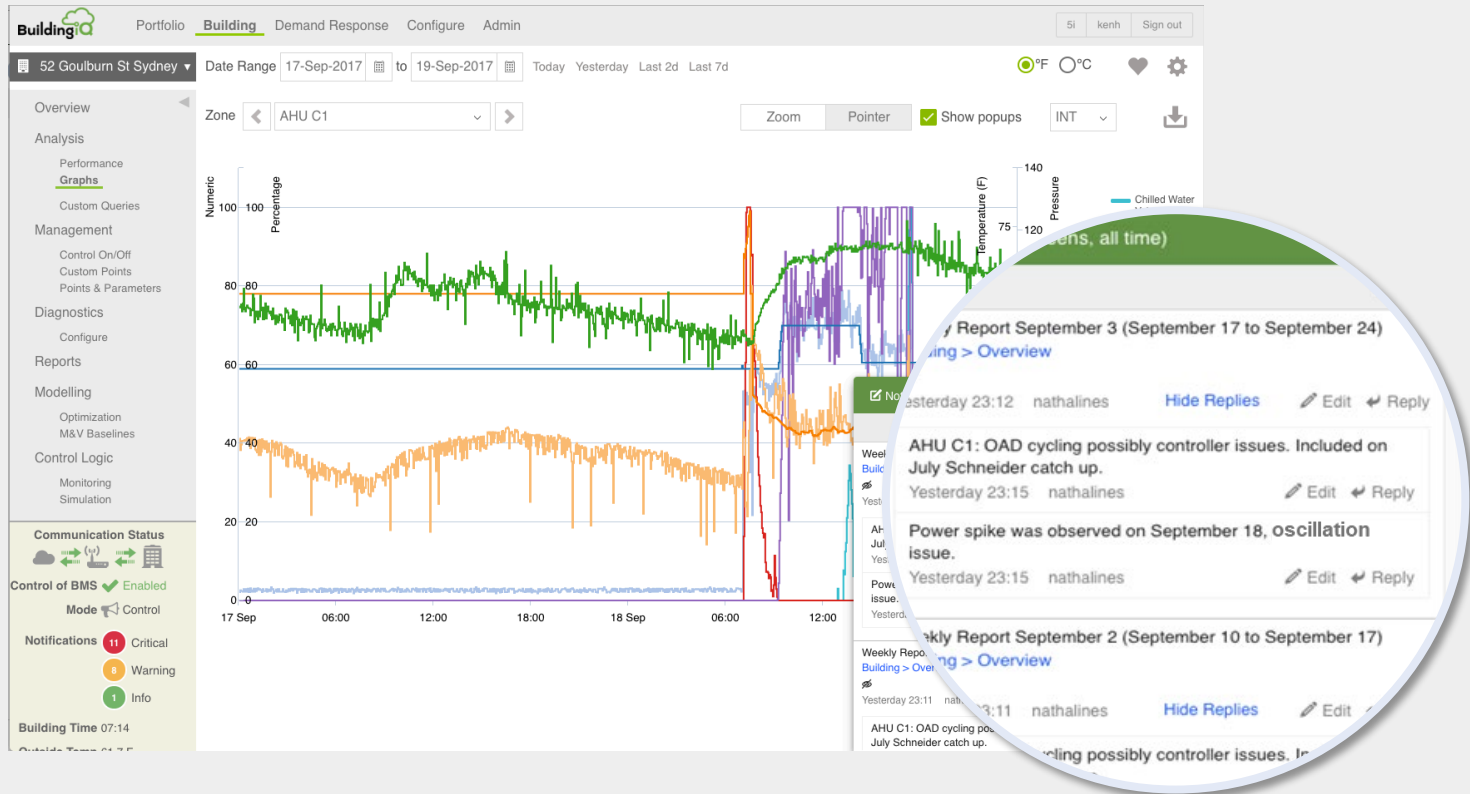
Recommendation Engine: Bringing it all together
Future development

Digital Twin – by Wikipedia

A digital replica of physical assets, processes and systems that can be used for various purposes. Provides both the elements and the dynamics of how an Internet of Things device operates and lives throughout its life cycle. Digital twins integrate artificial intelligence, machine learning and software analytics with data to create living digital simulation models that update and change as their physical counterparts change.

A digital twin continuously learns and updates itself from multiple sources to represent its near real-time status, working condition or position. This learning system, learns from itself, using sensor data that conveys various aspects of its operating condition; from human experts, such as engineers with deep and relevant industry domain knowledge; from other similar machines; from other similar fleets of machines; and from the larger systems and environment in which it may be a part of. A digital twin also integrates historical data…

BuildingIQ Knowledge Base
Powered by OFD

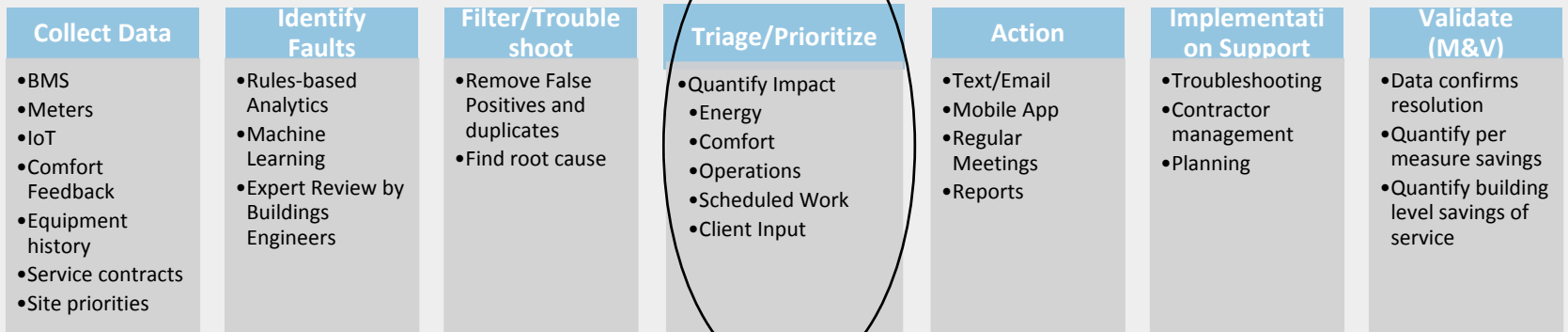- Protects against key employee turnover

- Minimizes risk, cost and exposure of "human-centric" deep knowledge

- Minimizes risk and cost of H2H knowledge transfer

- Protects against predatory vendors

Raw Data
10 years

Contextual Data

Relationships

Discussions

Root Causes
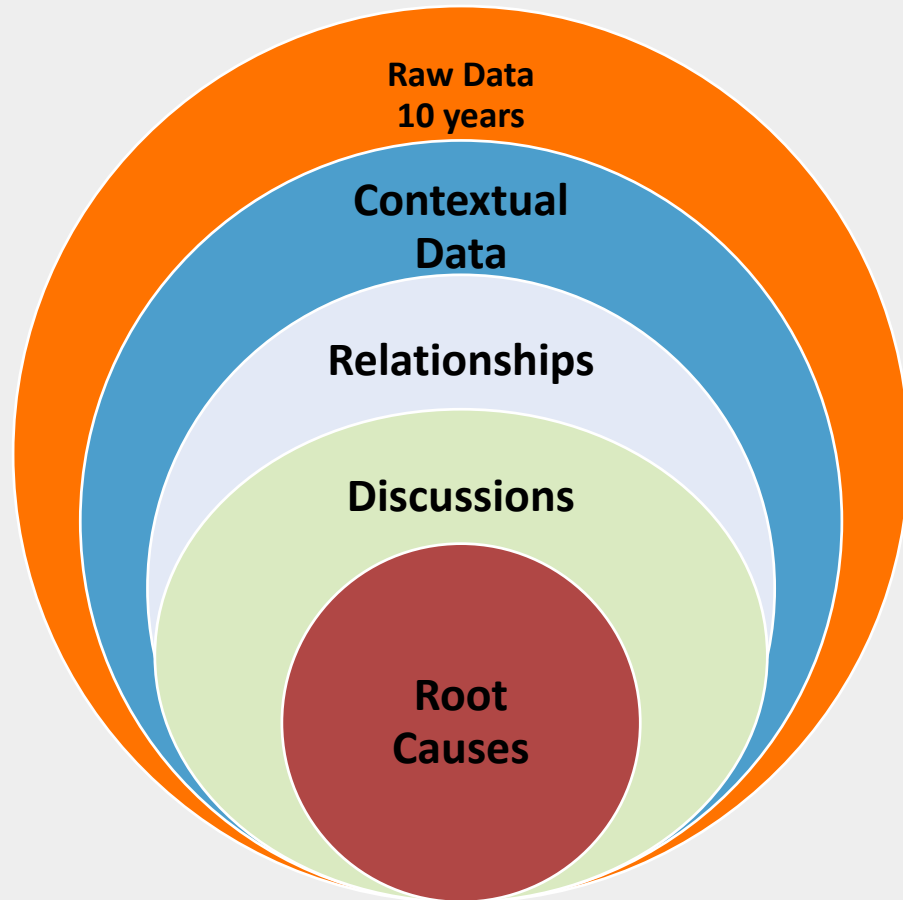
Fancy tools aren't enough
Helping drive action through services

Collect Data	Identify Faults	Filter/Trouble shoot	Triage/Prioritize	Action	Implementation Support	Validate (M&V)
• BMS • Meters • IoT • Comfort Feedback • Equipment history • Service contracts • Site priorities	• Rules-based Analytics • Machine Learning • Expert Review by Buildings Engineers	• Remove False Positives and duplicates • Find root cause	• Quantify Impact • Energy • Comfort • Operations • Scheduled Work • Client Input	• Text/Email • Mobile App • Regular Meetings • Reports	• Troubleshooting • Contractor management • Planning	• Data confirms resolution • Quantify per measure savings • Quantify building level savings of service

Questions?