

Sleeping Digital Twins

Exploring the appetite, benefits and challenges of whole-life performance modelling

Executive Summary

Created by IES in collaboration with:



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Introduction

Take a look at the buildings around you and there is a good chance that an existing 3D design, energy compliance or BIM model already exists for almost each and every one of them. Often created during the design or refurbishment phase of a building’s lifecycle, or to show compliance with building regulations, codes, or other voluntary standards, rarely are they utilised to their full potential throughout the building’s remaining lifecycle.

This paper introduces the concept of Sleeping Digital Twins, the theory that these existing models harness significant untapped potential to improve the performance of our current building stock. By extending the useful life of these models into operation as part of a whole-life performance modelling approach, and integrating real operational data, therein lies an opportunity to transform these underutilised digital assets into live digital twins capable of supporting improved performance outcomes across the building lifecycle.

This collaborative paper acts as both an informative and instructive guide for both AEC practitioners and their end clients on the value and need to embed better performance modelling practices at every project stage. It draws together viewpoints from a range of leading industry bodies, AEC consultants and building owners/occupiers, together with the results from an industry-wide survey, to consider:

- The current uptake of whole-life performance modelling and the extent to which its value is understood.
- The various challenges – technical, legal or otherwise – which are currently preventing Sleeping Digital Twins from being utilised beyond the design stage.
- The benefits which can be unlocked through the improved digitisation of building performance, including the crucial role a whole-life performance modelling approach can play in the race to decarbonise.
- A best practice approach for the storage, handover, and retrieval of models throughout a building’s lifecycle.
- The path ahead – recommendations and actions for the future.

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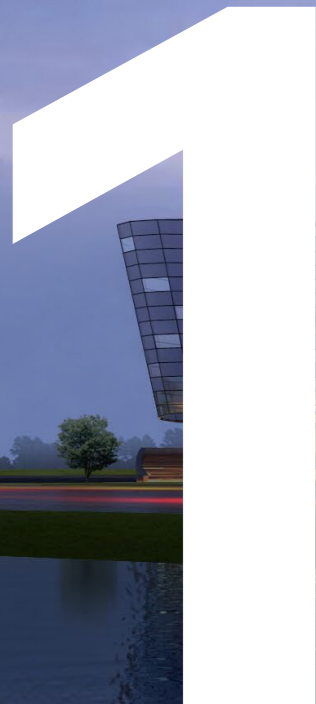
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Engagement and Understanding of Whole-Life Performance Modelling and its Potential

A key theme which has emerged throughout this research is that awakening existing design models, in particular energy models, has value for both AEC stakeholders and end clients alike, especially within the net-zero arena. But while the tide is turning, many are still not utilising existing models to their full potential – and there are technical and legal blockades standing in their way.

Net-Zero Potential

AEC contributors saw energy models as a key tool for bridging the performance gap between the design stage of a building and the actual operational stage. For both consultants and clients, the role of energy models in reaching net-zero targets was also clear; this being the most commonly cited benefit from client respondents (66%) and second to the performance gap for AEC consultants (83%).

Current Uptake of Post-Design Model Utilisation

While the vast majority of both AEC practitioners and end clients understand the hugely important role these models can play in reaching net-zero targets throughout the entire lifecycle of a building, there was consensus that energy models are frequently commissioned primarily for compliance purposes, and only rarely are they passed on or fully utilised beyond this stage. In our survey, less than half of AEC respondents reported that they have developed operational or calibrated energy models, and only 23% say they have ever handed energy models over to a client.

Legal Barriers

While there is an appetite for knowledge and data sharing, the fear of change is most palpable when it comes to the legal landscape. Professionals across the board are hesitant to act on their appetite for new processes due to potential repercussions. 58% of AEC professionals and 53% of building owner/managers surveyed list legal implications as a concern with model sharing, making it the most frequently cited concern for consultants and second most frequent by their clients. Data governance was another prevalent concern across all stakeholders, with many reluctant to introduce external work into their proprietary environments.

Technology Barriers

Technological disparities further hinder the appetite for better utilisation of models and the take up of a new approach. Contributors on both the AEC and client side mentioned that many stakeholders within building projects are using computers which are not capable of using the latest modelling software.

Education & Upskilling

A key factor behind many of the challenges identified is education. 63% of AEC respondents surveyed cited a lack of understanding as a barrier to using energy models in operation, with 51% of client respondents saying the same.

Among AEC industry representatives, there was a prevailing view that many clients may lack the proficiency and resources needed to fully exploit the potential of these models if handed over. Meanwhile, a need for upskilling was also noted on the AEC practitioner side, with design for compliance approaches still preventing many from learning the skills required to model with a heightened energy focus.

Key Takeaways

- A Sleeping Digital Twin approach is recognised by both AEC consultants and end-clients as key to closing the performance gap and reaching net-zero.
- A compliance only approach to energy modelling is currently perceived to be the norm.
- Only 23% of AEC consultants say they have ever handed energy models over to a client.
- AEC industry representatives perceive that most clients lack the proficiency and resources needed to fully exploit the potential of energy models created at design stages. However, some forward-thinking clients are starting to include modelling guidelines within their specifications to ensure the models are useful to them.
- Barriers to the uptake of the Sleeping Digital Twin approach include resistance to change, perceived cost, resource availability, legal concerns, data governance issues, technological disparities, a lack of awareness, and education and skills.



Benefits Beyond Net-Zero

Decarbonisation of the built environment and contributing to the net-zero goal are, of course, major benefits of whole-life performance modelling and, by extension, the Sleeping Digital Twin approach. But additional perks extend to providing value for money, balancing occupant comfort needs, alongside swathes of others. All could dramatically improve how we design and operate our buildings.

Cost-Conscious: Maximising Value for Money

Optimising the model beyond the design stage means a building owner is squeezing every last drop of value out of a model that would otherwise have been left dormant. Many contributors pointed to the fact that owners spend considerable amounts of money developing these models at the design stage, just for them to get shelved in operation.

It was noted that stakeholders should constantly be reminded to design with the end in mind, particularly when considering that the design and build stages may only take a few years, while the operational phase of any building could potentially last up to 100 years or more. If the industry can succeed in overcoming the barriers to reinstating existing Sleeping Digital Twins, it was noted that the approach could unlock significant productivity savings on future projects.

Creature Comforts: Occupant Comfort and Wellbeing

A whole-life performance modelling approach offers many human-centred benefits too. Carrying existing models through into operation can help to balance the trade-off between energy and comfort, helping to understand where efficiencies can be realised in a way that is mindful of occupant needs.

Both practitioners within the AEC sphere and end clients recognised the value of awakening Sleeping Digital Twins to ensure the fine-tuning of comfort strategies once buildings enter into the operational stage, making it easier to monitor and adapt to changes in the way a building is used over time.

Moving In: Realising the Value of In-Use Evaluation

The use of energy models in operation to conduct monitoring-based commissioning (MBCx), post occupancy evaluation (POE) or in-use building performance evaluation (in-use BPE) studies, was identified as another key benefit to awakening a Sleeping Digital Twin. While in-use studies can be conducted with or without a model, having an accurate digital twin which is dynamic and calibrated with live data from the building can go a long way in improving this process.

Several AEC contributors mentioned that POE studies are coming up more frequently in project briefs, driven by a heightened demand for sustainable, smart buildings. It was further highlighted that it is now much easier for clients to demonstrate how a building is or is not performing and as a result, consultants need to be involved in and leading on POE.

Futureproofing: Making Smarter Renovation and Rebuild Decisions

Buildings will adapt and evolve, and the building created initially at the design stage may look very different 50 years later. This is one reason why having a digital asset that evolves with the building and is updated at key project stages is so important.

With 80% of the buildings that will exist in 2050 already standing today, systems need to be put in place to quantifiably assess the best route for our ageing building stock. This is another key area where the reuse of an existing model can help to deliver future projects for the same building and help to guide important retrofit/rebuild decisions.

Demonstrating Excellence: Achieving In-use Certifications & ESG Reporting

Performance digital twins, including those developed from an existing model, can also help support the attainment of in-use performance certifications, such as NABERS, BREEAM, and LEED for Operations and Maintenance (O+M). The paper also discusses how such digital twins can serve as the central repository for key ESG data, helping to demonstrate compliance or de-risk and secure funding for future projects.

Benefits Beyond Net-Zero (Continued)

Key Takeaways

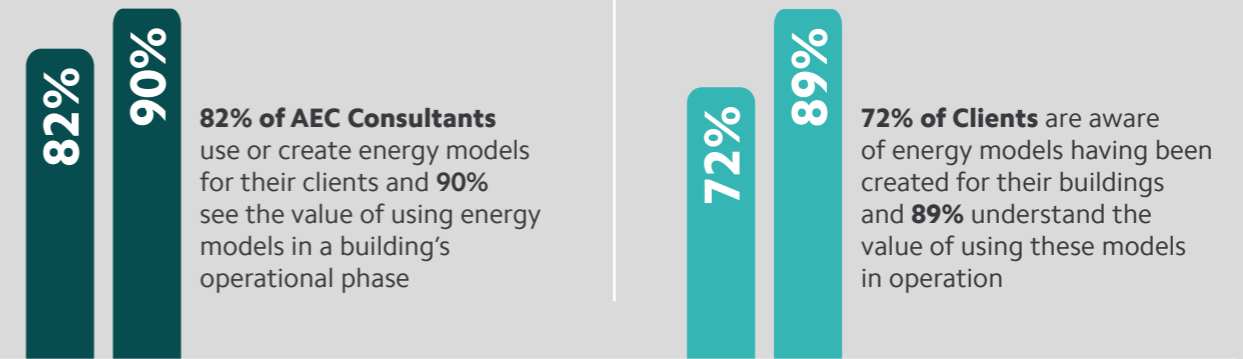
- Dormant energy models = wasted time and money. Awakening and using these models throughout a building's lifecycle can yield significant time and cost savings for consultants and clients.
- AEC practitioners and clients recognised the value of awakening Sleeping Digital Twins to ensure the fine-tuning of comfort strategies during both commissioning and building operation, as well as adapting for future climate predictions.
- Reusing existing models can help down the line to guide decisions around the most suitable retrofit options, or whether it may be more sustainable to rebuild.
- Having a performance digital twin can help support post occupancy studies, the attainment of in-use performance certifications and ESG reporting.

Survey Results at a Glance

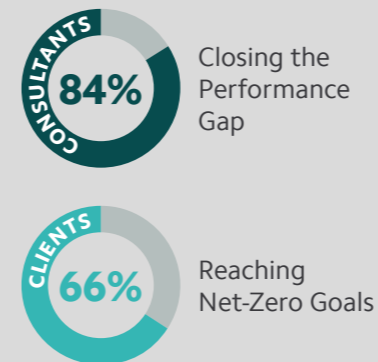
Our stakeholder survey gathered insights from 169 AEC practitioners and 74 building owners, occupiers and facilities managers to understand how energy models are currently being used and shared between built environment project stakeholders, and the challenges and benefits of using these models from design through into the operational phase of buildings. The geographical spread of respondents was global, with the largest response received from: UK & Ireland, North America, and Asia. The following is a sample of these results – for further insights please download the full paper.

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Using Energy Models in Building Operation



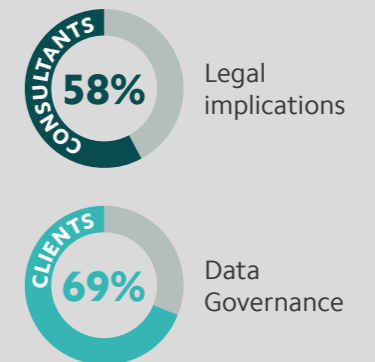
Main Benefit



Main Barrier



Main Concern



Over
90%

of both AEC consultants and clients agree upskilling is needed to be able to take an energy model and use it in the building's operation phase

Over
80%

on both sides agree there should be an online collaborative portal for model sharing



The Model Ownership Debate

This report also considers the ownership and accessibility of models, and assesses the challenges of making whole-life performance digital twins possible. Viewpoints from industry contributors differ over a possible best-practice approach for the storage, handover, and retrieval of models.

Where Are We Now?

A Review of Current Model Ownership

Several contributors said that the AEC consultant who built the original model currently retains ownership. However, while most agreed that the client probably should own the model, there were reservations about whether they would know what to do with it if ownership was handed over.

There is a clear appreciation, even acceptance, that clients should own the model as they have paid for the building. But with that comes a requirement for a certain level of education for models to be used effectively. Firstly, for the client to even want to take ownership of the model and secondly, for them to be able to utilise it to influence the building's operation.

It could be that there is no one answer to the question of who owns the models. Some contributors argued that it is dependent on the building, but that ultimately, ownership should stay with the person responsible for the management of the building, which is not always the same stakeholder group.

Breaking Up is Hard to Do:

The Model Handover Process

The majority of architects, engineers and contractors surveyed said that they do not hand over the models to clients, with our contributors indicating a number of potential reasons for this.

One reason is that clients are not asking for them. A consistent claim that came from the industry experts was that it's a small minority of clients who are asking for energy models to be handed over, either as part of the contract at the beginning of a project or on completion. It was felt that this is because the majority of clients don't understand the value that these models could have for them. However, there are some clients that do understand and are at the forefront of best practice use of models, such as those contributing to this paper.

When looking at the Sleeping Digital Twin approach, another barrier to adoption is that the models are often archived by design and build teams and difficult to get hold of to awaken. For the Sleeping Digital Twin approach to work, clients must know firstly that a model exists but secondly, where to find it and how to access it.

Another widely cited barrier to handing over the models to clients and passing them between stakeholders is fear of legal ramifications if a model has inaccuracies. Many contributors highlighted the 'blame culture' as a barrier to model sharing, often forcing consultants to retreat into silos to protect themselves. Industry experts and consultants widely acknowledge that this hesitation to share models does disrupt the flow of information. However, several point out that there is a fine balance between ensuring information transfer and managing business risk.

For the Sleeping Digital Twins approach to work, it was suggested that the intent of why the model needs to be accessed should be made clear and that there won't be any repercussions if mistakes are found. A memorandum of understanding (MOU) was suggested as one solution to minimise the reluctance to hand over models.

Model Storage

Whilst it was found that the majority of AEC consultants store models in a shared drive accessible to all within their organisation, a small number of those surveyed said they store models in the cloud so that they can be accessed by all project stakeholders. If the industry is to move towards a more collaborative approach, this number needs to increase so that models are stored in a way that better facilitates the flow of information between stakeholders.

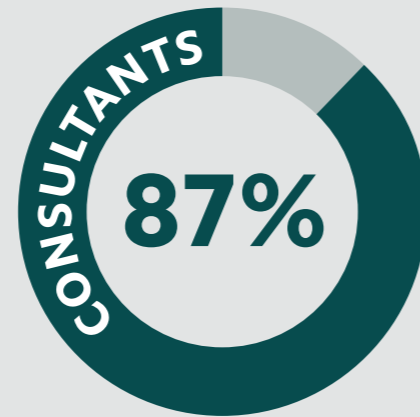
The majority of contributors felt that a standardised best practice approach was necessary, and will be crucial to mitigating liability concerns, but most were unsure of exactly what form this would take. The consensus was that there are several gaps and challenges that a best practice approach needs to address to change the way that models are created, handed over, stored and utilised.

An overwhelming majority (87%) of AEC respondents and building owners (86%) said that there is a need for an online portal to facilitate energy model sharing. Whilst this echoes the fact that most of the paper contributors believe shared ownership to be a good idea in theory, in practice, there were concerns about how it would work. Some suggested a centralised model may be best hosted by the client commissioning the work, who has the right to share the model as they please, as opposed to the stakeholders who are unsure of sharing outside of their circle.

Many contributors mentioned the need for change to happen at the contractual stage for clients to have better access to the model and for stakeholders to be clear on what they need to provide. Information flow needs to be agreed upon at the very beginning of a project to create a benchmark and ensure that models are included as a deliverable.

The consensus was that there are several gaps and challenges that a best practice approach needs to address to change the way that models are created, handed over, stored and utilised.

A need for an online portal to facilitate energy model sharing.



Key Takeaways

- There is abundant support for a best practice approach, whether that be in the form of an industry standard/regulation, or not, which addresses who owns the models, who can access the models and where they are stored.
- A best practice approach should address the legal and data governance challenges which are evidently creating a significant barrier to information dissemination and collaboration between different stakeholders and clients.
- There was consensus amongst contributors and those surveyed that the end-client has the power to really drive the required change by including whole-life modelling specifications in their contracts. However, it was also clear that a collaborative effort is needed with industry bodies and consultants educating clients on the benefits of this approach and pushing for it to be considered in the initial contractual phase.



The Path Ahead

While the next steps are not straightforward, and there are a number of barriers to overcome to make a Sleeping Digital Twin approach work, the reuse of existing energy models could prove to be a worthwhile endeavour, with many already on board with the concept.

So, what needs to happen to achieve industry-wide uptake of this approach?

Cross Stakeholder Collaboration

A need to bring all of the key stakeholders, both within the AEC community and the ultimate owners and operators of buildings, together across the lifecycle of a project was identified as a crucial requirement for making the Sleeping Digital Twin approach a success. Having a collaborative portal in some shape or form, which allows the owner to refer back to the model at key stages, and which the consultant can apply updates to as required, seems to be the favoured approach to facilitate better sharing of data.

Bigger Picture

There is a need for both consultant and client stakeholders to look beyond their own small part in the design or build process. At all times, there is a need to ensure that the end building, and its performance in operation, is kept in mind.

In-use Evaluation

There needs to be an increased uptake of initiatives such as monitoring based commissioning (MBCx), post occupancy evaluation (POE) or in-use building performance evaluation (in-use BPE) studies. These are crucial to closing the performance gap between design and operation, and are a key driver and potential starting point for embedding a whole-life performance modelling approach.

Best Practice Approach

Whilst data governance issues and fears of legal ramifications have been identified as barriers to model sharing, it appears that many in the AEC sector would get behind the shift to more collaborative working if a best practice approach were introduced to support model handover. Some form of legislation, or memorandum of understanding which could be signed at the point of handover, was proposed as one potential route to overcoming many of the legal concerns raised.

Upskilling and Knowledge Sharing

AEC professionals, in particular, have a role to play in increasing awareness and educating clients on the benefits of utilising digital models throughout the building lifecycle. Clients also need to upskill to understand and manage the models, or alternatively AEC professionals could take advantage of this knowledge gap to expand their service offerings and manage models for clients. Client and AEC contributors also raised that the quality of digital models often don't meet requirements to enable them to be put to good use and transformed into a performance digital twin. Improving energy modelling practices, and upskilling the workforce to go beyond a compliance only approach by fully embracing the application of building physics and other digital skills can ensure that design teams, owners, tenants and contractors have the data and tools needed to design, construct and manage buildings that meet net-zero energy targets.

Start the Conversation

As net-zero targets loom ever closer, we cannot afford to be complacent and continue with the status quo. By recognising the role that each of us must play in the race to decarbonise, whether as an AEC practitioner, facilities manager, building owner or occupant, we can all play our part in supporting the shift towards a whole-life performance approach. We also need to be sharing stories of best practice, allowing others to learn from our successes so they can follow suit.

Whilst it is clear that there is still some way to go to fully realise the potential of the Sleeping Digital Twin approach, we encourage all stakeholders to enter into an open dialogue of how we can begin to make better use of our existing digital assets to make a real impact across the full building lifecycle.

Sleeping Digital Twins

Bringing together some of the biggest industry voices to discuss the challenges, issues and wins for both consultants and clients that taking a digitisation of building performance approach delivers.

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