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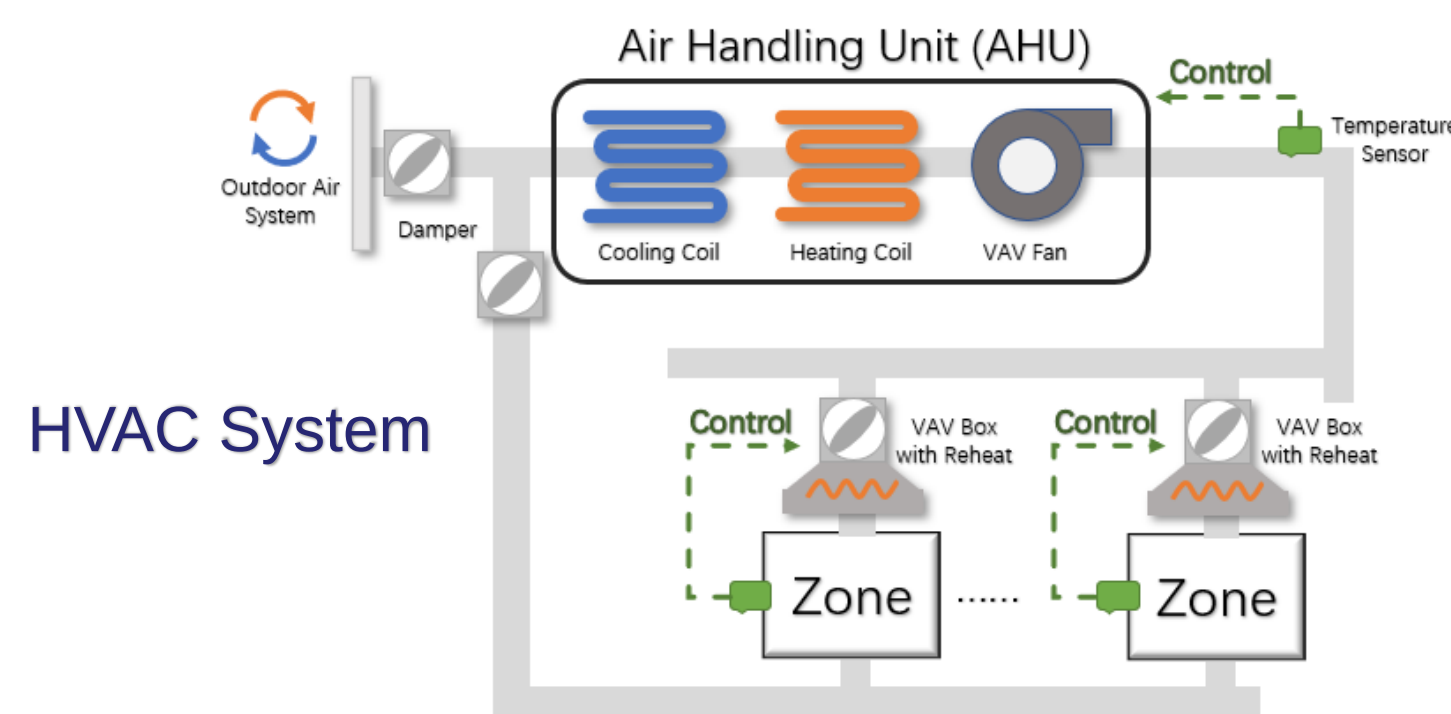
In Collaboration With

Roberto Yus



MOTIVATION

- The HVAC (heating, ventilation and air conditioning) system is used to provide thermal comfort in offices, accounting for **30% to 50%** of the energy consumption in commercial buildings.
- The **diversity and sustainability** challenges in providing thermal comfort for groups of people in shared spaces are an important research topic, because they involve people's health, well-being and productivity, as well as the energy efficiency and environmental impact of buildings.
- In shared spaces, different people may have different thermal comfort preferences and needs, so a method to **balance individual thermal comfort, energy consumption and equality** is needed.

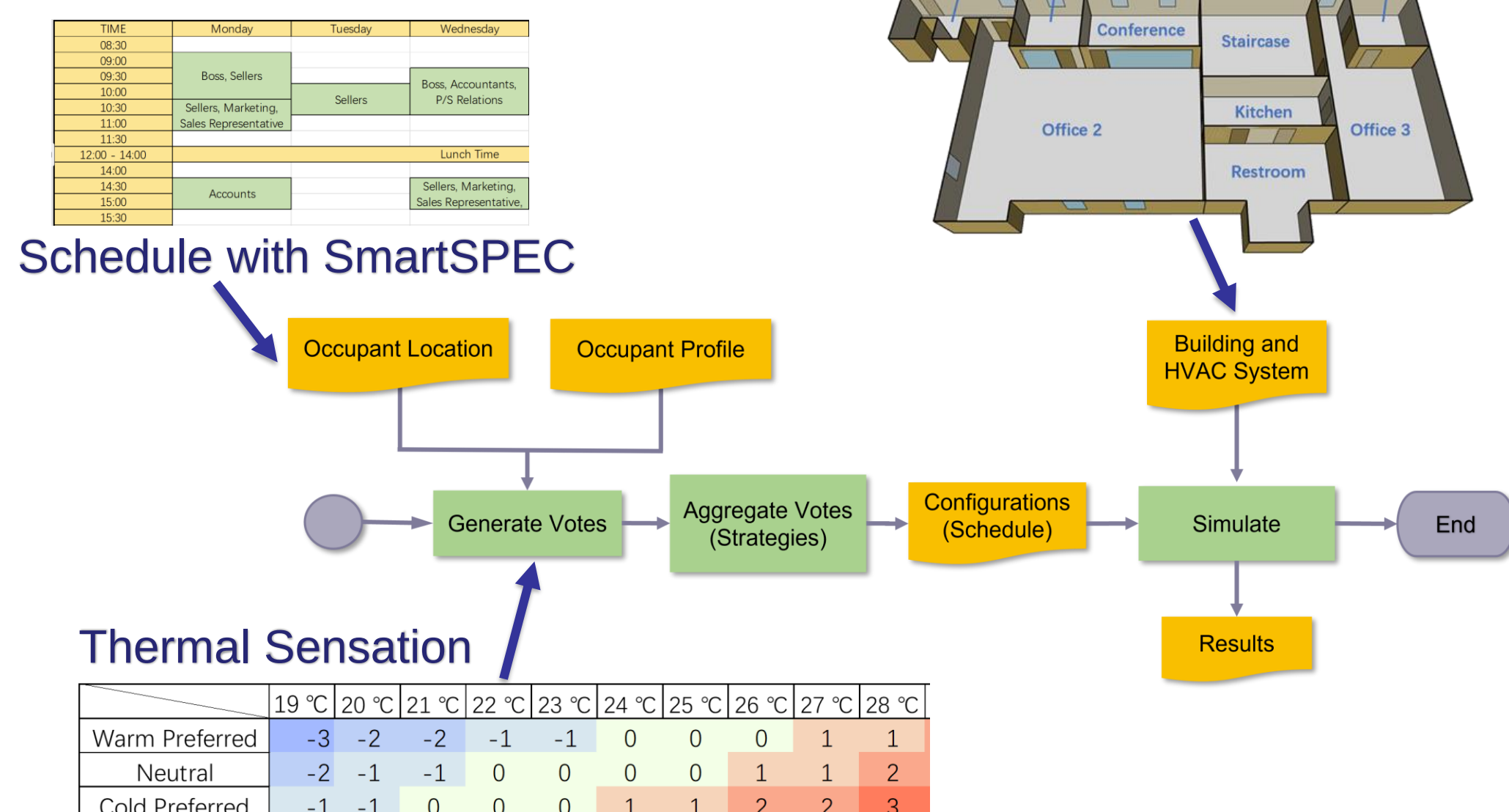


METHODOLOGY AND SET UP

The **goal of the simulation** is twofold: helping in setting up a realistic **HVAC system** response and a realistic interaction of the **occupants** with the building.

- To simulate the occupants of the building, our methodology considers three main aspects: their **location, preference, thermal sensation**.

We model people's diversity by distributing them three type of preferences by: **Majority Cold, Neutral, Majority Warm** and we assumed occupants vote on their thermal comfort. Then we aggregate their votes on the five strategies for the HVAC:



- Majority**, based on the majority's thermal sensation,
- Drift**, drift setpoint to the outdoor temperature to save energy,
- Fairness**, based on cost and benefit,
- Hybrid**, a combination of the previous three.
- Const-23**, always use 23 degrees as the setpoint.

Afterward we evaluate them using three metrics:

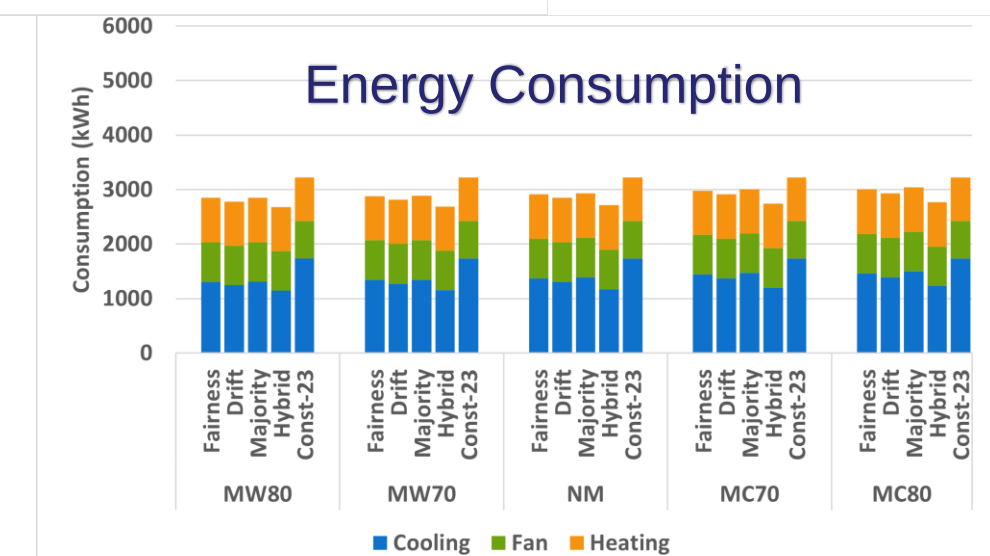
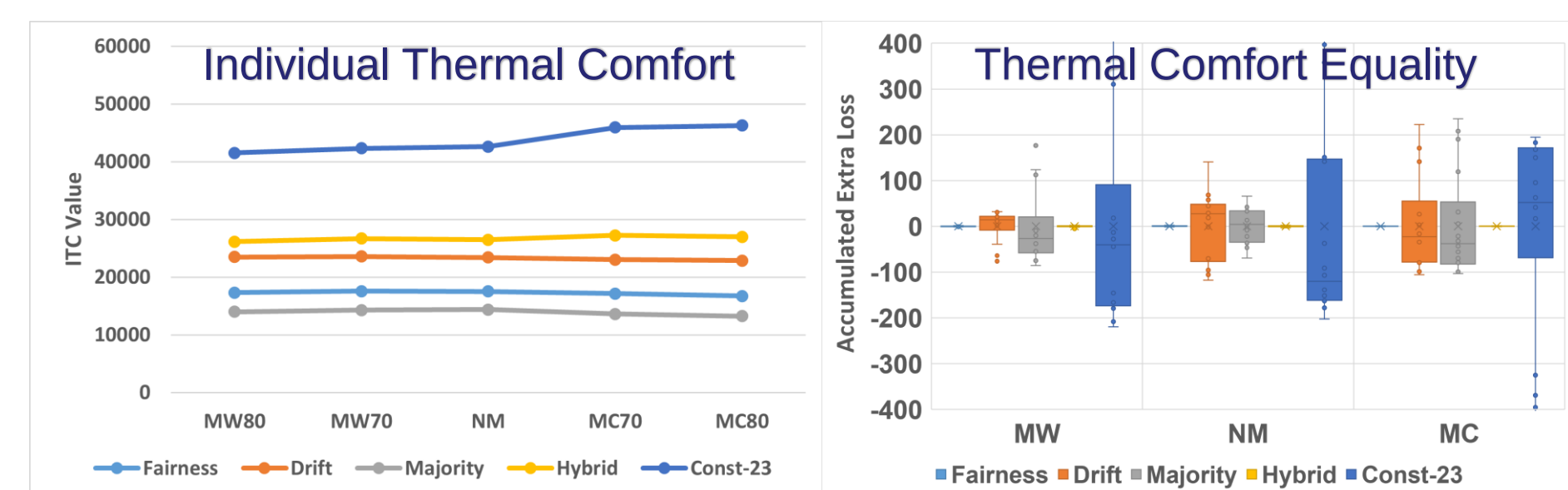
- Individual Thermal Comfort**, which measures how much people's votes differ from the action.
- Thermal Comfort Equality**, which measures how much people are treated unfairly.
- Energy Consumption** by the HVAC system.

RESULT

The result shows:

- Majority** Approach instinctively performs the best on Individual Thermal Comfort.
- For Thermal Comfort Equality, the **Fairness** and **Hybrid** Approaches, as expected, obtains the best results overall.
- The **Drift** and **Hybrid** Approaches, designed for energy savings, ends up outperforming the rest of the approaches

To evaluate which strategy is **better overall**, we compute the average **z-scores** of the 3 metric in scenarios of five cities, result shows the Hybrid Approach generally outperforms the others



Z-scores of the strategies for each city.

City	Fairness	Drift	Majority	Hybrid	Const-23
Mumbai	-0.53	-0.17	-0.22	-0.67	1.58
Cairo	-0.50	-0.15	-0.29	-0.65	1.58
Los Angeles	-0.50	-0.22	-0.30	-0.60	1.61
Paris	-0.34	0.25	-0.04	-0.19	0.32
New York	-0.51	-0.16	-0.19	-0.64	1.51