

Building Whole-Life Performance



Whole-Life performance is increasingly talked about within the building sector. But what is it and why is it important? This document provides answers, examples and references.

This document has been developed by the Built Environment Knowledge Transfer Network. Our objective is to bring organisations together to encourage closer consideration of the challenges, to enable knowledge transfer and to provide inspiration for innovative solutions.

What is Whole-Life Performance?

'Performance' is the action or process of performing a function. 'Whole-life performance' is to perform the function throughout life.

There are many functions we require buildings to perform, such as:

- well-being for occupants
- efficient use of resources (e.g. energy, materials, water)
- convenience to maintain
- ability to make adaptations
- affordable to build and operate

These can each be considered at any moment in the building's life, and, technically, interventions can always be made to improve whole-life performance; at any point from construction, right through the building's life and also at the end of its life.

Interventions to improve whole-life performance must be procured. Then, once in place, good management practices are needed to maintain performance and to identify further opportunities to improve whole-life performance.

How can whole-life performance be evaluated?

The list of functions a building will be required to perform is almost matched by the list of ways in which performance can be evaluated. The following is just a small selection.

- PAS 1192 Part 3 (from BSI at: <http://shop.bsigroup.com/forms/PASs/PAS-1192-3/>)
- Soft Landings, and Government Soft Landings (GSL)
- Building Performance Evaluation (BPE)
- In-use factors, which provide a greater incentive for manufacturers to ensure their products perform operationally in buildings
- Life Cycle Assessment (LCA), ref. EN 15804
- Life Cycle Costing (LCC), ref. ISO 15686

Whole-life performance is not always easy to evaluate

Whole-life performance is challenging to evaluate on some very important functions, such as occupant wellbeing, productivity or building adaptability. These functions could be the drivers of the business case for making an intervention, so it may be important to consider them accurately.

These functions are often considered using proxy measurements, and there may be a good opportunity for innovation to improve the accuracy of these techniques or to develop entirely new techniques.

To integrate or not

Optimising whole-life performance for one function often impacts whole-life performance on one or more other functions.

To account for this, one approach has been to try and combine performance measurements into a single integrated framework, to provide a more complete understanding.

An alternative approach is to present the different performance measurements independently, and leave it to the user to decide which functions are most important to them.

As a minimum, those who claim a solution improves whole-life performance should carefully consider any negative impacts the solution could have against other building functions. Ideally these impacts could be avoided by improving the solution. If not, then a failing to disclose the risk of consequential impacts may damage the trust between the customer and supplier.

Proxy measurements

As some functions of whole-life performance are challenging to evaluate it is common for researchers, in their search for the truth, to use indirect measurements, also known as proxy measurements. These measurements could be an interesting area for business-led research, so that the business case for procuring and managing for whole-life performance can be strengthened by creating new knowledge around how to evaluate the business drivers for whole-life performance.

Here are some examples in practice:

- Mackenzie and Airey (2000) studied the effects of acoustics in **healthcare buildings** in Scotland. They showed that poor noise levels correlated with slow patient recovery times.
- Multiple proxies can be drawn on to evaluate the **productivity of office workers**, such as absenteeism, churn and surveys.
- The benefit of a more pleasant, **healthy and safe work environment** might also be seen in a reduced number of worker injuries or safety incidents.
- Studies have demonstrated the benefit of **good lighting, ventilation, thermal and acoustic conditions** in education buildings, such as schools and universities. The mental and physical performance of teachers and students can be improved, with measurements including the vocal effort of teachers, learning rates, observed concentration levels and exam results.
- Making improvements to the **environmental conditions in housing** can have positive health benefits and may also benefit the education of children in the home



Examples of innovative products and initiatives

The following examples are either already in the marketplace, or their research findings are available in the public domain. Some have been supported by Innovate UK or the Research Councils.

Software

- In June 2013, twelve prototype software tools for sustainable building design were launched. Part funded by Innovate UK, these tools covered activities from life cycle analysis and life cycle costing, to embodied carbon reporting and conceptual in-use carbon calculations.

The 'Design and Decision Tools' programme ran before the emergence of the UK's protocols for Building Information Modelling (BIM). Several of the prototype tools have since been further developed and integrated into BIM tools available today in the marketplace.

Further information: <https://connect.innovateuk.org/web/design-and-decision-tools/design>

Smart technologies

- **iCOMP2** from Skanska, BRE and Selex, is a condition-based monitoring technology, enabling real-time data to be gathered and used to more effectively maintain electrical and mechanical plant and equipment.

Sensors are placed on assets creating a stream of data and informing an estate team when parts need maintenance or replacement. The technology is an enabler for effective and reliable facilities maintenance and has the potential to reduce operation and maintenance costs and improve certainty of outcomes.

"It's a bit like modern cars today which can tell you when they need servicing," says Ian Brixey, Principal Consultant and innovation specialist at Skanska.

Further information: www.skanska.co.uk/services/facilities-services-/sustainability-and-innovation-/icomp2/

Addressing the social functions of buildings

- UK-GBC was a partner in a major World Green Building Council (WorldGBC) project, "**Health, wellbeing and productivity in offices: measuring impact and sharing best practice**".

The aim was to evaluate and present the best and latest information on building design features which are known to have positive impacts on health, wellbeing and productivity of office occupants and to highlight financial implications where possible. It aimed to provide a high-level framework for building owners, occupiers and their advisors to start tracking the impacts of buildings on employee health, wellbeing and productivity in order to use that information in financial decision-making.

Further information: www.ukgbc.org/content/health-wellbeing-and-productivity-offices

Circular Economy and resource efficiency innovations

- The **RE-Fab** project is an example of a circular economy approach to the construction sector, which has been developed by a consortium, including the Alliance for Sustainable Building Products. This groundbreaking project explores, develops and demonstrates new forms of construction which allow improved construction efficiencies, adaptation of buildings in use and the re-use of components from deconstructed buildings at the end of life. The project has progressed through feasibility of a residential demonstration project, to the design and build of the first RE-Fab building on the former Olympic park, and is now working to explore the benefits of flexible life buildings for schools, hospitals and other public sector rolling infrastructure.

Further information: www.asbp.org.uk/research/



Outcomes of a KTN workshop:

"what does whole-life performance for buildings mean to you?"

"The term 'whole-life performance' provides a framework within which to consider issues related to the long-term performance of building components as well as the indirect consequences of component decisions."

"WLP for buildings depends on how the buildings are maintained. It requires people to think long-term and invest money to make their existing buildings more efficient."

"Minimising cost, energy use and environmental impacts by adopting a whole life-cycle approach in designing. Then ensuring real-world performance meets the design and changing requirements of building users for the building's lifetime."

"WLP considers the impact and benefits throughout the building's lifetime from resource sourcing, through [to] manufacturing, operation [and] into resource use. It requires greater holistic thinking across the supply and operation chains."

"To significantly expand WLP requires future adaptation features to be designed into buildings, including provision of information for future users."

"WLP provides a building that, through its design life, achieves the 'designed' levels of performance in terms of cost, carbon and energy."

"WLP considers and tackles the environmental impacts across the whole life-cycle of a building - from the materials used in construction, the construction process, the use, maintenance, retrofit and, finally, the end-of-life through reuse, recycling potential."

Outcomes of a KTN workshop on Whole-Life Performance for Buildings

Following a KTN Workshop on 28 August 2014, some key challenges were identified:

1. Building a common purpose behind whole-life performance
2. Design and performance data
3. Motivating ambitious approaches
4. Incentives for success
5. Building adaptability and flexibility
6. Integrating whole-life performance into building procurement
7. Integrating whole-life performance into BIM

Having identified these key challenges, workshop members were able to advance their thinking on particular areas. For instance, on integrating data on the behaviour of people into the design process.

According to Blane Judd, Chief Executive at EngTechNow "The property and construction industries are way behind many product designers in this respect." To be fully realised, Judd believes that whole-life performance requires the industry to consider user experience at the early design stage.

"There are instances of good practice," he says. "In the USA, Disney took chefs into the design process and worked with them at the Building Information Modelling (BIM) stage. Together, designers and users were able to determine the most effective placement of kitchen facilities." In addition to the benefits in usability, Disney saved considerably by minimising the design iterations that it had previously had to contend with.

This suggests a need for structured data on the way people use buildings, to positively influence the way buildings are designed.

It also highlights the potential value of technology that enables a building to learn about the needs of its users over time, and for the building's functionality to be adaptable as the users' needs change.

Delegates present at the event included representatives from: London South Bank University, SIG plc, RIBA, Hilson Moran, EngTechNow, WRAP, UK InDemand Centre, BRE, Constructing Excellence, BASF, ASBP, Construction Products Association, Tesco Stores, UK Green Building Council, Lighting Industry Association, Innovate UK, Zero Carbon Hub, CIOB and the South East Centre for the Built Environment.

Continuing the discussion

Would you like to contribute to this discussion? Have you got a new idea and are you looking for partners to develop it? Are you interested in funding to develop innovative products, process or services that can provide a contribution to building whole-life performance?

If so, you may like to get involved in our community!

The Built Environment KTN community website

<https://connect.innovateuk.org/web/modernbuiltktn>

The online community dedicated to Building Whole-Life Performance

<https://connect.innovateuk.org/web/bwlp>

The Consortia Building Zone

www.surveymonkey.com/s/BWLP-SCIC

Our Twitter account @MBECommunity

Or get in touch by writing to valeria.branciforti@ktn-uk.org

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