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Systems thinking in the built environment: seeing the bigger picture, understanding the detail

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Introduction

Over the last 20 years, environmental sustainability in buildings, with its links to climate change concerns, low embodied carbon and sustainably sourced materials and energy efficiency has grown from being a niche enterprise to a major driver of new business; a trend that Indoor and Built Environment has followed with interest. However, beyond this and with the rise of the wellbeing agenda clients are now beginning to expect buildings to also contribute to the health and wellbeing of the people who live, work and learn inside them. This has created a new focus around the issues of healthy environments, wellbeing and increased productivity in addition to the low-carbon agenda. So, with this added and important emphasis, how do we ensure that this will be more than an ephemeral trend and that in the future 'business as usual' will be truly both sustainable and healthy? Previous research on the impacts of energy efficient design on the indoor environment has shown that there is the potential for numerous unintended consequences when decarbonising the built environment.[1,2] How can we be certain that processes to ensure wellbeing in buildings will be positive, or do we have to accept that as with energy efficiency measures, multiple trade-offs (for example between emissions reduction and public health) will not occur? This editorial argues that to ensure health and wellbeing co-benefits two changes need to occur: First, we need to move away from a purely reductionist and siloed rational towards integrative whole systems thinking and action; second, in order to achieve this, we cannot remain closed inside our disciplinary boundaries and we need to learn how to traverse them.

Systems thinking

The built environment is a complex and dynamic system. In the face of such complexity, there is a need to develop study designs, measurement and evaluation tools that are appropriate. This includes the adoption of cross-disciplinary approaches, and the development of low-cost measurement and evaluation tools for largescale field studies.[3] Systems thinking offers a holistic approach to analysis that focuses on the way that a system's constituent parts interrelate and how systems work over time and within the context of larger systems. In some scientific quarters the term 'holistic' is treated with suspicion perhaps due to the unfortunate association of the word with new age pseudoscience.[4] The systems thinking approach contrasts with traditional analysis (reductionist), which studies systems by breaking them down into their separate elements. Reductionist approaches have resulted in discrete scientific disciplines, as phenomena are understood at a variety of levels; however, such disciplines are still interrelated and share fundamental principles.[5] Systems thinking is a set of synergistic analytic skills used to improve the capability of identifying and understanding systems as a whole, predicting their behaviours, and devising modifications to them in order to produce desired effects.[6]

In complex systems such as the built environment, the formulation and application of regulations, standards and construction processes that focus on limited objectives, while taking inadequate account for the complex and dynamic inter-relationships between objectives and outcomes, are likely to be vulnerable to failure and negative unintended consequences.[1,2] One example of this is perhaps the so called 'performance-gap', where the occupied energy use and building performance do not meet the as-designed criteria. A systems approach to investigate and understand the critical components of the 'building construction system' in order to achieve the intended building energy and environmental performance standards is proposed.[7] This requires interdisciplinary and transdisciplinary methodologies being brought together in combination that sees a wide range of scientific disciplines working together in a collaborative learning process around dynamic system complexity.

Initial studies have begun to emerge, for example using a systems approach to investigate links between housing, energy and wellbeing, highlighting the dynamic and complex links that exist between different elements, which cannot be considered in isolation. In investigating the 'performance gap' in buildings, the Total Performance of buildings (TOP) project[8] at University College London combines traditional 'building physics' approaches (including empirical monitoring and modelling) with a system thinking and system dynamics approach to evaluate building performance that spans regulation and its evolution, industry actors and their interactions, building project development and management. The project includes various aspects of the 'total performance gap' such as energy-use design shortfalls, impacts on IEQ, among others. Additionally, it explores the notion of a dynamic relationship occurring between different factors and that the gap is in fact a socio-technical-economic and regulatory driven phenomenon.[9] Initial results are encouraging and already a number of areas for future research and practice have been highlighted as shown below.

Challenges for future research and practice

In light of the current lack of joined-up-thinking in current policy, regulatory and construction approaches, the research and practical questions that must be addressed are the integration of:

- Multiple levels of abstraction so that design, technical details, project management, and others factors are thought of in terms of social, environmental and financial sustainability
- Cost and quality, with sub-dimensions of
    - Monitoring and responsibility
    - Industry capabilities and reputation
    - Value engineering and delivering true value to people sustainably
- Multiple dimensions of building performance, e.g. energy performance and indoor environmental quality, lifetime sustainability and human wellbeing
- Technological advances and robust technological interfaces, but also effective ways to communicate and collaborate across academic disciplinary boundaries and interfaces
- Communicating the importance of dealing with complexity, in a way that is clear and relevant to those who have to translate academic outputs into policy initiatives and further research.

With the rise of the wellbeing agenda, there is a further opportunity to consider a systems approach and new methods to evaluate its integration and impacts with other objectives around buildings. This will help clarify any potential trade-off between energy/carbon reduction strategies and health/wellbeing. This issue is particularly challenging as the concept of wellbeing is not clearly defined in most studies or limited to facets such as comfort or satisfaction.[3] Furthermore, systematic reviews of the links between aspects of buildings and a wide variety of outcomes are needed as inputs

into the modelling process. Such reviews need to use a holistic framework that includes potential outcomes across a range of domains and objectives. Only by approaching the system as a whole, whilst also acknowledging and understanding the importance of its constituent parts, can we hope to avoid negative unintended consequences and ensure health and wellbeing co-benefits are achievable.

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Author's Contribution

Clive Shrubsole is the only contributor for this article.

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