Theme D: Data Analytics for the Built Environment

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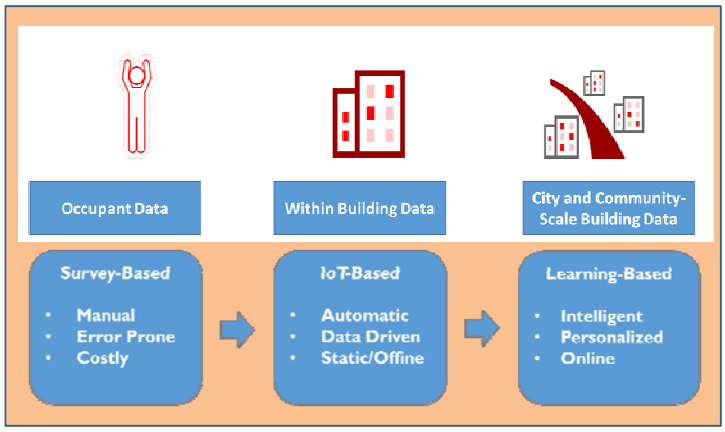
The broad research objective in this theme is to develop analytics engines to analyze building related datasets with the purpose of:

- Modeling occupant needs and preferences that can be fulfilled by intelligent building control systems, and their behavioral response to energy reduction incentives;
- Assessing the system state for preventive maintenance scheduling and low-latency fault detection of building components;
- Identifying characteristics of highly energy efficient buildings at the community-scale; and
- Making aggregate data and data analytics algorithms and software available to the community using widely acceptable open source principles.



Project 1: Real-time Estimation of Building System State

Development of algorithms and software to automatically integrate and analyze both structured and unstructured data from facilities design and operations, and thus enable facilities managers to be more proactive in improving building occupant comfort, conducting efficient resource allocation, and reducing wasted energy through machine learning and optimal control techniques

Project 2: Applications through Preventive Building Maintenance and Fault Detection

Examination of the optimal maintenance scheme for an entire set of building facilities to reduce or eliminate downtime, prolonging components' life cycles and protecting investment cost. Based on facility degradation assessment, advanced techniques such as reinforcement learning and stochastic dynamic programming will be suitably applied alone or in combination to minimize the cost incurred in component replacement, repair and intervention.

Project 3: Learning-Based Thermal Comfort Modelling

Validation and extending both the PMV and the adaptive models will be performed through white-box modeling between in-situ and crowdsourcing measurements, and the list of personal and environmental parameters Deep-learning techniques will be employed to develop a black-box thermal comfort model, capturing the physiological and psychological semantics, to model human thermal comfort, health and satisfactions in the tropics.

Project 4: Virtual Energy Auditing of Existing Building Stock

Identification of commercial buildings that are excellent targets for cost-effective energy efficiency programs. This work focuses on operational energy efficiencies that can be addressed through the building energy management system. An anonymized database of building electricity consumption, cross-linked with meteorological data, and tagged with metadata of construction details and occupancy statistics will be assembled. Several metrics that capture the operational energy efficiency of buildings will be proposed.

"This research project is funded by the National Research Foundation Singapore under its Campus for Research Excellence and Technological Enterprise (CREATE) programme."