



A Key to Make Sustainable Buildings People Centric: User- environment Interactions

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Introduction

The construction sector - a main contributor to climate change and greenhouse gases emissions

- ~28% of energy-related CO₂ emissions are released from buildings

Sustainable buildings emphasise a holistic system approach of creating value chains along the life cycle by meeting the environmental challenges, assuring economic viability and developing the social capital

- Reduce energy consumption and carbon footprints
- Promote human health and well-being

Problem Statement

- The quality and performance of sustainable buildings are not necessarily consistent
- Lower performance in sustainable buildings than predicted
 - 28 - 35% of LEED buildings used more energy per floor area than their individually matched buildings (Newsham et al. (2009)
 - Some certified green buildings failed to deliver the desired sustainability goals during post occupancy stage (Goh, 2014)
 - Green apartment buildings in Germany missed the predicted energy savings by 5% - 28%
 - 50 modern buildings in United Kingdom used up to 3.5 times more energy than the design had allowed for and produce approximate 3.8 times the predicted carbon emission (Conniff, 2017)

Why do these happen?

- Human factors are not widely integrated into sustainable solutions of built environments.
- Building characteristics are proven to be insufficient as determinants but user behaviours and socio-economic factors
- Considerable performance gaps when users fail to conform with the ways sustainable buildings are designed to.
- User expectations, attitudes, perceptions, and behaviours are important in determining the effectiveness of building solutions



User-environment Interactions in Sustainable Buildings

- Active user participation for optimised sustainability performance
- The relationships between users and built environments change over time
- There are diversified needs and expectations of users towards sustainable buildings
- A clear need to understand user-environmental interactions to examine the capability of sustainable building solutions in meeting the evolving needs and expectations of people
- Appropriate interventions incorporated in sustainable buildings
 - To enhance user interactions within the environment to align their initiatives to meeting the sustainability goals



User-environment Interactions in Sustainable Buildings

- Passive design strategies e.g. natural ventilation, natural sun light and thermal mass in the building systems
 - Variations in the surrounding environment can directly influence the indoor environmental quality
 - An interactive building system allows users to respond to changing conditions in the surroundings for the required comfort and demands

User-environment Interactions in Sustainable Buildings

Increase users' ability of resilience and adaptation to the climate change

Consider varying behavioural aspects of users in sustainable buildings to suit user needs

Interactive building solutions to allow users monitor their environmental footprint and make adaptation/ change their behaviours

Introduce a dynamic demand-control based building system



Interventions for Enhanced User-environment Interactions

- Engaging and empowering users the control of space
 - with proper architecture, interior design and space planning strategies by understanding environmental psychology of users
- Simple interventions - manual controls of building systems, opening or closing of switches, adjustable curtains and windows, etc

Interactive Solutions for Sustainable Buildings

- The incorporation of Information and Communication Technology (ICT) to give ease to users to control the physical environment
 - Using remote control, monitoring devices and teleservices
 - Building information systems, instructional signage and experiential building systems including smart real-time web-based feedback, kiosks, metres, etc.
- Make the environmental efforts visible
 - An interactive display of up-to-date building achievements on energy consumption and carbon footprint
- Users can make necessary adjustments to the physical conditions by changing behaviours and attitudes



Methodology

- A survey design was employed to collect data from users of selected sustainable buildings
 - Web-based questionnaire because of practicality, accessibility and free of access
- The two selected sustainable buildings are certified green buildings in Malaysia
- Distributed to 100 respondents and 41 responses were received.



Results and Findings

- More than half of the respondents (58.5%) spent more than 3 days in a week while around 41.50% respondents spent less than 3 days
- A change of user' usage pattern in sustainable buildings following the COVID-19 pandemic outbreak
- Data was collected in during the recovery period of COVID-19 and some organisations may not resume to 100% physical work condition

Results and Findings



Around 88% respondents agree or strongly agree that sustainable building solutions enable meaningful user-environment interactions and improve user satisfactions



Over 80% agreed that the presence of appropriate lighting control in sustainable buildings enable them to align the physical environment to their lighting needs



Only 73% and 68% agreed to have adequate control to interact with the building ventilation and thermal comfort systems

The adoption of centralized air conditioning systems
The changeable parameters with no fixed comfort levels

Results and Findings

Moderate and low agreement scale on the following statements of sustainable buildings:

Provide clear instructions to users to operate and manage the buildings

Promote user experience without triggering forced adaptive responses

Capture and display usage data to promote environmental behaviour



Areas for improvement for increasing the interactions between users and built environments for optimized sustainable performance



Discussions

- People-centric approaches

- A holistic method that emphasise the understanding of human factors and their interactions with building systems
- Maximise human wellbeing and overall system performance in sustainable buildings
- Capture the users' interactions and perceptions with physical environments
- Optimise the ability of sustainable built environment to harmonise with surrounding environments through sensory design for improved user-environment interactions



Conclusion

- Sustainable buildings help to enable meaningful user-environment interactions but there are sometimes limited access to interact with and control the building systems
 - A lack of clear instructions of managing and operating sustainable buildings
 - Unavailable or limited access to visual data of environmental performance over time
- To advance the goals of sustainable development, we need to improve understanding of user-environment interactions
- A more people-centric approach can fill the gap and unlock the next-level values of sustainable built environments



Thank You

Q&A