Editorial

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Two key themes dominate this issue of *Engineering Sustainability*: what do we need to know in order to understand fully the potential implications of our actions; and how do we use this information most effectively to deliver the required performance of our built assets over their whole life?

In considering these themes, the papers presented remind us of the complexity of the urban contexts which increasingly dominate our decision-making processes. Within such contexts there are likely to be competing requirements and agendas from a broad range of different stakeholders. One of our key tasks, therefore, is to make clear the nature of any compromises or trade-offs that need to be made in balancing such requirements in order for us to be explicit about the impacts associated with our choices. This needs to be considered across scales, from the performance of individual buildings or infrastructure assets to the consequences of the interdependencies that characterise the relationships between different assets at a city scale.

The paper by Clark (2016) starts us off at building scale and highlights that even at the fundamental level of reporting energy consumption in buildings, in this case in the commercial sector, the data we use and the tools we adopt do not currently serve us as they should. The prerequisite for any protocols designed to report the energy performance of buildings must surely be to reflect the nature of use within a given building as well as highlighting where responsibility for different aspects of managing consumption reside. Only then can we not only be sure that interventions designed to improve the energy performance of buildings will be effective but also that any effect on the value of a given asset is appropriate.

We also need to recognise that the use of our built assets can change over their lifetime and that such changes can have a significant impact on performance as well as asset value. Xuereb and Parkin (2016) explore this issue in an analysis of the potential benefits of adopting data-acquiring systems in structural frames in order to help optimise the process of adaptation. The key here is again the need to tie the long-term value of an asset into the potential additional up-front costs associated with these types of systems. Traditionally, in the UK, where we have a compliance system based on design intent rather than in-use performance, we have relied on the nature of different tenancies to drive the quality of our buildings. For example, tenants that are long-term owner-occupiers have a greater stake in ensuring whole-life performance. If we are serious about delivering an efficient built environment, this has to change; providing appropriate data and understanding fully the nature of longer-term adaptive capacity are going to be crucial.

These first two papers begin to highlight that even at the fundamental unit of an individual building we are dealing with complex systems affected by uncertain futures. Cavada *et al.* (2016) remind us that such complexities and uncertainties are multiplied manifold when we broaden our perspective to the city scale. Here the desire to deliver a range of overarching policy imperatives in a way that allows us to compare the performance of different cities needs to be set against the impacts of local or regional contexts. Our pursuit of notions such as a ‘smart city’ which are often rather ill-defined and open to interpretation, much as the idea of the ‘sustainable city’ has been, mean that we run the risk of not realising the true benefits such ideas could and should deliver. In the midst of such uncertainty over what precisely these notions mean, we need to refrain from seeking a single, global interpretation but rather remember that local conditions will dictate the efficacy of our interventions at a city scale.

The impacts associated with our built assets are not limited to their construction and operation but are also linked to the preconstruction or planning stages of a project. While Plummer Braeckman and Guthrie (2016) focus on an infrastructure project in a developing country context, the lessons from their analysis doubtless echo more widely. Again, we see the potential conflict of differing agendas between a broad range of stakeholders; and their finding that the potential for the impacts of preconstruction or planning delays to be equal to, if not greater than, those experienced during construction delays is truly startling. Our existing conceptions of whole-life cycle decision-making are perhaps no longer sufficient. We also have to consider the nature of stakeholder relationships at the planning stage to ensure the potential benefits of a given scheme are not unnecessarily compromised by the unintended consequences of avoidable delays.

It seems clear to me that throughout these papers the role of the engineer, in whatever form, is going to be central to resolving some of the complexities and challenges we face across a broad range of scales. Imbuing our undergraduate engineers with an understating of such complexities and the impacts of the uncertainties that they will encounter in delivering interventions that remain effective over their whole life is absolutely critical. In a field where there is rarely a single, correct answer and the spheres in which our interventions have influence are likely to be highly interconnected we can only begin to explore these issues within the confines of the existing engineering syllabus. That is why proposals such as that by Arya and Vassie (2016), which seek to help engineers begin to establish the vocabulary and thought process necessary to make sense of these conflicts and contradictions, are so timely and should form

part of the discussions about the future pedagogical approach of our discipline.

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