Evaluation & Future Direction of Next Generation Automated FDD Tools in Australia

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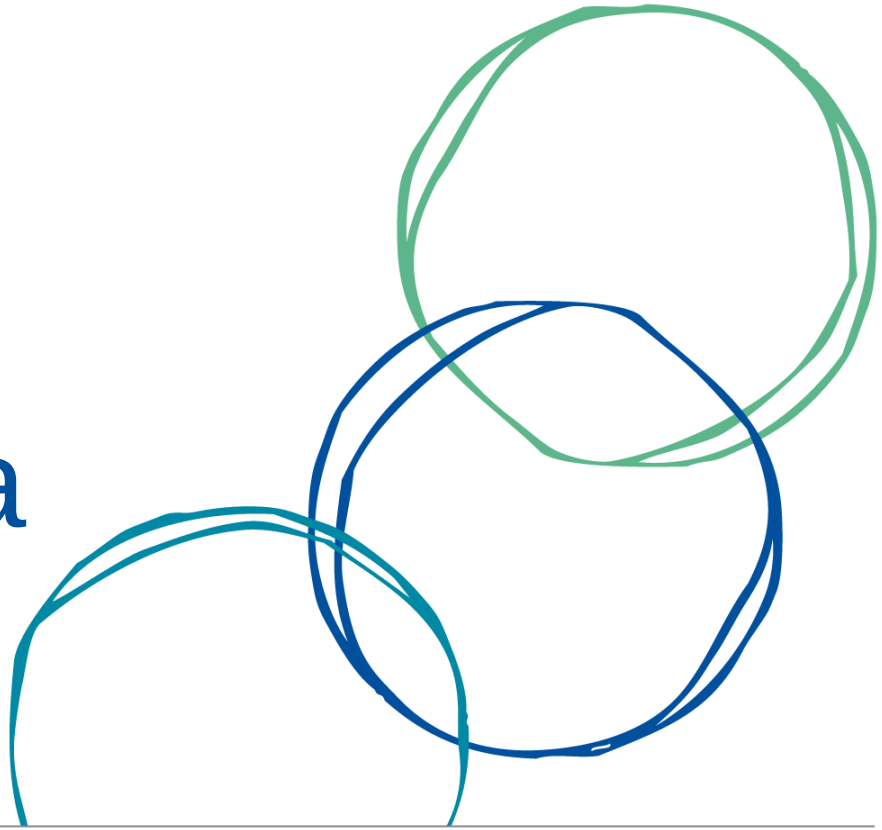


WORKSHOP: Ventilation for Indoor Air Quality & Cooling | 23 March 2018, Sydney

Summary

- What is FDD & can it help ventilation?
- Overview of RP1026: *Evaluation of Automated FDD Solutions*
- FDD Case Study Results in AU
- Future Direction

Automated FDD Solutions

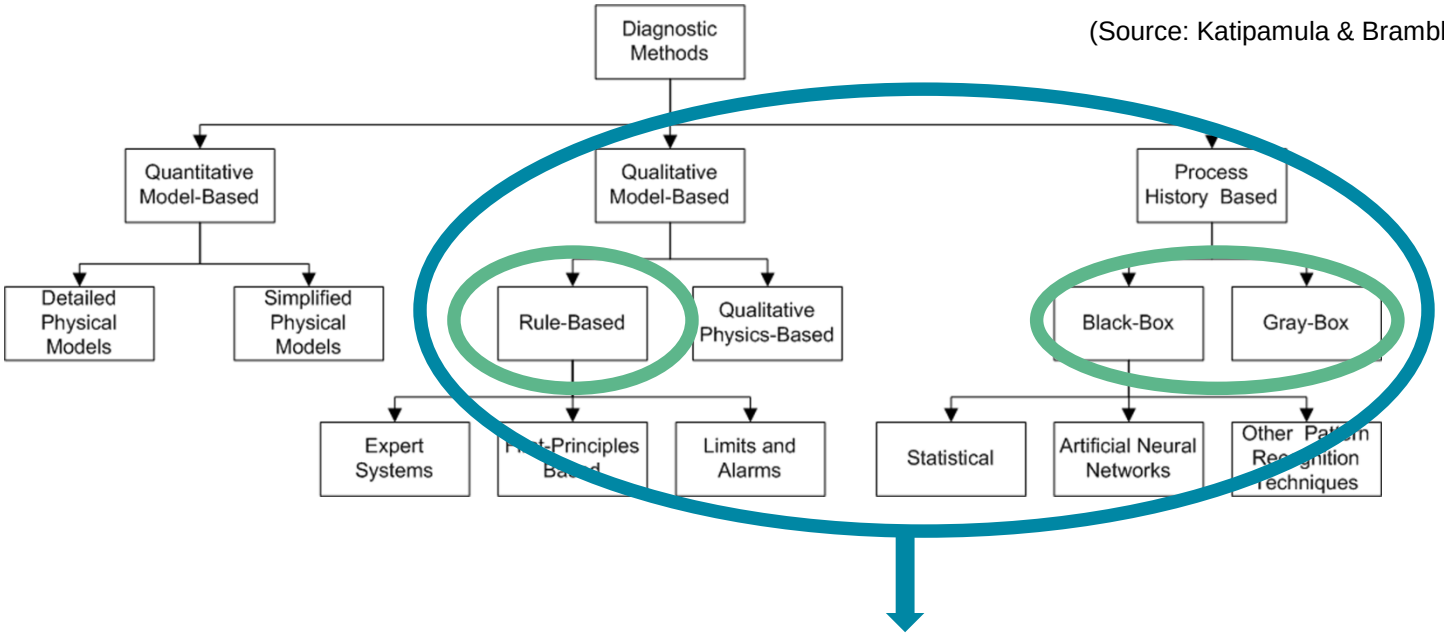
- WHAT IS FDD?
  - FDD is an area of investigation concerned with automating the processes of detecting faults within building systems and diagnosing their causes
    (Katipamula & Brambley 2005).

  - Software based (rules / algorithms)
  - Intelligent analytics to detect, diagnose and quantify operational inefficiencies.
    - Short-term ‘abrupt’ faults with systems or equipment
    - Longer-term performance degradation faults and energy wastage

Automated FDD Solutions

- Gen I FDD Tools:
  - Stand-alone software tools. Largely ‘Rule-Based’
  - Target Users: Facility Manager / Building Operator
  - Significant implementation effort & tuning
  - Downfalls: False alarms and ‘alarm fatigue’
- Gen II FDD Tools:
  - Managed Software as a Service (SaaS)
  - Rule-Based + Machine Learning-Based
  - Target Users: + O&M Contractors, BMS Controls Contractors, Building & Portfolio owners, Tenants
  - Better integration into O&M workflows

Classification of FDD Methods



(Source: Katipamula & Brambley, 2005)

- Hybrid Approach?
  - Rule-Based
  - Black-Box / Grey-Box
  - Baselining + Predictive Maintenance

RP1026 Overview

- RP1026 (Program 1: Integrated Building Systems):
  - *"Evaluation of Next-Generation Automated Fault Detection & Diagnostics (FDD) Tools for Commercial Building Energy Efficiency"*
  - Scope: … A systematic independent evaluation of the potential benefits of automated FDD solutions delivered as a managed service in Australia.
  - *Focus on FDD for HVAC Systems in commercial blds*
    - Part I: FDD Case Studies in Australia (publically available)
    - Part II: FDD Objective evaluation in an exemplar trial building (confidential)

RP1026 – Final Report

- Hot off the press!

"FDD Case Studies in AU"

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RP1026 Scope

- Independent evaluation:
  - Commercially available solutions in AU market
  - Solution Delivered as a ‘Managed Service’
- 6 FDD Solution Providers
  - CIM Enviro | Coppertree Analytics | Schneider Electric | UCTriX | Synengco | Control & Electric
- 7 different FDD Case Studies across AU
  - Mix of commercial building types (office, lab, museum, hospital)
  - Locations: NSW, ACT, QLD, VIC

RP1026 Scope

- Types of ‘Faults / Alarms / Insights detected:
  - Sensor faults (bias, drift, malfunction)
  - Equipment faults
    - Central plant faults (staging, pressure, not meeting SP)
    - Water values & air dampers stuck open/closed
    - Oscillating water values
    - Incorrectly tuned control loops
    - Fan motor / VSD faults / belt ware and slippage
    - Air filter blockages and duct leakages
  - System / Sub-system faults or inefficient operation
  - Anomaly detection & energy wastage

What FDD end users are saying:

"*Using CIM Enviro, we have achieved a seven half-star jump for $48,000 Opex, but most impressively, for no Capex expenditure* "

- Associate Director | Asset Management, NSW

"*The introduction of Synengco FDD for at our hospital site will enable us to use predictive techniques to proactively manage our energy usage.*"

- Facilities Maintenance Manager, QLD

"*The Joule AnalytiX platform integrates with our existing BMCS and helps us get the most from our contractors.*"

- Operations Manager, NSW

"*Building Analytics by Schneider Electric has helped us improve our proactive maintenance program of critical assets enabling us provide a high level of service to our customers*"

- Mechanical Asset Manager, VIC

" *Coppertree Analytics has been an integral part in driving our maintenance activities and lowering our energy consumption.*
It's implementation has helped streamline our maintenance, which means more time can be spent fixing problems instead of identifying them."

- Senior Building Manager, ACT

RP1026 FDD Case Study Results

- Summary of Key Results

	Case study Project:	Key FDD Outcomes:
	Melbourne Museum, Melbourne VIC	Yearly savings of 20% in electricity and 28% in gas
	Commercial Office Tower, Sydney NSW	1.5 Star to 5 Star NABERS rating in 24 months
	Commercial Office Tower, Canberra ACT	Improved thermal comfort conditions while achieving 15% total electricity reduction and 19% total gas reduction
	Melbourne Airport, Melbourne VIC	Reduction in the avoidable energy cost, number of comfort anomalies, and number of maintenance anomalies
	Public Hospital, Brisbane QLD	Decisions-support to reduce the life cycle cost of operation, and aided electricity, gas and facility management contract negotiations
	Research Lab Facility, Canberra ACT	20% decrease in monthly energy consumption and 744MJ/m² decrease in site energy intensity

- Full Results (Final Report):

RP1026: Evaluation of Next-Generation Automated Fault Detection & Diagnostics Tools for Commercial Building Energy Efficiency

What FDD Solution Features to look for?

(based on Clarke et al., 2015)

- Does it provide a real-time multi-user interface as well as periodic reporting for delivery of actionable insights?
- Can it integrate and utilise BMCS data, energy/power sub-meter data, and other building and external systems data?
- Can it pinpoint the source of failure at the sub-system or equipment level?
- What are the upfront and ongoing costs, and are there any extra or hidden costs?
- What data and information is required to fully implement the solution and what is the setup time?
- Can it integrate with maintenance processes and work-order systems to remove manual handling and data entry to fast-track rectification works?

Future Directions

- Emerging AI and machine learning tools + large amounts of data from disparate data sources
- Analysed in a way that provides meaningful insights into the short + longer term performance (and degradation) of all Building Energy Systems!
  - Data Sources: BMCS, sub-metering, localised high resolution weather data, building occupancy & preference, thermal comfort, building information models (BIM), commissioning data
- Accurate Predictive Maintenance outcomes
  - Estimate remaining time to failure (or time before reaching an unacceptable level of performance)
  - Rate of degradation
  - Nature of the failure if it were to occur

Conclusion

- Latest Generation FDD Tools & Services are demonstrating enormous value
  - Energy / cost / ratings / equipment life
  - Comfort & satisfaction (IAQ, thermal comfort…)
- Next Gen FDD & Analytics Solutions
  - Big data, complex systems, predictive maintenance
- FDD + Ventilation?
  - Maintain high operating efficiencies for HVAC and ventilation systems & sensors
  - Detect senor errors (operation, bias, drift)
    - CO_2, IAQ, occupancy/motion detection
  - Active ventilation systems: detect faults & energy wastage
    - Exhaust fans, AHU fans, VSDs, Drive belts, air filters

KEEP VENTILATED!

Thank you

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The CRC for Low Carbon Living also works with an extensive range of government and industry third parties at a project level

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