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/Department of the Built Environment

**/Unit Building Physics and Services**

7LY3M0 – Building performance and energy systems simulation

**Week Choose an item..Concept Choose an item.**

*Action*: Describe the difference between validation and calibration in the context of building performance simulation. Are validation and calibration always needed for every model to be useful? Why (not)?

***Student A***:

Calibration models compare theory to reality (actual utility use).

Text

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Description automatically generated with medium confidence***

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1: describe the difference between validation and calibration

**Validation**:

*"The process of determining the degree to which a [simulation] model and its associated data are an accurate representation of the real world from the perspective of the intended uses of the model."*

*“The validation phase of VV&A focuses on the agreement between the observed behavior of elements of a system with the corresponding elements of a simulation model of the system and on determining whether the differences are acceptable given the intended use of the model. If a satisfactory agreement is not obtained, the model is adjusted to bring it in closer agreement with the observed behavior of the actual system (or errors in observation/experimentation or reference models/analyses are identified and rectified).”*

Idealized validation

Validating whether the modelled physics actually match up to reality using ideal test cells.

Realistic validation

Comparison between building energy models and data from actual buildings. Here researchers don’t just try to validate the physics used to model the building, but also the methods used to account for the occupants and their behaviour. Occupants usually use buildings in different ways from what the designers envisioned, so they are difficult to account for.

**Calibration**:

making model output consistent with measurements done in the real world. This is done to achieve more accurate results from models. Important to note that calibrated models aren’t unique. Multiple different models of the same building can be calibrated to measurements on that building and all be considered calibrated at the same time.

You make a model

Compare it to real world results

Adjust model accordingly

Rinse and repeat

End up with a model that is a good virtual representation of building performance

This can be used to evaluate the impact of changes with a relatively high accuracy

**ACTUAL TEXT**

Validation is the process of figuring out whether a model is an accurate representation of the real world.[3] This can be split into two types, idealized validation and realistic validation. In idealized validation an ideal test cell is considered with sensors placed around the inside, and this is then used to validate whether the physics match up between the real world and the model. In realistic validation the results from a building energy model are compared to measurements done on a building that is in use, for example from the metered connections and audits.

Idealized validation comes with much fewer uncertainties compared to the amount of unknowns in realistic validation, which means it is a useful tool for validating physics. It however does not cover many of the assumptions that are made in a building model of realistic buildings, while it is very important to understand the effects of these. Knight et. al. found that occupants they surveyed were largely unable to estimate their own energy usage, underestimating it by 57%.[1] It is therefore understandably difficult for modellers to accurately estimate energy use by occupants in advance.

Calibration is a process where a model is compared to measurements done in the real world and adjusted accordingly.[2] This is done to create an accurate building model, in the hope of it being suitably realistic so that it can be used to predict the impact of changes to the building in advance. One important thing to note is that calibrated models are not unique. Multiple different models for the same building can be calibrated, even though the way in which they model the building varies strongly.

The main difference between calibration and validation is in their goals. Calibration serves to improve a model through an iterative process by comparing the model to the real world and adjusting the model accordingly until they concur. In validation the goal is to determine whether a model is valid, i.e. whether the expectations of the model line up with the results in the real world. This then determines whether a model can be trusted to predict the results of for example changes to a building. The goal of validation is not to adjust parameters until the model becomes valid.

Calibration is not always needed for a model to be useful. If calibration is necessary for every model using a certain method it would be impossible to use these models to predict anything, since you would need the actual building to properly calibrate it. A realistically validated model can however be used to predict the effects of future changes to a building.

***Student B***:

<. . .>

***Student A and B***:

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**References**:

[1] I. Knight, S. Stravoravdis, S. Lasvaux, Assessing the operational energy profiles of UK education buildings: findings from detailed surveys and modelling

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Coakley, D., Raftery, P., & Keane, M. (2014). A review of methods to match building energy simulation models to measured data. Renewable and sustainable energy reviews, 37, 123-141.

[2] Dirkes II, J.V. & Weaver, B. (2016). Modeled Performance Isn't Actual Performance. ASHRAE Journal 58.5

[3] Ryan, E. M., & Sanquist, T. F. (2012). Validation of building energy modeling tools under idealized and realistic conditions. Energy and Buildings, 47, 375–382. https://doi.org/10.1016/j.enbuild.2011.12.020