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IBPSA's first female President elected

FEATURE ARTICLES on the new IEA Annex 79 and the outcomes of its completed predecessor, Annex 66 — and a call for participants in Annex 71

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President's message

Dear IBPSA Colleagues and Friends,

This is my first Message as President and I would like to express my pleasure and thanks for the opportunity to serve in this position. I would also like to thank Chip Barnaby for all his hard work over the last three years, allowing me to pick up the reins with everything in good shape.

The new BoD and Executive (listed adjacent) were appointed at our AGM in Rome last month. We had a very successful meeting, focusing in on some of the areas where we have made good progress as well as on things we have yet to achieve.

There are certain things that we do really well, such as our IBPSA conferences, the Journal of Building Performance Simulation, our Newsletter, and Education Webinars on the IBPSA University YouTube Channel (see **www.youtube.com/channel/UCY9AD4H9_xKjKRTEvkce_8g**). We are also moving forward with two IBPSA Projects - Project 1 (BIM/GIS and Modelica Framework) which kicked off at Building Simulation 2017 (see **https://ibpsa.github.io/project1/**). Project 2 has been running since late 2017 and will develop an IBPSA modeller certification scheme that can be applied universally and for any tool - this is still in the development stage. These are all things that we can manage to deliver through the efforts of some very dedicated volunteers – some Board members and others through our Committees.

Looking to the future, while our reach covers 34 Affiliates in over 40 countries we tend to speak more to those we know than to a wider audience. Given the expected growth of the field, IBPSA will have to find ways to support a higher level of activity. We are also conscious that there is an opportunity for IBPSA to become the leading voice in the promotion and application of simulation beyond our current limits. Development of these initiatives would cost money that we would need to raise by other means, such as taking action on some of the things that we have struggled to progress over the last few years.

For my term of appointment, I would like to make sure that we move forward on a few key issues that have been on the agenda for a while but which we have yet to resolve:

- **Membership** – did you know that you can be a supporting member of IBPSA? See **www.ibpsa.org/?page_id=56#_Supporting_Members**. We are proposing to improve the existing membership services, developing new membership benefits and allowing IBPSA to operate more efficiently.
- **Practitioner publication** — We have in the past focused on the Journal for dissemination but we are aware of the need and value of attracting more practitioner members. So, we will shortly be surveying our practitioner

members on their interest in an IBPSA practice-oriented publication or magazine to present case studies, techniques, and other material of interest to practising modellers.

- **Fundraising/development** — We have set up a committee to explore sources of funding that could allow IBPSA to accelerate new pursuits. As chair of this committee I would welcome input from new talent on the team. Anyone with ideas, and commitment, welcome!
- **Website** – as an organisation with aspiration, we need to refresh our website in terms of improving accessibility and signposting. Watch this space!

I have been a champion of the routine use of simulation in practice for over 25 years, spending much of my career transferring modelling from research into practice. Building on the work started by previous presidents, I will focus on developing new areas of engagement that will take us to the next level as the body that represents simulation at both academic and increasingly at practitioner levels.

I am very much looking forward to being IBPSA's first woman President and as such it is possibly appropriate for me to end on another area where we need to make progress:

- **Equality/inclusivity** — We set up a committee in 2017 at the San Francisco conference to assess the systemic barriers that limit who participates in our field – determining to develop strategies such as mentoring to overcome those limits.

In order for IBPSA to be the organisation that we want it to be, we will need to make ourselves more attractive to a wider audience. We have strength and depth in our existing membership but this needs to grow and be more inclusive of the full range of talents who attend our events and participate in our activities across the world. We seem to achieve this at a student level but it drops off post graduation. We need new and diverse voices within our Board itself and also within the membership. I am passionate about this – but not through forced mechanisms such as positive discrimination – Building Performance Modelling offers great opportunities for all; there need be no barriers to succeed in our field. IBPSA should be open and inclusive not because it's topical, but because we are.

I hope to see participation from all of our affiliates at Building Simulation 2019 next September 2 – 4, in Rome.

Interview with IBPSA's new President

At the 2018 Annual Meeting held on 8 September in Rome, Italy, IBPSA installed its new officers and directors. The new president, Dr Lori McElroy, is a Director at BRE in Scotland. Lori McElroy has previously served on the Board of Directors as Vice president, two terms as Secretary, and as Director-at-Large, as well as having previously chaired IBPSA's award committee.

Times are definitely changing for women in leadership roles: Sheila J. Hayter, P.E., an ASHRAE Fellow, became ASHRAE's President for the 2018–2019 term and Professor Lynne Jack will become CIBSE's first female president when she takes office next year.

The election of IBPSA's first female president is massively overdue, and a positive change for the Institution. My thanks go to Dr Lori McElroy for providing us with the opportunity to pose a few questions regarding her recent appointment.

Christina Hopfe (CJH): Would you mind sharing with us a little bit about your background – your previous education, area of expertise, research and practice?

Lori McElroy (LMcE): I have an undergraduate degree in Environmental Engineering from the University of Strathclyde, a Masters in Design from Glasgow School of Art and a PhD in Embedding Simulation in Design Practice, from the Department of Mechanical Engineering at the University of Strathclyde.

I am a chartered building services engineer (MCIBSE) with a background spanning environmental engineering, architecture and sustainable design and have been active in the energy and environment field for around 30 years both in practice and research, working in the private and public sectors.

My interest in simulation started as a young practitioner in a forward thinking design practice that wanted to embed simulation in its design processes. Since that time I have been a champion of the routine use of simulation in practice.

My expertise is in the area of knowledge transfer between academia and practice and between architects and engineers, which I believe is facilitated by my practice based/ academic background, which gave me the opportunity to see things from different angles. My key contributions in this respect have been the delivery of three state-of-the-art academic/industry collaborative knowledge transfer programmes, developed and evolved over a period of 20 plus years for the UK and Scottish Governments.

This work resulted in the award of an MBE in the Queen's Birthday Honours list in 2012 for services to sustainability in the construction industry, and an Honorary Fellowship of the Royal Incorporation of Architects in Scotland (RIAS) later that year.

CJH: How do you feel about becoming the first female president of a quite large professional international society of building performance simulation researchers, developers and practitioners, whose work is dedicated to improving the built environment?

LMcE: I don't really know how I feel about it, to be honest. It is not something that crossed my mind before being asked the question. In truth, I'm surprised that it has taken so long for there to be a female president of IBPSA. I have never really thought much about being a woman in engineering, and have never encountered any real barriers to participation or negative attitudes from my undergraduate days through my professional life. In this field in particular, I have always found that women do well and are accepted. I believe that women do well in engineering because it's something they get involved in because they want to do it – it's not something they fall into. In addition, I have always found the simulation world to be open to all – but it could be even more so. It is an ideal area for those interested in science and engineering but less willing or able to be involved in site or construction works, for example. My only negative observation would be that while my experience of IBPSA is positive as far as inclusivity is concerned, I have noticed a fall-off in participation for women and other minority groups post completion of academic studies – evidenced by the proportion of women participating in IBPSA at a senior level, for example. That is something that needs to be looked into further and addressed.

CJH: IBPSA's vision as on the website is "To take a leading role in the promotion and development of building simulation technology". This is "to provide a forum for researchers, developers and practitioners to review building model developments, facilitate evaluation, encourage the use of software programs, address standardization, accelerate integration and technology transfer."

Do you think IBPSA has achieved its goals, or do you think this is a continuing process and there is still a lot to be done?

LMcE: I think that IBPSA has some way to go to be the organisation it aspires to be. We need to make IBPSA the go to organisation and recognised authority on simulation. To this end I am seeking support from members and the Board to consolidate a sustainable future for IBPSA as a membership organisation.

As a champion of the routine use of simulation in practice we need to find ways of securing wider engagement. In order for IBPSA to be the organisation that we want it to be, we will need to take stock, re-evaluate our objectives and goals and make ourselves more attractive to a wider audience. I am highly conscious that we have strength and depth in our existing membership but that this needs to grow and be more inclusive of the full range of talents who attend our events and participate in our activities across the world. This means including new and diverse voices within our Board itself and also within the membership. As alluded to already, I am passionate about this – but not through forced mechanisms such as positive discrimination – Building Performance Modelling offers great opportunities for all, there need be no barriers to succeed in our field. IBPSA should be open and inclusive by its very nature and not because it's topical to be inclusive.

CJH: Would you tell us more about your passion about the built environment and performance simulation, and why you chose this career path, as a director at the BRE Scotland, and now leading one of the largest professional organisations in the world?

LMcE: My original interest in building design was in architecture closely followed by technical aspects of the potential unintended health consequences and other risks that emerge as designers create internal environments. I entered the world of engineering at a time when we were simulating buildings without graphics – sending data to mainframe computers and hoping for the best! When we did get our results back, the numbers required analysis at a level that is seldom used in practice today as we had nothing else to look at to tell the story of the outputs. In a way this made it all the more exciting, and groans and laughter were heard around the lab as someone sent a simulation off only to spot a '0' that should have been a '1'!! So that was it – I was hooked. I love the complexity and the simplicity of it all.

I truly believe that better buildings can improve lives, but achieving this requires technical rigour, understanding of buildings and people's aspirations. IBPSA can and should play a key role in this.

CJH: One of your most recent activities is the development of the IBPSA Modelling professional accreditation program (IBPSA Project 2). Could you tell us more about this initiative and program?

LMcE: I have spent the last year working on a new IBPSA initiative – the IBPSA Accredited Modeller scheme, which will provide a tool agnostic framework that can be used by IBPSA to accredit modellers, across the world, providing quality assurance and certainty for those commissioning building performance simulation. The approach will be in part about education and in part about CPD. It will be aimed at practitioners to make sure that they understand the fundamentals of thermodynamics and building physics before plugging numbers into black box commercial tools and also aimed at academics and researchers to make sure that they are realistic about expectations in the real world. In addition, the implications of in-built assumptions and defaults will be a key learning outcome. This will link with the other initiatives that are exploring long term sustainability and improving the visibility of IBPSA.

CJH: Though you have accomplished so much, do you still have further goals and dreams that you would like to realise?

LMcE: Difficult question – there is so much to do!

From a simulation perspective I would like simulation to be fully recognised as playing a pivotal role in shaping the quality and performance of the built environment of the future. Simulation offers an opportunity for delivering better buildings, but for this to happen it must be fully integrated into our design processes and codes worldwide. As the only worldwide organisation that represents the power of simulation, IBPSA can develop, support and promote the delivery of the most appropriate tools and training into the right hands to do this. We should develop a position on this that can be applied worldwide and grow and use our influence to deliver through collaboration with our affiliate network.

From an IBPSA perspective we will need to strengthen ties and build opportunities across our affiliate network to be able to achieve this.

CJH: The IBPSA fellow program has been in place since 2011. To date, 49 fellows have been announced but only three are women. What are your plans to change this?

LMcE: I was unaware of this until recently but I don't think that this is something that we should tackle through a forced route. We need to encourage more women to present themselves and to be confident and supported to do so. The equalities issue has been rumbling under the surface for a number of years but came to the fore in San Francisco with an inaugural meeting of the IBPSA Inclusivity Committee, which has yet to be fully constituted, but which has already had an impact by bringing broader recognition of the fact that these 'issues' exist – even in IBPSA. There was much discussion around increased participation at all levels – from the Conference Executive Scientific Committee to Fellowship to Committee Chairing at the recent AGM and Board meeting in Rome and I think there was broad recognition that the time for women (and other less vocal groups) to be more visible in leading the organisation rather than playing supporting roles is long overdue. We left the meeting with many (men) genuinely expressing their concern that they hadn't noticed that there was an issue – which I think may lead to some long overdue nominations – so watch this space. However, this is not something that will be solved without maintaining effort – we can't afford to become complacent again!

CJH: How much do you think simulation or modelling can 'change' the world – the way we practise, build, and use our buildings? What can and can't simulation do or provide?

LMcE: As some older wiser heads than mine have said in the past – the only alternative to simulating it is to build it – and the latter is costlier if you get it wrong. Simulation cannot answer all of our questions about buildings but it can (in the right hands) guide us towards appropriate, robust and flexible solutions. I believe that the future lies in the combining of different approaches – using simulation and monitoring together, to improve our understanding of how buildings work in reality and the impacts of people on performance – in order to refine what we model, how we model and to improve and calibrate our simulation tools to deal with the real world. While we can use simulation to predict behaviours to an extent, I do not believe that we can use simulation to influence behaviours – nor should we try – but we can use it to learn more about the impacts of what we do on performance outcomes.

CJH: Thank you Lori. And many congratulations again on becoming IBPSA's president. ■

From IEA EBC Annex 66 to 79

Key outcomes and challenges in building occupant modelling and simulation

Liam O'Brien[1], Tianzhen Hong[2], Sara Gilani[1], Mohamed Ouf[1], Isabella Gaetani[3], Burak Gunay[1], Da Yan[4], Andreas Wagner[5]

As building envelope and mechanical and electrical equipment become more efficient, the impact of occupants on building energy increases (e.g., Hoes et al. 2009). Meanwhile, trends in teleworking, co-working, and home-sharing result in vastly different occupancy than the standard occupancy schedules. Finally, global expectations for comfort are increasing, while a variety of new technologies may or may not succeed in meeting this demand. The convergence of these trends has necessitated a new look at how occupants are modelled in simulation-aided building design, code compliance, and operation.

The field of occupant modelling emerged over four decades ago; however, it has surged in the past decade – particularly as a result of the International Energy Agency Energy in Buildings and Communities (IEA EBC) Annex 66 – "Definition and Simulation of Occupant Behaviour in Buildings". Annex 66 played an important role in formalizing research methods, modelling and model validation, and simulation of occupant behaviour. Given the number of unanswered questions about occupant comfort and behaviour and the minimal penetration of advanced occupant modelling into practice, the follow-up IEA-EBC Annex 79 - "Occupant Behaviour-Centric Building Design and Operation" - is introduced. This extended article provides a summary of Annex 66, a deeper look into some of the key issues in occupant modelling and building design, and the aspirations for Annex 79.

A summary of IEA EBC Annex 66: Definition and simulation of occupant behaviour in buildings

Occupant actions such as adjusting a thermostat for comfort, switching lights on/off, using appliances, opening/closing operable windows, pulling window blinds up/down, and moving between spaces can have a significant impact on energy use and occupant comfort in buildings. Having a deeper understanding of occupant behaviour and the ability to quantify its impact on the use of building technologies and building performance using simulation tools is crucial to the design and operation of low-energy buildings. Past studies of occupant behaviour have lacked in-depth quantitative analysis; moreover, available models of occupant behaviour have been developed across different case studies and have shown inconsistencies, lacking consensus on how to approach experimental design and modelling methodologies.

Annex 66 (Yan et al. 2017) is a recently completed 4.5-year international collaborative project under the IEA-EBC Programme. The Annex developed a scientific methodological framework that will guide occupant behaviour research in the areas of data collection; model building and evaluation; simulation tool development,

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integration, and application; and interdisciplinary issues. Key contributions are: (1) identified quantitative representation and classification of occupant behaviour; (2) developed methods for occupant behaviour measurement, modelling, evaluation, and application; (3) implemented occupant behaviour models in building performance simulation (BPS) tools; and (4) demonstrated applications of occupant behaviour models in design, evaluation and operational optimization of buildings through 32 case studies covering various building types across several countries

Major research activities and outcomes are shown in Figure 1. Research outcomes were also presented in four topical journal special issues (one in Journal of Building Performance Simulation, two in Energy and Buildings, and one in Building Simulation) as well as a Springer Nature book on occupant research methods. The Annex 66 final report, deliverables, and occupant behaviour modelling tools are available at **www.annex66.org**.
There are unanswered questions on modelling and simulating occupants and applications, which will be further studied under the newly established IEA EBC Annex 79.

For more information, please read *IEA EBC Annex 66: A Recently Completed International Collaborative Project Advanced Methods and Tools to Better Understand and Model Occupant Behavior in Buildings* by Tianzhen Hong and Da Yan, on page 19 of this newsletter.

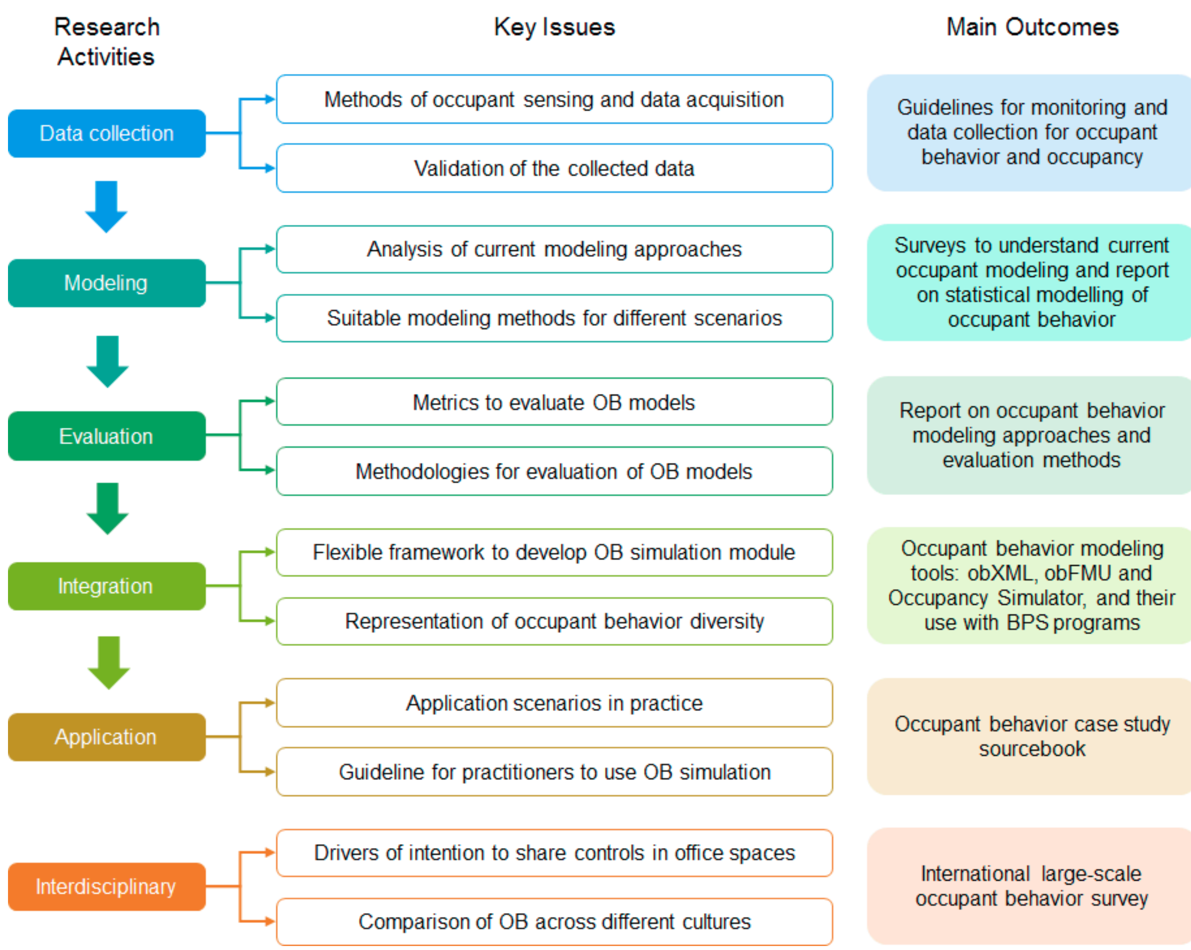

Fig 1: Main research activities, key issues to address, and main outcomes

Occupant modelling techniques

In this section, we focus on key fundamental occupant modelling issues. Before we talk about the state-of-the-art in occupant modelling, it is important to understand how practitioners currently represent occupant-driven thermal loads in building energy simulation. Building energy codes and standards (e.g., ASHRAE Standard 90.1 (2016) and National Energy Code of Canada for Buildings (2015)) prescribe weekly profiles for building occupancy, lighting, and plug-in equipment loads (e.g., Figure 2).

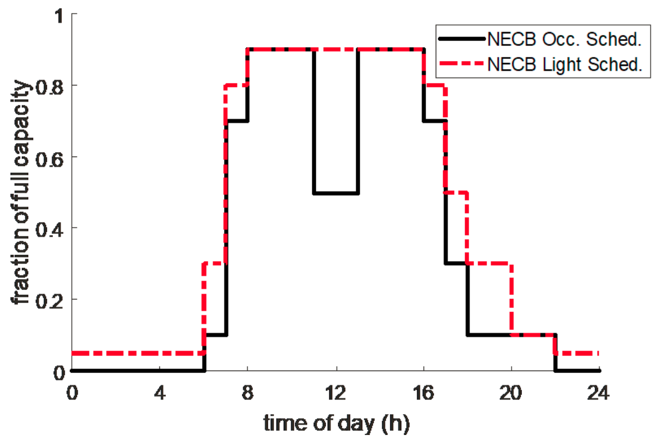

Fig 2: Example weekday schedules from National Energy Code of Canada for Buildings

However, numerous field studies have suggested that typical occupancy, lighting, and plug load profiles are vastly different from the defaults proposed by these codes and standards (e.g., Gunay et al. 2016b; Bennet and O'Brien 2017). Moreover, unlike these steady-periodic schedules, occupant-driven thermal loads vary greatly from one building to another, over time, and as a result of building design and controls. Therefore, key limitations of existing schedule-based occupant models are that they are: (1) outdated, (2) not influenced by building design, thus neglecting the potential impact that design can have on behaviour, and (3) not stochastic, meaning that uncertainty (and conversely, robustness) cannot be quantified.

Based on field and laboratory measurements, the state-of-the-art in occupant modelling seeks to establish statistical relationships that can characterize the uncertainty, diversity, and reactive nature of occupants' interactions with lights, blinds, operable windows, thermostats, plug-in equipment, and other systems. Moreover, modelling occupancy (i.e. occupants' presence) has been an active area of research – particularly with new advances in occupant sensing strategies. Figure 3 presents a simple generic example of a light switch model – predicting the likelihood of observing a light switch-on action at occupants' arrival as a function of a ceiling photosensor's illuminance reading.

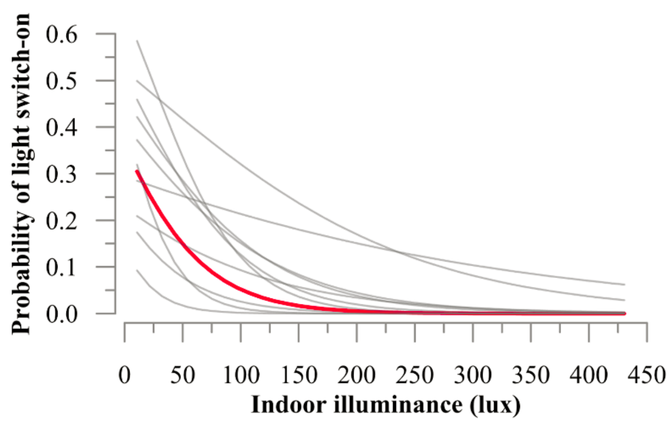

Fig 3: A generic logistic regression model predicting the likelihood of a light switch-on at arrival as a function of a ceiling photosensor's reading. The thick red line represents the average of the ten occupants – each one shown with a different grey line

Model complexity has increased from simple regression models to over several hundred lines of code (e.g., implementation of occupant models in EnergyPlus (Gunay et al. 2016a)). Many occupant model formalisms have been introduced such as discrete-time and event Markov models, Bernoulli models, survival models, and agent-based models. Gaetani et al. (2016) presented a comparison of the predictive ability of different occupant model formalisms and concluded that the best model form is dependent on the application domain. The paper also put forward a fit-for-purpose occupant modelling framework which suggests varying occupant modelling complexity depending on the investigated building and on the resolution of the energy modelling exercise.

In 2011 and 2017, IBPSA's *Journal of Building Performance Simulation* published two special issues on the fundamentals of occupant modelling. For instance, Mahdavi and Tahmasebi (2017) studied approaches to assess the quality of occupant models. They compared performance metrics (e.g., true positive predictions and window opening ratio) that were used to assess occupant models from the literature. Mahdavi and Tahmasebi (2017) demonstrated the necessity of a systematic and dependable quality assurance procedure for occupant model development. Beyond modelling the average behavioural patterns of a population, Haldi et al. (2017) and O'Brien et al. (2017b) studied incorporation of inter-occupant diversity in models and showed that common occupant modelling approaches risk suppressing this diversity.

Despite these fundamental steps towards the integration of occupant modelling in building energy modelling practice, there are several barriers and enablers in this field. The absence of large open databases has led to the generation of occupant models developed upon a population of 10 to 30 occupants. Researchers often do not follow a transparent data collection and pre-processing procedure, and moreover contextual details pertaining to the monitoring approach are not necessarily included in the publications (O'Brien and Gunay 2014). This situation hinders the fidelity of occupant models and calls their transferability to other contexts into question. Several comparative studies have revealed that models from different contexts can vary significantly (Schweiker et al. 2012; Tahmasebi and Mahdavi 2016).

Many advanced occupant models (e.g., for predicting blind use) require detailed occupancy models that represent occupants as individuals rather than as schedules. Existing schedules predict fractional occupants, which is rooted in the notion that the objective of occupancy characterization in building models is to estimate internal heat gains. Moreover, schedule-based occupancy modelling does not characterize arrival and departure events. For example, consider the importance of whether an office occupant first arrives before or after sunrise in the morning. That fact may result in the lights being left on all day or not. Such interrelationships between all occupant-related modelling domains and the aspects of indoor environmental quality (IEQ) that may trigger them are complex, with considerable remaining research. Most occupant monitoring campaigns aimed at model development measure a limited number of behaviours and triggers (e.g., IEQ parameters). As a result, there is little understanding of how occupants cope and react to multiple environmental stimuli. For instance, how do occupants compromise between street noise and thermal comfort when choosing whether or not to open a window? And if an office occupant feels too warm, do they open the window, turn on the fan, drink a cold drink, leave the office, go for a swim, or reduce the thermostat setpoint?

There also remain questions regarding how to treat occupant diversity. There are some inherent benefits of understanding and quantifying uncertainty (e.g., robust building design and risk assessment for equipment sizing). The two key methods in the literature are to discretize occupants into types (e.g., passive and active (Reinhart 2001)) or to have continuous distributions (e.g., generalized linear mixed models with random effects (Haldi et al. 2017; O'Brien et al. 2017b)). Each has its own strengths and weaknesses but has seldom made it past the conceptual level.

Beyond fundamental modelling issues, major obstacles to integration of advanced occupant models in the design process are: (1) practical and user-friendly implementation of the models into mainstream BPS tools, and (2) practical aspects of using advanced stochastic models for design and their implementation into building standards and codes. These issues are discussed in the next two sections; what remains unresolved will be addressed by IEA-EBC Annex 79.

Implementation of occupant models in simulation

BPS programs have been widely applied to evaluate the performance of building energy systems and technologies.

However, occupant behaviour - a key driver of building performance - is usually represented in BPS models with oversimplified and predefined static schedules or fixed settings and rules, leading to deterministic and homogeneous simulation results that ignore the stochastic nature, dynamics, and diversity of occupant behaviour.

Quantifying occupants' influence on building performance requires the integration of energy-related occupant models with BPS programs. Popular BPS programs, including EnergyPlus, IDA ICE, ESP-r, DeST, TRNSYS, and DOE-2, use various approaches at various levels of fidelity to represent occupant-related input and to implement occupant models for simulation (Hong et al. 2018). Typically, occupant models are developed based on independent variables and metrics. The selection of different drivers for similar occupant models makes it difficult to compare the models and incorporate them into BPS programs. Occupant models also tend to be located in multiple locations of BPS program code, making any changes difficult to implement. A recent review of modelling and simulation approaches for occupant behaviour in buildings (Cowie et al. 2017) discussed the problem of transferring occupant models that have been developed based on selected observation studies to different building models. Additionally, one of the key takeaways drawn from previous studies has been the lack of a standardized method to represent and implement energy-related occupant models in BPS programs. Despite major efforts towards the integration of occupant models in building energy simulations, there is no widely-accepted integration method, as highlighted by Lindner et al. (2017).

Annex 66 developed quantitative representations of occupant models and integrated them with BPS programs to improve the analysis and evaluation of the impacts of occupant behaviour on building performance. A comprehensive review was conducted to identify and compare approaches to representing and implementing occupant models in eight of the most widespread BPS programs in the engineering and simulation community. BPS programs use varying and non-standardized input syntaxes to represent occupant models. For occupant model implementation in BPS programs, four approaches were used: (1) direct user input or control using BPS input syntax (most BPS programs) or through middleware OpenStudio measures to implement occupant models in EnergyPlus models, (2) user functions or custom code (EnergyPlus, DOE-2, and IDA-ICE), (3) built-in occupant models (DeST and ESP-r), and (4) co-simulation with dedicated OB software tools such as obFMU (EnergyPlus and ESP-r). Annex 66 developed three new occupant modelling and simulation tools: (1) obXML – an XML schema representing occupant models using the DNAS (Drivers-Needs-Actions-Systems) ontology (Hong et al. 2015, 2016), (2) obFMU – an occupant model solver using the functional mock-up unit (Hong et al. 2016), and (3) Occupancy Simulator – an agent-based Markov chain model of occupant presence and movement in buildings (Chen et al. 2018).

These tools help standardize the input structures for occupant models, enable the collaborative development of a shared library of occupant models, and allow for a rapid and widespread integration of occupant models in various BPS programs. These developments ultimately improve the simulation of occupant behaviour and quantification of its impact on building performance. However, another obstacle in using occupant models in the design process is how to use these models in practice, as we will discuss in the next section.

Approaches to apply occupant modelling to building design

The occupant behaviour research community strives to integrate occupant models in the building design process to avoid two main risks: (1) inaccurate prediction of building performance, and (2) poor design decision-making resulting from the first risk (Gilani et al. 2016). However, despite recent advances in occupant modelling research and the demonstrated benefits of quantifying its impact on building performance, its uptake in design practice and policy has been relatively slow (O'Brien et al. 2017a).

A recent international survey (O'Brien et al. 2017a) revealed that building simulationists most frequently use the standard occupant-related schedules in their building models. Based on the survey, many simulationists were under the misconception that it does not matter if occupants are appropriately represented in building energy models, as long as the same assumptions are made for all investigated design cases. The majority of the respondents reported that they were highly confident with their assumptions regarding occupants. However, Ouf and O'Brien (2018) demonstrated how minor changes in occupant-related inputs can alter building energy modelling outcomes for code compliance and incentive programs. Similarly, Gilani et al. (2016) showed that optimal building design is affected by assumptions about occupants.

In a recent follow-up stakeholder workshop with 25 Canadian building simulation practitioners and researchers (Figure 4), the topic of occupant modelling in building design was also discussed in great detail (Abuimara et al. 2018). The workshop revealed that simulationists do not feel they have the time to apply more detailed models and they fear the liability to deviate from the norm. A notable outcome of the workshop is that participants indicated that the level of detail of occupant modelling is determined based on the overall modelling purpose which ranges from code compliance to net-zero building design. However, only in specialized, ambitious, and advanced types of projects, detailed occupant modelling is considered, especially if specific building performance targets are contractually required. Among workshop participants, practitioners noted the challenges related to advanced occupant modelling including: (1) the complexity of stochastic occupant models, (2) the difficulty of representing stochastic occupant-related inputs and implementing stochastic occupant models in BPS tools, (3) the extensive time and computational requirements of using stochastic occupant models and processing their results, and (4) the lack of representative schedules to reflect current occupancy and usage patterns.

What can researchers do to make it simpler for practitioners to represent occupants in simulations without using advanced stochastic occupant models while maintaining their main characteristics? As previously noted, it is critical to understand how building design may affect occupant behaviour. But, how can this characteristic be reflected in simulations while avoiding the complexity of using advanced occupant models? Fixed threshold models are one good solution for this purpose since they link indoor environmental quality to occupants' adaptive actions (e.g., those in the commonly used daylight metric standard IES LM-83). Gilani et al. (2018) found that fixed threshold models for light or window shade use in a large group of private offices (more than 100) gives reasonable annual energy use prediction similar to stochastic models at the building level. The important point of using such models is that thresholds must be based on indoor conditions rather than outdoor conditions, to reflect how occupants behave differently in various building designs.

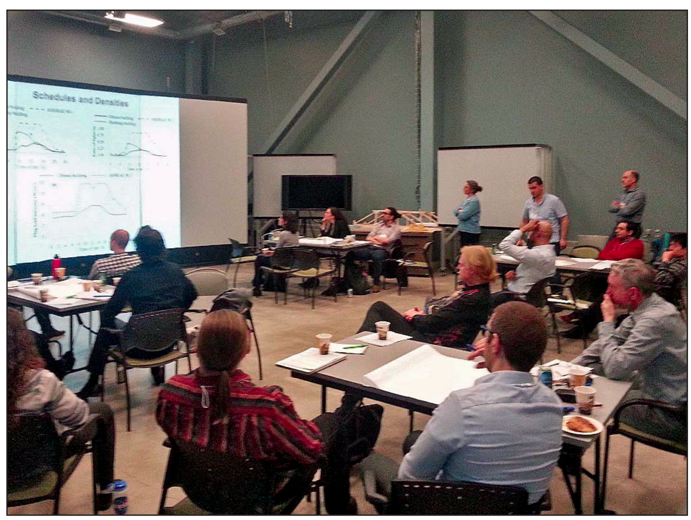

Fig 4: Stakeholders' workshop on occupant modelling at Carleton University, Ottawa, Canada

Another solution to consider two-way interactions between buildings and adaptive occupant behaviour is to customize them by generating different sets of schedules that are building design-specific. For instance, Ouf et al. (2018a) provided a decision tree diagram (Figure 5) to select appropriate light use schedules based on design factors such as window sizes and building orientations. This decision tree was developed based on the results of thousands of parametric building simulations that implemented stochastic occupant models for lights and blinds use. This approach is less flexible than using the original occupant models, but is vastly simpler and more practical for practitioners, and could serve as an intermediate approach.

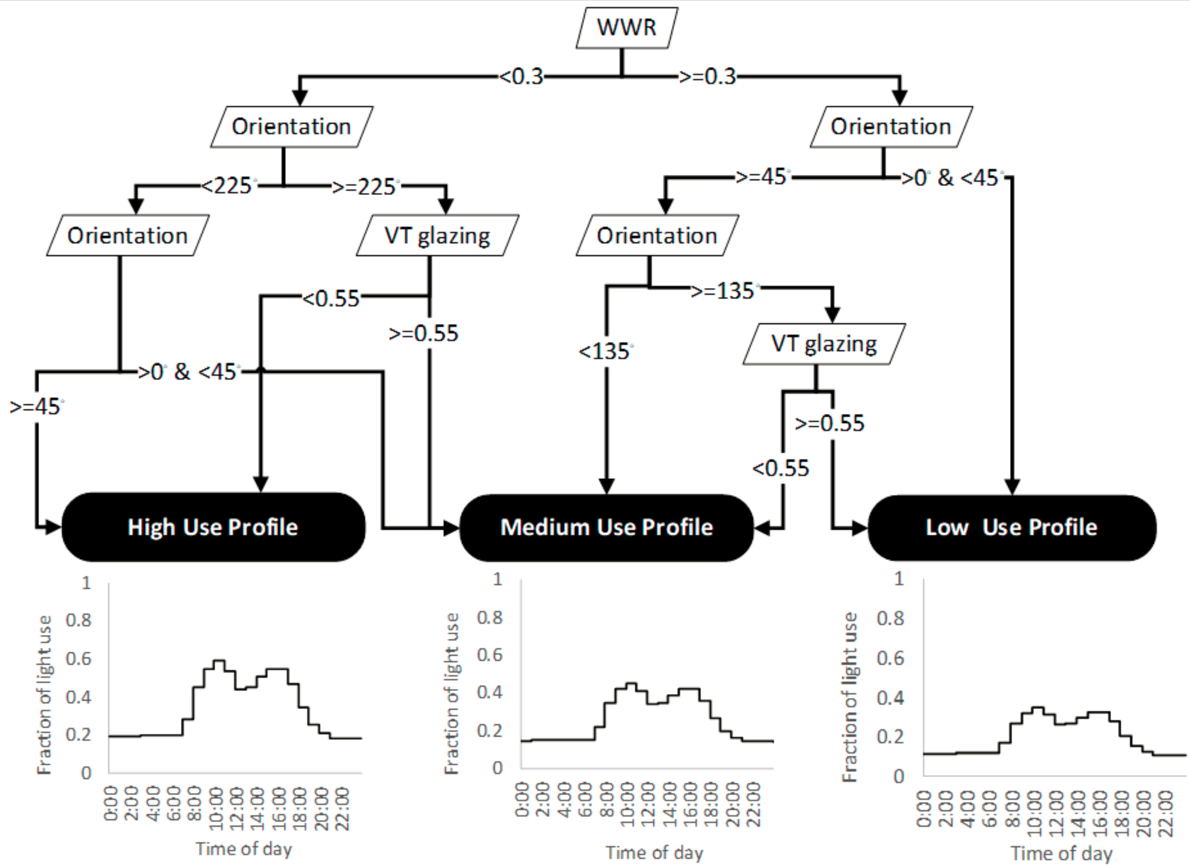

Fig 5: Decision tree diagram to select design-sensitive lighting schedules

Another challenge in using advanced occupant models in the building design process is the additional time and computational effort needed to run multiple simulations as well as to present probability distributions and visualize uncertainty. One of the solutions to reduce simulation runs is to identify which occupant behaviour has a relatively larger impact on building performance using simple methods (e.g., Clevenger and Haymaker 2006; Gaetani et al. 2018). To address the BPS-related challenges, Ouf et al. (2018b) presented a framework to improve occupant modelling capabilities in BPS tools with the objectives of simplifying this process for users and improving the accuracy of occupants' representation. Recommendations focused on improving the inputs of current BPS tools, modifying some of the underlying modelling processes, and finally increasing automatically-generated BPS outputs. Some of the proposed recommendations include enabling more probabilistic inputs in BPS tools to simulate occupants' presence and actions using stochastic rather than deterministic rules. Adding this functionality necessitates changes to the modelling process, such as automatically running multiple simulations if probabilistic occupant-related inputs are specified. Finally, BPS outputs from these multiple simulations should be automatically processed to characterize the effect of occupants on building performance, thus facilitating this process for building designers.

In addition to simplifying occupant models and improving BPS tools, practitioner training is of high importance in applying advanced occupant models in building design processes. The majority of participants in the international survey (O'Brien et al. 2017a) were interested in learning more about occupant modelling. The workshop participants (Abuimara et al. 2018) also pointed out the complexity of advanced occupant models as a challenge. Moreover, they stated that they need to be convinced that advanced occupant models impact their simulation outputs significantly. Educational materials such as workshops, videos, and guidelines, are necessary in this regard. For instance, Gilani and O'Brien (2018) provided a best practices guideline which is accompanied by on-line videos on basic principles, step-by-step working examples, and recommendations on which occupant modelling approach is most appropriate for different application cases.

Lastly, the occupant behaviour research community should work towards distilling the research findings to influence building energy codes and standards, as current building code compliance paths do not necessarily require building design teams to apply detailed occupant models in the design process. Major steps towards these goals are to continue studying the significant role of occupants in building design and operation, as are sought by IEA-EBC Annex 79.

Introducing IEA EBC Annex 79: Occupant behaviour-centric building design and operation

Following the highly-successful Annex 66 and some of the above knowledge gaps, IEA EBC Annex 79 seeks to further elevate the state-of-the-art in our understanding of occupants, while improving the way occupants are treated in design processes and building operations. The Annex will last from 2018 to 2023 and involve researchers, practitioners, and policymakers from all over the world. Together, the team of experts seeks to address fundamental research questions while effectively disseminating results to practitioners and policy makers. Moreover, to test concepts and build industry confidence, Annex 79 seeks to prove the potential for new occupant-centric building design processes and control strategies through demonstration projects.
Key research questions for Annex 79 include:

- What are the relationships and interdependencies between different indoor environmental parameters (thermal, visual, olfactory, and aural comfort) and their impact on perception and behaviour?
- How do building controls' interfaces and their underlying logic affect behaviour? How can and should interfaces be systematically tested in experimental, in situ, immersive environments, and simulation approaches?
- How can we systematically leverage data from building automation systems and other readily-available data sources (e.g., using data-mining and artificial intelligence methods) to develop occupant models, inform building design, and optimize building controls and operations?
- How can uncertainty and risks from occupants be managed and exploited in building design?
- How should experimental and occupant modelling findings be used to influence building codes, standards, and policies?

Annex 79 is comprised of four subtasks focussing on the following topics:

- Subtask 1: Multi-aspect environmental exposure, building interfaces, and human behaviour
- Subtask 2: Data-driven occupant modelling strategies and digital tools
- Subtask 3: Applying occupant behaviour models in performance-based design process
- Subtask 4: Development and demonstration of occupant-centric building controls

Subtasks 1 and 2 are focused on fundamental research and new research methods and tools. Subtasks 3 and 4 will make use of findings of the first two subtasks, while focusing on new occupant-centric design processes and controls technologies. Policy guidance will be provided to improve mainstream uptake of the developed methods and technologies. Subtasks 3 and 4 will each involve approximately five detailed case studies to demonstrate new methods and technologies.

The first Annex 79 meeting is in Ottawa on October 10-12, 2018, while subsequent meetings will occur every six months. The third meeting will immediately follow BS2019 in Italy. Researchers, practitioners, and other potential participants are encouraged to visit **http://annex79.iea-ebc.org/**.

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IEA EBC Annex 66: A recently-completed international collaborative project

Advanced methods and tools to better understand and model occupant behavior in buildings

Tianzhen Hong[1], *Da Yan*[2]

Energy-related occupant behavior is a key factor influencing building performance. Depending on the building type, climate, and degree of automation in operation and controls, occupants could increase or decrease energy use by a factor of up to three for residential buildings [Andersen 2012], and increase by up to 80% or reduce by up to 50% for single-occupancy offices [Lin and Hong 2012]. One simulation study [Sun and Hong 2017] also estimated occupant behavior measures have a 41% energy savings potential for office buildings. Occupant behavior in buildings refers to (1) occupant presence in spaces and movement between spaces, (2) occupant interactions with building systems, and (3) occupant adaptations (e.g., changing clothing, having hot/cold drinks). Occupant actions such as adjusting a thermostat for comfort, switching lights on/off, using appliances, opening/closing windows, pulling window blinds up/down, and moving between spaces can have a significant impact on energy use and occupant comfort in buildings. Having a deeper understanding of occupant behavior and the ability to quantify its impact on the use of building technologies and building performance using simulation tools is crucial to the design and operation of low-energy buildings. In current practice, however, the influence of occupant behavior is under-recognized and over-simplified in the design, construction, operation, and retrofit of buildings.

Occupant behavior is complex and requires an interdisciplinary approach to be fully understood. On the one hand, behavior is influenced by external factors such as culture, economy, and climate, as well as internal factors such as individual comfort preference, physiology, and psychology. On the other hand, occupants' interactions with building systems strongly influence building operations and associated energy use and operating costs; in turn, building operations influence occupant behavior, thus forming a closed loop.

Past studies of occupant behavior have lacked in-depth quantitative analysis; moreover, available models of occupant behavior have been developed across different researchers and have showed inconsistencies, lacking consensus on how to approach experimental design and modeling methodologies. Accordingly, a strong need emerged in recent years for researchers to work together on devising a consistent research framework for occupant behavior definition and simulation.

Annex 66: Definition and simulation of occupant behavior in buildings is a recently completed international collaborative project that laid the groundwork for this occupant behavior research framework. Annex 66 was led by the United States (sponsored by Department of Energy's Building Technologies Office) and China, and included more than 120 researchers from 20 countries working together from November 2013 to May 2018

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under the International Energy Agency's (IEA) Energy in Buildings and Communities (EBC) Programme. In terms of research contributions, Annex 66: (1) identified quantitative representation and classification of occupant behavior; (2) developed methods for occupant behavior measurement, modeling, evaluation, and application; (3) implemented occupant behavior models in building performance simulation tools; and (4) demonstrated applications of occupant behavior models in design, evaluation and operational optimization of buildings through 32 case studies covering various building types across several countries.

The major product of Annex 66 is a scientific methodological framework that will guide occupant behavior research in the areas of data collection; model building and evaluation; simulation tool development, integration, and application; and interdisciplinary issues. Key research findings from the Annex are summarized as follows:

1. **Occupant behavior has significant impacts on energy use and occupant comfort**. Insights into occupant behavior, developed through quantitative representation and simulation of occupant-building interactions, can help building designers, engineers, and policymakers understand and reduce the gap between simulated and measured building energy performance.
2. **Data collection is fundamental to occupant behavior modeling**. Methods of collecting data are evolving with the rapid development of sensors and Information and Communication Technologies (ICT). Most data collection campaigns are conducted in a typical working or living environment rather than a laboratory. Researchers must have a good understanding of the available data collection methods and apply them to the most appropriate situation – a particular challenge given the rapid evolution of occupant behavior data collection technologies.
3. **Occupant behavior models need to be integrated with building performance simulation programs**. An XML schema (obXML) was developed through the Annex to represent occupant behavior in a standardized ontology, enabling the interoperability of occupant behavior models across simulation tools and user applications. An associated occupant behavior software module (obFMU) was developed which enables co-simulation of quantitative behavior models with building performance simulation tools such as EnergyPlus, ESP-r and DeST. In parallel, an agent-based Occupancy Simulator was also developed and integrated with OpenStudio, allowing the generation of more realistic occupant schedules as inputs to building simulations.
4. **The choice of occupant behavior model depends on the building context**. Studies suggest that probabilistic models of occupant behavior do not necessarily always perform better than simpler deterministic models. The development of thermal comfort research and its combination with sociological studies can potentially shed some light on key socio-economic factors to be considered in modeling occupant behavior. Evaluation of occupant behavior models requires the use of explicit, application-specific metrics that quantify model performance under the given application.
5. **User-friendly interfaces and modeling guides are needed for effective behavior model application**. A collection of 32 case studies were compiled to showcase the applications of occupant behavior sensing, data collection, modeling, simulation, and analysis in the building life cycle. Fit-for-purpose guidance on occupant behavior modeling and application was developed.
6. **Energy policy makers can use occupant behavior modeling to improve decision making**. The availability of quantitative behavior models can facilitate the development of more effective policies for reducing energy consumption in buildings that leverage knowledge of likely occupant actions and their influence on building performance – for example, by enabling estimation of the energy and occupant comfort consequences of using particular policy levers (e.g., regulation, information campaigns, incentives) and/or supporting the development of new technologies (e.g., occupant-centric sensing and control packages).

7 **Interdisciplinary research across the building, social, behavioral, data and computer sciences is needed to understand, represent, model, and quantify the impact of human behavior on building energy use and occupant comfort.** In addition to establishing an interdisciplinary research community and framework, Annex 66 developed an interdisciplinary cross-country survey on occupant energy-related behavior in buildings, which provides valuable insights into occupant behavior and the basis of occupant behavior modeling and simulation.

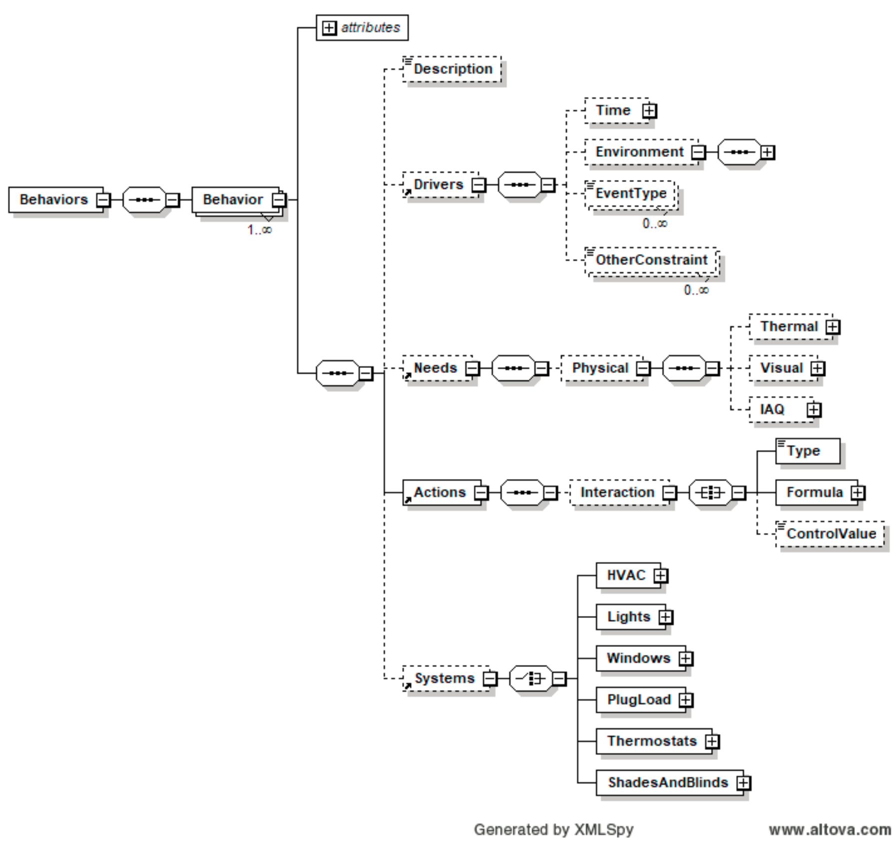
These findings are discussed in greater detail in [Yan and Hong 2017]. Annex 66 research outcomes were also presented in four topical issues [Hong 2015, Wagner and Dong 2015, O'Brien et al. 2017, Andrews and Dong 2018] as well as a Springer book [Wagner et al. 2018]. The Annex 66 final report, deliverables, and occupant behavior modeling tools are available at www.annex66.org.

Going forward, several ongoing research efforts will continue to tackle some of the open challenges left by Annex 66 and further integrate the human factors in the building life cycle to improve performance, including: IEA EBC Annex 79: Occupant behavior-centric building design and operation; the ASHRAE Multidisciplinary Task Group on Occupant Behavior in Buildings (MTG.OBB); and Building Technologies Office (BTO)'s building energy modeling and sensors and controls subprograms. Some of these open challenges include: viable and cost-effective ways to collect large-scale occupant behavior data; improved representation of inter-occupant behavior diversity and social interactions; methods to improve model evaluation and validation; behavior or best practices of operation and maintenance for commercial buildings; and human-in-the-loop sensing and controls.

Three figures illustrate some of the key ideas that have emerged from Annex 66:

Fig 1: The obXML schema with the DNAS (Drivers-Needs-Actions-Systems) ontology

Source: Hong T, et al. An ontology to represent energy-related occupant behavior in buildings. Part II: Implementation of the DNAS framework using an XML schema. Building and Environment 94 (2015) 196-205



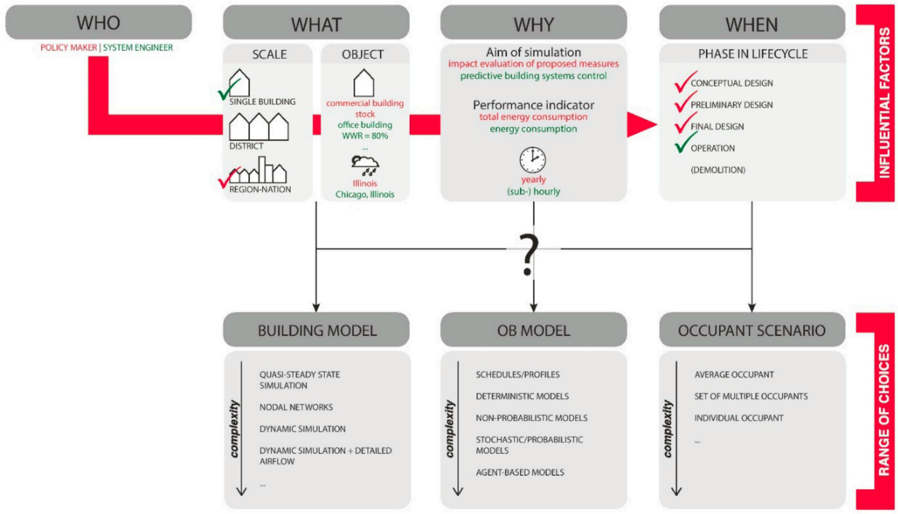


Fig 2: The driving factors (who, what, why, when) upon which a suitable energy modeling technique should be elaborated for each specific case
Source: Gaetani, I., Hoes, P.-J. & Hensen, J. L. 2016. Occupant behavior in building energy simulation: towards a fit-for-purpose modeling strategy. Energy and Buildings, 121, 188-204

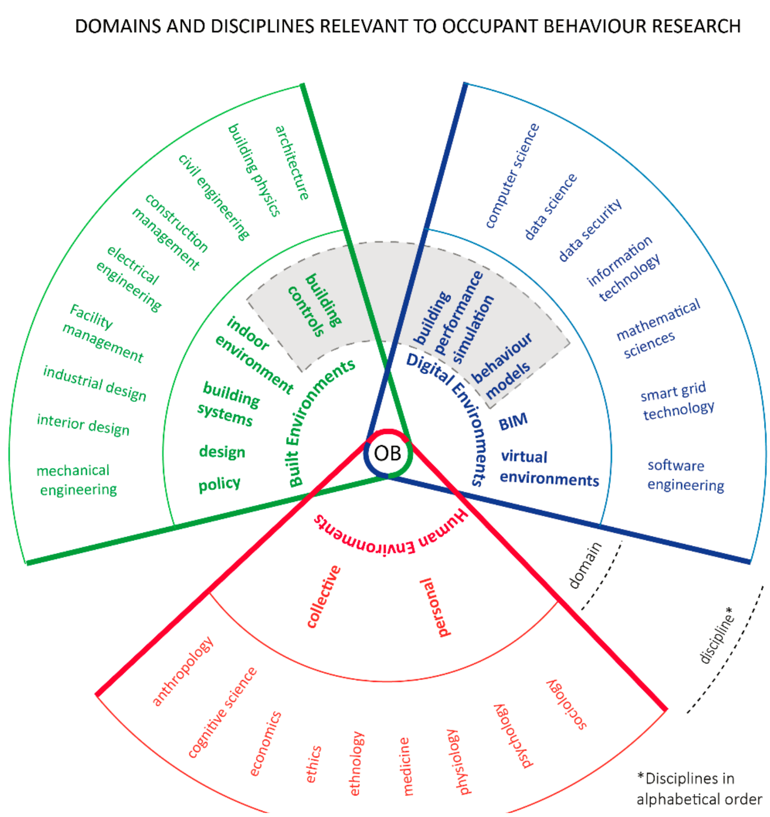


Fig 3: Domains and disciplines relevant to occupant behavior research
Source: Annex 66 Final Report

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IEA EBC Annex 71: Modellers wanted!

Paul Strachan[1], *Matthias Kersken*[2]

A new empirical validation study is planned within the International Energy Agency (IEA) Energy in Buildings and Communities (EBC) programme Annex 71 *Building energy performance assessment based on in-situ measurements,* which will involve whole-model empirical validation of a full-scale building including building service equipment and synthetic users. This article outlines the objectives of the study and provides details of how interested program developers and experienced modellers can participate.

The study follows on from an empirical validation study undertaken as part of the recent IEA EBC Annex 58. In this project, experimental data were gathered in two experiments conducted on the identical Twin Houses (Figure 1) at the Fraunhofer IBP test site at Holzkirchen in Germany [1]. There was a high level of engagement from modellers (over 20 sets of modelling predictions from 16 organisations using 12 different programs, both research and commercial), with the developed experimental specification being implemented and thoroughly tested. Programs in the study included IESVE, IDA ICE, TRNSYS, EnergyPlus, ESP-r, Wufi and programs based on Modelica and Matlab. The experimental data sets ([2], [3]) and their documentation [4] is publicly available, with a significant number of downloads (currently 60 and 36 for Experiment 1 and 2 respectively). The validation study proved valuable to many participants, for assessing the accuracy of the tested program, or for identifying flaws in the programs' models or modelling techniques, or for general simulation training purposes.

Fig 1: Twin Houses (left) and south façade of one of the houses (right)

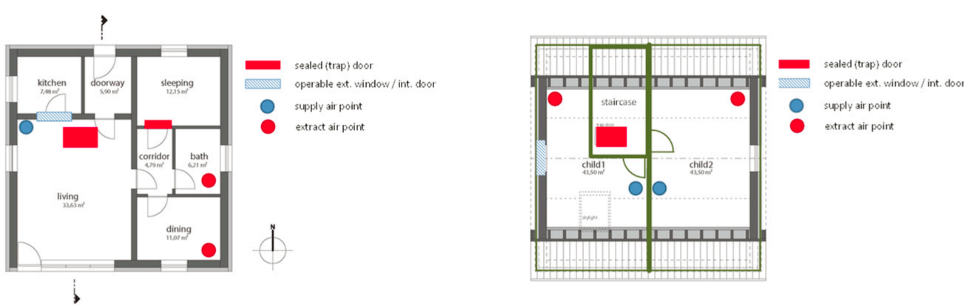

Fig 2: Floor plans of the twin houses including mechanical ventilation and operable openings

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The Twin House experiments were full scale, multi-zone, subject to real weather conditions and lasted for approximately two months for each experiment, but the experimental design was deliberately kept simple to focus on the validation of the basic models such as thermal transfer through walls and windows, internal and solar gains, and ventilation. The intention in Annex 71 is to increase the complexity with experiments throughout the winter of 2018/9. Again, the Twin Houses will be used, but significant changes will be the inclusion of two bedrooms in the upper attic space, room-by-room synthetic occupancy profiles, comparison of electrical and underfloor heating systems, some changes to fabric insulation and monitoring of inter-room air flow. Schematic floor plans are shown in Figure 2. As for the previous validation experiment, there will be extensive high-quality instrumentation to capture boundary conditions and internal heat flows and temperatures during the experiments.

The room-by-room synthetic user profiles are derived from a statistical occupancy model based on time use survey data [5], [6]. The profiles include changes to the heating set points, the timing of heat and moisture emissions, and the operation of external windows and internal doors. During the main experiment the identical (as confirmed by experiment) Twin Houses will be used to compare the effect of different heating systems: electric convectors with minimal thermal mass as used in Annex 58, and an underfloor heating system with an air source heat pump. In an extended experiment both Twin Houses will be heated with electrical convectors, which can be modelled reliably. The difference between both houses in this extended experiment is the addition of internal moisture loads in one of the houses, injected through the supply air, to allow for the validation of simulation program moisture models.

Several participating modelling teams in Annex 71, given the detailed specification of the buildings and the measured time-varying boundary conditions, will submit predictions of the heat inputs (given temperatures) or temperatures (given heat inputs). However, modelling teams not involved directly in the Annex research are also welcomed. The intention is to assess detailed simulation programs against the measured performance, so we wish to involve experienced modellers, and particularly program developers.

The validation methodology will be a two phase blind validation, as used in Annex 58 [4] and similar to other previous major empirical validation studies. These steps are as follows:

1. Blind validation (Phase 1). Modellers predict heating energy and indoor climate using the experimental specification, measured climate data and operational schedules but without knowledge of the measured heating energy consumptions and indoor climate. At this stage there are usually additional questions regarding the experimental details – these questions and answers are distributed to all modelling teams. Modelling teams submit predictions together with modelling reports containing details of the programs used and assumptions made.
2. First stage analysis. This compares predictions against experimental data for indoor climate and heat fluxes. Inevitably at this stage, differences are due to a mix of user and modelling error (and potentially measurement uncertainties).
3. Re-modelling (Phase 2). The measured data is disseminated. Modelling teams are encouraged to investigate differences between measurements and predictions and resubmit predictions and up-dated reports. Only changes which correct user modelling errors or alter a modelling assumption (with documented rationale) are allowed. It is important to ensure that model input parameters are not simply tuned to improve agreement with measurement. This step separates the modelling from the user error by eliminating the user errors.
4. Final analysis and archiving of high quality data sets. The improved predictions are compared against the measurements to identify remaining flaws. The intention is that the resulting specification and datasets will be useful for developers of new programs and those improving modelling algorithms.

Regarding timescales, it is expected that the detailed specifications and the measured climate data will be released to modelling teams in early spring 2019. When the validation exercise is completed the resulting datasets can still be used for validation and also for training and teaching purposes. Please email **paul@esru.strath.ac.uk** for further details if you are interested in participating.

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Forthcoming events

Date(s)	Event	Web site
2018		
29-30 November 2018	**uSIM 2018: Urban Energy Simulation** Glasgow, UK	www.usim18.org.uk
03-05 December 2018	**Asim2018: 4th IBPSA Asia conference** Hong Kong, China	www.bse.polyu.edu.hk/ASIM2018
10-12 December 2018	**PLEA 2018** Hong Kong, China	www.plea2018.org
2019		
12-16 January 2019	**ASHRAE Winter Conference** Atlanta, Georgia, USA	www.ashrae.org/conferences/winter-conference
07-09 April 2019	**SimAUD 2019** Atlanta, Georgia, USA	www.simaud.org/2019/
25-26 April 2019	**CIBSE ASHRAE Technical Symposium 2019** Sheffield, UK	www.cibse.org/technical-symposium-2019/abstract-submission
22-26 June 2019	**ASHRAE Annual Conference** Kansas City, Kansas, USA	www.ashrae.org/conferences/annual-conference
30 June - 03 July 2019	**EG-ICE International Workshop on Intelligent Computing in Engineering** Leuven, Belgium	https://eg-ice.org/upcoming-events
02-04 September 2019	**BS19: Building Simulation 2019** Rome, Italy	www.buildingsimulation2019.org *** SEE WARNING BELOW ***
17-18 October 2019	**VI South American Congress of Building Performance Simulation** Mendoza, Argentina	[Not yet available]

Note that the dates in this calendar may, but do not necessarily, include pre and/or post-conference workshop days

WARNING: Predatory Building Simulation conferences!

The Board of IBPSA has noted that there is a call for papers for an International Conference on Building Simulation, to take place in Rome in January 2019. This is NOT the IBPSA Building Simulation 2019 conference: that will take place on 2-4 September 2019. The host of the January event is known to be a predatory conference host and publisher.

Predatory conferences and publications are a relatively new phenomenon that take advantage of the pressure on academics and research students to publish widely. They use conference and journal names closely related to existing events and publications, and may even have an online submission system, and come back with some perfunctory review results. However, their key objective is to capture a registration or publication fee. In the end, the unsuspecting 'delegate' may end up travelling to a foreign country only to find out that he or she is alone in an otherwise empty hotel venue. Research students are a high-risk group, as they may not note irregularities in submission and review processes and other clues that an event is not right.

For Building Simulation 2019, please make sure to follow the official announcements via IBPSA!

07-09 April 2019
Atlanta, USA
www.simaud.org/2019/

Call for Submissions

We invite you to submit and present an original contribution for SimAUD2019, which is run collaboratively with ACM/SIGSIM and is sponsored by The Society for Modeling and Simulation International.

All submissions are peer-reviewed and considered for selection by the Scientific Committee. All the accepted submissions (both full and short papers) will be published in SimAUD's proceedings, and all accepted full papers (8 pages) will also be published in the ACM Digital Library.

Please observe the submission types and deadlines on the Symposium website.

Areas of Interest

SimAUD topics include, but are not limited to:

- Simulation-Based Collaborative Design
- Simulation-Based Generative Design
- Simulation-Based Design Tools and Methods
- Multidisciplinary Design Optimization
- Simulation Performance and Scalability
- Building Comfort & Energy Performance
- Simulation of Occupant Behavior
- Simulation of Building Controls
- Physics-Based Simulation in Design
- Whole Building Energy Simulation
- Thermal Comfort & Occupant Satisfaction
- Lighting and Daylighting
- Airflow In & Around Buildings
- Acoustics Modeling, Simulation & Design
- Visualization of Simulation Data
- Urban-Scale Modeling
- Uncertainty, Validation and Risk Management
- Augmented and Virtual Reality

- Design Agency & Multi-Agent Systems
- Intelligent Buildings & Building Lifecycle Management
- Sensor Networks & Building Performance Monitoring
- Interactive Environments
- Responsive Facades
- Robotic Fabrication in Design

Submission Types

Research works can be submitted in several categories:

- Full Papers (Archived at the ACM Digital Library)
- Short Papers (Not archived at the ACM Digital Library)
- Invited Papers (Archived at the ACM Digital Library)
- Projects & Videos (Not archived at the ACM Digital Library)

Additional information on the key topics of interest and on the submission types is available on the website, **www.simaud.org/2019/**.

The symposium chairs are Siobhan Rockcastle and Tarek Rakha, **srockcas@uoregon.edu** and **trakha@syr.edu** and the scientific chairs are Carlos Cerezo Davila, Dimitris Papanikolaou and Tea Zakula.

www.buildingsimulation2019.org

Conference Venue: ***Angelicum Congress Center*** **seat of the Pontifical University "S. Tommaso d'Aquino"**

CALL FOR ABSTRACTS STARTED IN APRIL 2018

Program:
- Presentations on research
- Case studies and best practices
- Panel discussions
- Software demos and exhibition
- Simulation competitions
- Technical tours and cultural visits

Topics:

Building acoustics
Building Information Modelling (BIM)
Building physics
CFD and air flow
Commissioning and control
Daylighting and lighting
Developments in simulation
Education
Energy storage
Heating, Ventilation and Air Conditioning (HVAC)
Human behaviour
Indoor Environmental Quality (IEQ)
New software development
Optimization
Simulation at urban scale
Simulation to support regulations
Simulation vs reality
Solar systems
Validation, calibration and uncertainty
Weather
Windows
Zero Energy Buildings (ZEB)

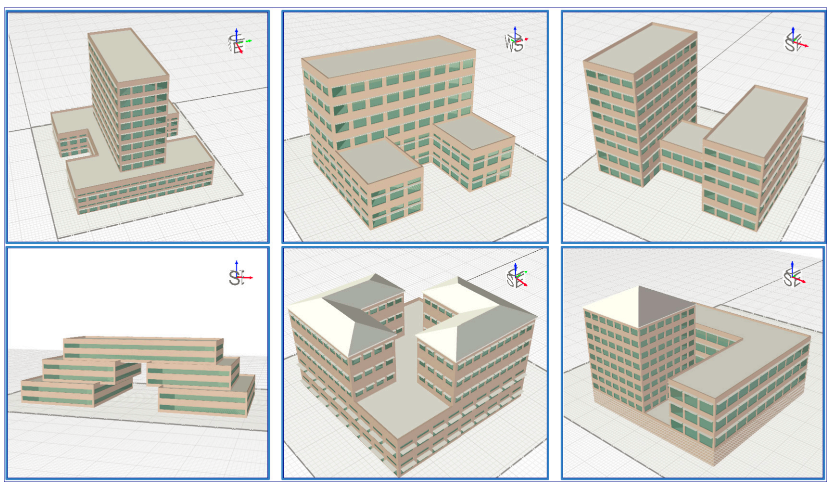
Software news

Digital Alchemy release Simergy v3

Simergy v3 includes several new features and dozens of significant enhancements, and Digital Alchemy believe it is the most robust version to date. More information about it (both the free and Professional versions), and about forthcoming events like webinars and online training, is available at https://D-Alchemy.com.

New features

- **Building sections:** This new feature enables users to create much more interesting and diverse buildings by supporting multiple connected or disconnected sections. Sections can be stacked, side-by-side, or separated.



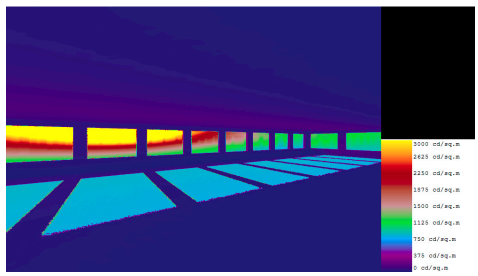
  Each of the following can differ between sections:
  - base elevations
  - floor-to-floor heights
  - constructions
  - occupancy (loads, schedules, setpoints, etc.)
  - building systems (HVAC, SHW, Lighting)
  - roof configuration.

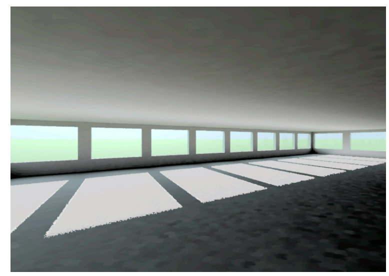
- **Scripted model changes:** In this new version Simergy supports automated (scripted) changes to Building Energy Models (BEMs) using DOE's 'Model Measures' framework. This allows users to leverage scripts that have already been developed by DOE to auto-edit BEMS, such as:

  - increase or decrease window/wall ratio by 5%
  - increase or decrease insulation in exterior walls by 5%

- **Occupancy-driven defaults**: This feature enables automated defaults for the selected occupancy to be assigned for zone loads, target zone conditions, and most schedules. Occupancy definitions cascade from Project > Section > Story > Space but can be overridden at any level. For example, an office building might still have a section which is retail. In that case, office loads, conditions, and schedules will be used for most of the building, but the retail section will use loads, conditions, and schedules that are appropriate to retail.

- **Radiance daylighting simulation**: Simergy v3 includes support for a new simulation engine, Radiance — DOE's premier daylighting simulation package, considered to be the best in the world.





- **Undo/Redo extensions**: Support for undo and redo is available for virtually all features in Simergy v3.
- **New HELP and User Guides**: Hundreds more pages of end-user help content has been updated, completing this revision cycle.

Enhanced features

- **Licensing**
  - Floating licenses -- Simergy Professional licenses can now be shared across any number of machines
- **Workflow simplifications**
  - 'Create New' added to most template and library entry dropdown lists
  - Improved 'Edit in Table' feature
  - '…' navigation to referenced objects is available throughout Simergy
- **User customization**
  - Improved user-customized workspaces -- user changes to workspaces are remembered
- **Project management**
  - The 'Design Alternatives' workspace is now the 'Project' workspace.
  - Creation of multiple design alternatives is faster
  - Project team definition added (used in reports like code compliance)
- **Site design**
  - Undo/Redo extensions and improvements
  - Add 'Cancel' button to Site workspace -- giving users the option to cancel changes instead of saving them
  - Enable freeform shaped solar obstructions
  - Add anchor and move/rotate support for solar obstructions and solar surface arrays

- **Buildings design**
  - Improved custom openings
    - Workspace is now standalone (removed from building story creation)
    - Customization of solar shading is improved
  - Improved interiors
    - Workspace is now standalone (removed from building story creation)
    - Reseeding spaces is improved
  - Improved façade format painter — copy/paste custom window sets onto other facades
  - Right-click > Remake space tool added
  - Space boundary generation is faster and more accurate
  - Support for multiple window arrays is improved
  - Support for more door & window types has been added
- **Systems design**
  - Improved Building Systems Creator™ -- the new sister to Simergy's Building Model Creator™ – This feature will auto-generate all HVAC and SHW equipment for an entire building – driven by a user selected template defining the loop types and typology (i.e. loop per building, story, or zone)
  - Whole-building systems templates – several whole building templates have been added to the Templates library -- for standard ASHRAE system configurations
- **Simulation**
  - Simulations are now done in EnergyPlus v8.8
  - Simulation error resolution: Errors and warnings from EnergyPlus are now grouped into summary rows. This dramatically simplifies understanding of what needs to be done to get models working. An error resolutions checklist supports users in this process by giving single click access to objects with errors
  - Error resolution knowledgebase is expanded
  - Simergy can be used while EnergyPlus simulations are running
  - The time-consuming generation of all report tables has been made 'on-demand' for each report
- **Reports**
  - Several new and innovative reports that are only available in Simergy
  - On-demand report table generation
- **Results visualization**
  - Improved performance
  - Improved filtering of simulation output variables – for selection and use in graphs
- **Libraries and templates**
  - 'View all in table' improved
  - Dozens of new entries in various libraries and template categories. ■

IES release IESVE 2018

IESVE 2018 was launched in June this year and is available to download via its download centre. Packed with lots of new features, this new release also improves ease of use and reduces simulation times.

New features

The new features include:

- **VE start-up interface**
  IESVE 2018 opens with a new start page which includes:
  - Pinned weather data to give quick access to each user's most common location settings
  - New project creation: Prototype model import options, including ASHRAE 209 prototype models
  - Dynamic information about new events and online content (new scripts, reports, etc.).
- **Daylight simulation enhancements**
  - Spatial Daylight Autonomy (sDA) & Annual Sunlight Exposure (ASE) graphics improvements, shown on the working plane of the 3D model viewer
  - Contoured working planes
  - Global processing capability to entire model for sDA and ASE
  - Rule-based daylight-sensor locations (e.g. by orientation) for daylight-harvesting.
- **Faster simulation**
  Simulation speed in ApacheSim is up to 85% faster using the new parallel simulation mode.
- **New VRF (Variable Refrigerant Flow) capabilities**
  Detailed VRF capabilities in ApacheHVAC now include:
  - Air source VRF with heat recovery
  - Water source VRF with heat recovery
  - Fully integrated with detailed HVAC modeling (e.g. for ASHRAE 90.1 etc.)
  - Complete with performance curve data sets
  - Auto-sizable prototype systems available.

IES welcome user feedback and use it to direct further development. Send suggestions for new features to feedback@iesve.com.

For help with licence key set-up email **keys@iesve.com, and for** technical help email **support@iesve.com**.

First Martin Gough Student Award winner

Earlier this year IES launched a new Student Award based around the use of Apache and thermal simulation in memory of a longstanding staff member, Martin Gough, who was a true expert in this field. The company was touched to receive entries from students around the globe showcasing their use of IESVE to help honour Martin's legacy.

The top prize was awarded to Mohataz Hossain, PhD student at the University of Nottingham, UK, for his paper *Application of the IES-VE simulation tool in quantifying the indoor environmental benefits of retrofitting a garment factory: A case study in the tropical climate*. Mohataz will be the first ever entrant to be named on the winner's plaque and also receives the top prize of £1000, a full 12 month IESVE software licence and access to IES's distance learning portal for one year.

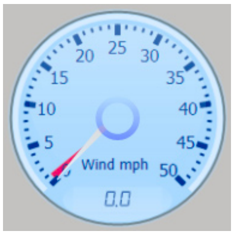
On receiving his award, Mohataz said: "I feel extremely honoured to be the first ever winner of this global student award. I am earnestly grateful to the jurors and IES team and would also like to express my gratitude to my academic supervisors and others who supported me in numerous ways during my doctoral study. I plan on using my prize to enhance my technical knowledge and to extend the present scope of my doctoral research. It will also financially support me to attend a number of CPD courses arranged by organisations, such as, CIBSE, RIBA and BRE."

The runner-up is Rehnuma Parveen, PhD student at the University of Adelaide, Australia, with a paper on *IES-VE for Achieving Energy Independence*. Well done to Rehnuma, who will also receive a £500 cash prize (in local currency equivalent), as well as an annual IESVE software and distance learning licence.

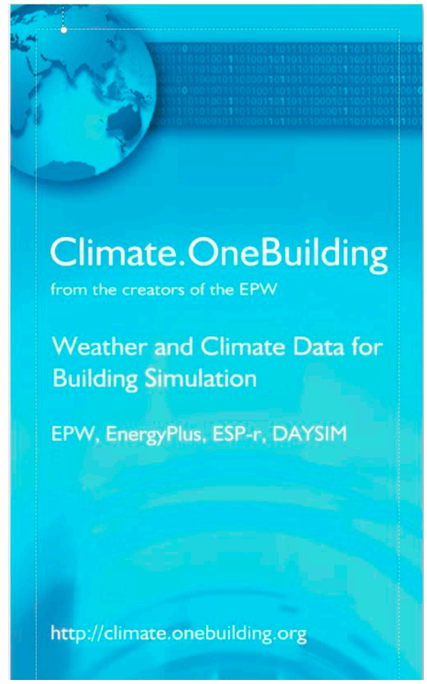
Rehnuma said: "What great news! Many thanks to all at IES. No words are enough to express my appreciation for the arrangement of this award and the cause behind it. Truly honoured to be a part of this."

Judging the award, Craig Wheatley, Chief Technological Officer at IES, commented that both papers stood out, firstly in terms of their subject matter — improving indoor environmental conditions in garment factories in Bangladesh and energy independence for rapid urban growth in mega-cities — and secondly, for their topicality and relevance. Recommendations for improving worker thermal comfort and providing the understanding of the interventions needed for energy independence are critical and timely areas for academic study, he said. Finally, both papers understood the need for calibration with real world data to ensure that any recommendations are based on accurate virtual representations of the actual building. In the end, the difference was in the breadth of study performed for Mohataz Hossain's paper where both a calibrated dynamic thermal simulation and a validated computational fluid dynamics simulation were used to establish the paper's findings.

Entries for next year's award will open in early 2019. To participate, sign up to receive updates via IES's newsletter (**www.iesve.com/newsletter-signup**) or visit the website (**www.iesve.com/martin-gough-student-award**) for further details being posted in due course. ■



New simulation weather data for Africa, South Asia, Southwest Pacific/ Australasia, and part of Europe available from Climate.OneBuilding.Org



Climate.OneBuilding.org is pleased to announce the availability of new simulation weather data (TMYx); this will be available in October 2018 for locations in Africa, South Asia, Southwest Pacific/Australasia, and part of Europe, derived from the ISD (US NOAA's Integrated Surface Database) with hourly data through 2017. TMYxs for more than 3,000 new locations are available. There may be two TMYxs for a location, e.g., MEX_MEX_Cuidad.Mexico-Juarez.Intl.AP.766793_TMYx, and MEX_MEX_Cuidad.Mexico-Juarez.Intl.AP.766793_TMYx.2003-2017. In these cases, there's a TMY for the entire period of record and a second TMY for the most recent 15 years (2003-2017). Not all locations have recent data.

With the addition of these data, Climate.OneBuilding.org now provides free data for more than 7,000 locations worldwide. Future work will develop data for remaining countries in Europe and North Asia. All data have been extensively checked to identify and correct data errors and out of normal range values where appropriate.

Each weather location .zip contains: EPW (EnergyPlus weather format), CLM (ESP-r weather format), and WEA (Daysim weather format) along with DDY (ASHRAE design conditions in EnergyPlus format), RAIN (hourly precipitation in mm, where available), and STAT (expanded EnergyPlus weather statistics).

For more information or to download any of the weather data (at no cost) go to **http://Climate.OneBuilding.org**. ■

RENNOVATES

REnnovates: The journey towards net-zero energy neighbourhoods concludes

August marked the successful conclusion of REnnovates, a Horizon 2020 project that began three years ago. The focus of the project was on the development of energy-neutral residential districts, and nine different project partners from all over Europe contributed to its success.

The project resulted in around 250 net-zero energy buildings in three different neighbourhoods in The Netherlands. These buildings were refurbished during the project to reduce thermal losses, and equipped with heat pumps to cut the cord on the use of natural gas for heating and hot water production. The implementation of the EEBus protocol during the project enabled remote, smart control of the heat pumps in a standardized manner.

Modelling and active control of the heat pumps helped improve operational efficiency which resulted in annual savings of over 200 kWh / house for hot water production, with additional savings of almost 100 kWh / house possible for space heating as well. The operational improvements thus realized have the potential to save hundreds of megawatt-hours over the lifetime of these heat pumps, further contributing to the goal of societal decarbonization. Furthermore, as the modelling and control strategies developed are completely data-driven, i.e. require absolutely no prior information about the thermal system, the results are generalizable to other settings – a major goal of REnnovates.

Another avenue where modelling and active control was employed in the project was to reduce grid congestion issues as a result of increasing electrification of the neighbourhood (owing to both the heat pumps and rooftop solar PV panels installed in every house). In this context, maximum consumption of local solar energy through both electrical (as residential and district-level batteries) and thermal storage (building thermal mass and hot water storage vessel) were investigated with promising initial results.

The models developed during the project were also used to simulate building and district (energy-related) performance in other European countries which were participating in the project, i.e. Spain and Poland. It was found that thermal storage provided by the household hot water vessels offers ubiquitous flexibility at an inexpensive price point. This flexibility is however substantially affected by occupant behaviour, ambient conditions and control algorithm. Of interest to the simulation community will perhaps be the fact that the determinants of energy flexibility were found to diverge substantially from the determinants of energy consumption in buildings. Ambient conditions meant that the flexibility offered by the same heat pump in Spain was almost 50% lower than that in Poland. Furthermore, occupant behaviour played a pivotal role in determining the regeneration period of available flexibility.

Besides other avenues, some of these results were reported in the IEA Annex 67 on Energy Flexible Buildings. Additional information can be found at **www.rennovates.eu**. ■

DoE to transfer OpenStudio to third parties

Recognising that whole-building energy modeling (BEM) is a multi-purpose enabling technology for improving building energy performance, the U.S. Department of Energy's Building Technologies Office (BTO) has supported BEM research and development for decades. A significant part of BTO's strategy is funding and managing the development of BEM software. The focus has largely been on physics engines such as DOE-2 and EnergyPlus but BTO has developed some applications as well. One highly visible example is the OpenStudio Application, a graphical model editing environment that works in conjunction with the OpenStudio SketchUp plug-in. Together, these have been responsible for a significant increase in EnergyPlus adoption.

Despite the success of the OpenStudio Application the most expedient and effective growth channel for BEM is applications and services. After a year-long discussion with industry stakeholders, including the IBPSA-USA Advocacy Committee, BTO has decided to transition responsibility for management, development, distribution, and support of the OpenStudio Application to third parties by April 2020. BTO plans to retain the OpenStudio SDK—the non-graphical components of the project that support application development and large-scale simulation—within its open-source BEM software portfolio. BTO and the national labs will spend the next 18-plus months working to maximize the chances of a successful transition and to minimize disruption to existing OpenStudio Application users. BTO and the labs plan to engage stakeholders throughout this process to both provide updates and receive feedback. A more in-depth discussion detailing the components involved and expected timeline for transition is available at www.openstudio.net/node/2226. Questions, concerns, or comments about this plan can be sent to openstudio@nrel.gov. ■

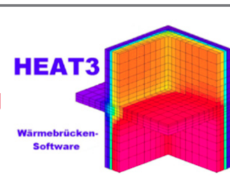
Four new online courses from Peel School of Passive House

Following the success of their first online course, *Using PHPP in Passive House Design and Certification*, Peel School have launched four more cost-effective, accessible courses to support Passive House education across the world. All four are PHI accredited and PHI-affiliated members are eligible for a 10% discount. They are:

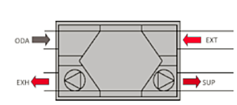
Using DesignPH for Passive House Design

PHPP Variants

HEAT 3 Modelling



Ventilation in Large Passive House Buildings



Other new features on the Peel School web site include:

- An *Intro to Passive House* video, free to view at **www.passivehousetraining.ca**
- Additional free material for students enrolled in the online school. The first two items are a video introduction to the EnerPHit standard and a case study, *Salus Clementine - A Passive House Affordable housing project in Ottawa*.

The HIT2GAP project

Experience shows that there is always a 'performance gap' between the anticipated energy use of a building and what actually happens once the building is occupied. This arises because the design and construction of a building involves compromises, construction issues and unforeseen behaviours, some of which will have an energy impact.

HIT2GAP seeks to reduce this gap by research which focuses on what happens, and on what could be done, while a building is in operation. Funded under the EU's Horizon 2020 research and innovation programme, it began in September 2015 and will run to September 2019. HIT2GAP's overall aims are:

- To reduce the energy performance gap, focusing on the operation phase of buildings
- To propose a new paradigm for the development of energy management platforms in buildings, integrating existing expertise and resources
- To provide a marketable, smart platform.

The project combines monitored and simulated data plus feedback from building users to give insights into the root of the problem(s). A new and innovative energy reporting platform is being developed and tested on four buildings in Poland, Ireland, France and Spain, using a variety of monitoring and modelling techniques. The outputs will be:

1. A generic information platform with protocols for communication with devices and user interfaces
2. Building energy modelling, to establish energy consumption benchmarks
3. A variety of tailored modules to inform users, energy managers and engineers.

The HIT2GAP partners are working together to create a platform which is both generic and modular, which could be used in a wide variety of buildings and groups of buildings. It will include plug-and-play modules that are designed to inform users about the operational performance of their building(s), based on data collected at building level. They will not be tool-specific.

Approaching the final year of the project, results are beginning to emerge that promise to be of use to the construction and building management industries.

For more detailed information about HIT2GAP visit **www.hit2gap.eu**.

IBPSA announcements

IBPSA 2019 Student Modelling Competition: SIMULATION PENTATHLON

Dear simulators - this is your challenge!

As part of the 16th IBPSA International Conference and Exhibition (**www.buildingsimulation2019.org**), IBPSA is organizing a student modelling competition. The aim is to facilitate wider participation in the conference and to provide a competitive forum for student members of the building simulation community. It is expected that several tutors of relevant courses in universities around the world will use the brief of this competition as part of their teaching material.

The 2019 Modelling Competition is set up as a SIMULATION PENTATHLON. Nowadays simulation is used in many fields to control different aspects of building design, such as limitation of energy demand, improvement of indoor environmental quality, or optimization of building management and controls. Moreover, simulation can be applied to support not only the design of new buildings but also the refurbishment of existing ones. This is especially important for European Countries because in Europe, about 35% of buildings are over 50 years old and almost 75% of the building stock is energy inefficient. In relation to retrofit design, building performance simulation can help designers to compare the effects of intervention alternatives on different parameters, i.e. cost, energy savings and indoor environmental quality. In this framework, the modelling competition will be organized in five sections: energy simulation, thermal comfort, daylighting and visual comfort, multi-objective optimization and retrofit design.

The object of the competition is the simulation of a seventeenth-century palace in Rome, Italy, now hosting classrooms and offices.

If you are a team of simulators with different competencies, this is your chance to test these competencies in our five sections of the pentathlon.

Two finalists will be notified by 1 June 2019 and will receive free registration to the conference plus up to EUR2000 in reimbursed travel expenses. Both will be expected to attend the Building Simulation 2019 conference and to prepare a short presentation and produce a poster for display. Poster requirements and travel/registration information for the finalists will be provided at that time. An overall winner will be selected based on the conference presentation and poster, and announced at the conference.

More information will be available soon at **http://buildingsimulation2019.org/competitions**.

Key dates

Announcement of brief	1 November 2018
Entrants notify their intent to submit an entry	31 January 2019
Deadline for completed entries	28 April 2019
Finalists notification	1 June 2019
Winner announced at BS2019 Conference in Rome, Italy	2-4 September 2019

Call for nominations for IBPSA Awards

The Board of Directors of IBPSA is seeking nominations for Awards to be presented at Building Simulation 2019, in Rome, Italy (2-4 September 2019). IBPSA makes three awards for outstanding work in the building performance simulation field. These awards are made on a biennial basis at each Building Simulation Conference, providing there is a qualified candidate. The three categories awarded are:

IBPSA Distinguished Achievement Award

This award, formerly named the IBPSA Award for Distinguished Service to Building Simulation, recognizes an individual who has a distinguished record of contributions to the field of building performance simulation, over a long period.

IBPSA Outstanding Young Contributor Award

This award recognizes an individual at the beginning of their career who has demonstrated potential for significant contributions to the field of building performance simulation.

IBPSA Innovative Application Award

This award, formerly named the IBPSA Award for Distinguished Practice, recognizes an individual, group or firm, who has made a significant contribution to the effective application and/or advancement of building performance simulation in practice. The award may be given for a unique or noteworthy use of simulation in practice; development of simulation software or supporting software that has had a significant impact on industry practice; or other contribution that has advanced building performance simulation in practice.

Nominations

Nominations for awards **must** be made by an **independent** third party. They must be submitted via email to the Chair of the Awards and Fellows Committee, Michaël Kummert, at **michael.kummert@polymtl.ca**. The deadline for nominations is 30 November 2018. We would like as many nominations as possible, so please contact Michaël Kummert to discuss a possible nomination if required.

Details of nomination packages and a list of recent past recipients of these awards can be found on the IPBSA website at **www.ibpsa.org/?page_id=62** ■

Call for nominations for Fellows of IBPSA

The Board of Directors of IBPSA is seeking nominations for the 2019 class of Fellows. The IBPSA membership grade of Fellow recognizes individuals who are:

> "A member who has attained distinction in the field of building performance simulation, or in the allied arts or sciences, or in teaching of major courses in said arts and sciences, or who by way of research, simulation code development, original work, or application of building simulation on projects of a significant scope, has made substantial contribution to said arts and sciences, and has been active in the field for at least ten (10) years".

The IBPSA Board of Directors elects new Fellows on a two-year cycle, culminating with recognition at the biennial Building Simulation conferences.

Nominations

Nominations may be made by IBPSA members other than the nominee. They must be submitted via email to the Chair of the Awards and Fellows Committee, Michaël Kummert, at **michael.kummert@polymtl.ca**. The deadline for nominations is 31 October 2018. We would like as many nominations as possible, so please contact Michaël Kummert to discuss a possible nomination if required.

Nominations should include details of the nominee's accomplishments in one or more of the following categories: industrial leadership, research, simulation code development, application of building simulation on projects of significant scope, educational leadership, and significant technical contributions to the allied arts and sciences. Details of nomination packages and a list of IBPSA fellows can be found on the IPBSA website at **www.ibpsa.org/?page_id=310** ■

Student Travel Awards – supporting students to attend BS2019

Travel to IBPSA Conferences can be an expensive business – especially for students. In order to assist as many students as possible to participate in Building Simulation 2019 in Rome, Italy, IBPSA will grant a number of travel awards of up to $1,000 (US) to students presenting peer-reviewed papers. Student travel awards are limited to a maximum of 5 grants per biennial conference and are therefore highly competitive.

The selection committee bases its decisions upon the following selection criteria:

- need for financial assistance, evidenced in a letter of recommendation from the student's supervisor/ advisor of studies (must be on university letterhead);
- overall quality of the peer-reviewed paper;
- relevance of contribution to the field of and/or furthering the effective application of building simulation.

To be eligible, the student must be:

- enrolled in a graduate program related to building simulation at the time of the conference; **and**
- the thesis project must be directly related to building simulation.

Applications

Applications must be submitted via email to the Chair of the Awards and Fellows Committee, Michaël Kummert, at **michael.kummert@polymtl.ca**. The deadline for applications will be aligned with the deadline to submit full papers at the conference, and is expected to be around mid-January 2019.

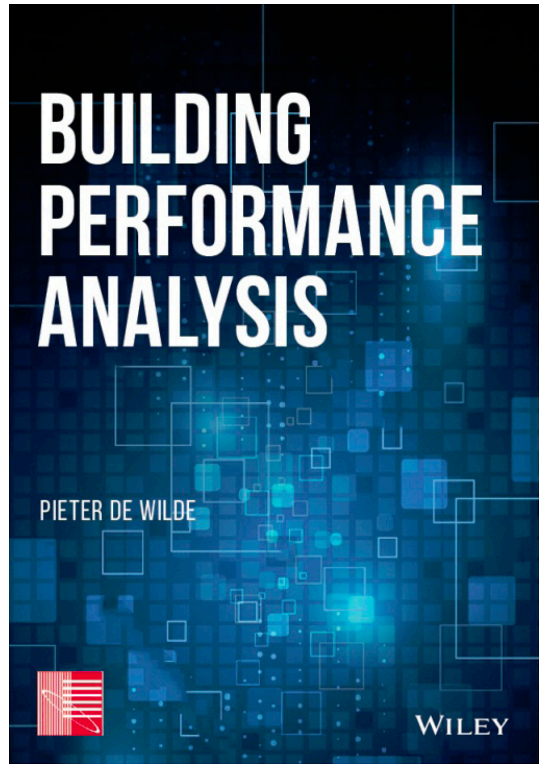
Details of applications can be found on the IPBSA website at **www.ibpsa.org/?page_id=62** ■

IBPSA Webinars

The IBPSA Education Committee has produced a series of webinars encompassing various subjects ranging from weather data for simulation to urban scale environment modeling. The recorded version of these webinars is available from the IBPSA University channel on YouTube (**www.youtube.com/channel/UCY9AD4H9_xKjKRTEvkce_8g**).

The Committee now invites building performance simulation (BPS) practitioners to offer further webinars. Through the proposed new series of webinars, we expect to enhance awareness of the best practices of BPS. Each webinar will focus on a project demonstrating exemplary use of BPS. We are expecting to cover topics such as BPS for high performance/net-zero buildings, BPS for code compliance, BPS for rating systems, innovative application of BPS for building operation or application of BPS at the community scale. Interested experts are requested to contact Rajan Rawal at **rajanrawal@cept.ac.in**. ■

***Building Performance Analysis*, by Pieter de Wilde**



Building Performance Analysis is a new book by Pieter de Wilde, published by Wiley. After Building Performance Simulation for Design and Operation, sometimes affectionately known as 'the orange book', Building Performance Analysis is the second book to be endorsed by IBPSA.

The key topic of the book is building performance. While a lot has been published on the subject of simulation, the application area is often taken for granted within the IBPSA community. Yet to do meaningful simulations, one of the hardest challenges is to define the question that is to be answered. The answer to deep questions about building performance may be gained by simulation, but there are other approaches available as well, especially in the realm of physical measurement. These are also covered in the book; hence the use of the word analysis in the title.

Building Performance Analysis offers a comprehensive and systematic overview of the concept of building performance analysis, bringing together many existing notions and ideas in one single title. It consists of three main parts. Part I deals with the foundations of building performance, Part II deals with performance assessment, and Part III with the impact of applying building performance analysis throughout the building life cycle. The book concludes with an epilogue that presents an emerging theory of building performance analysis. Building Performance Analysis is a substantial book: it has 11 chapters, 600 pages, and includes over 1600 references.

Building Performance Analysis is written for the building science community, both from industry and academia. Amongst others, it aims to make the following contributions to the field:

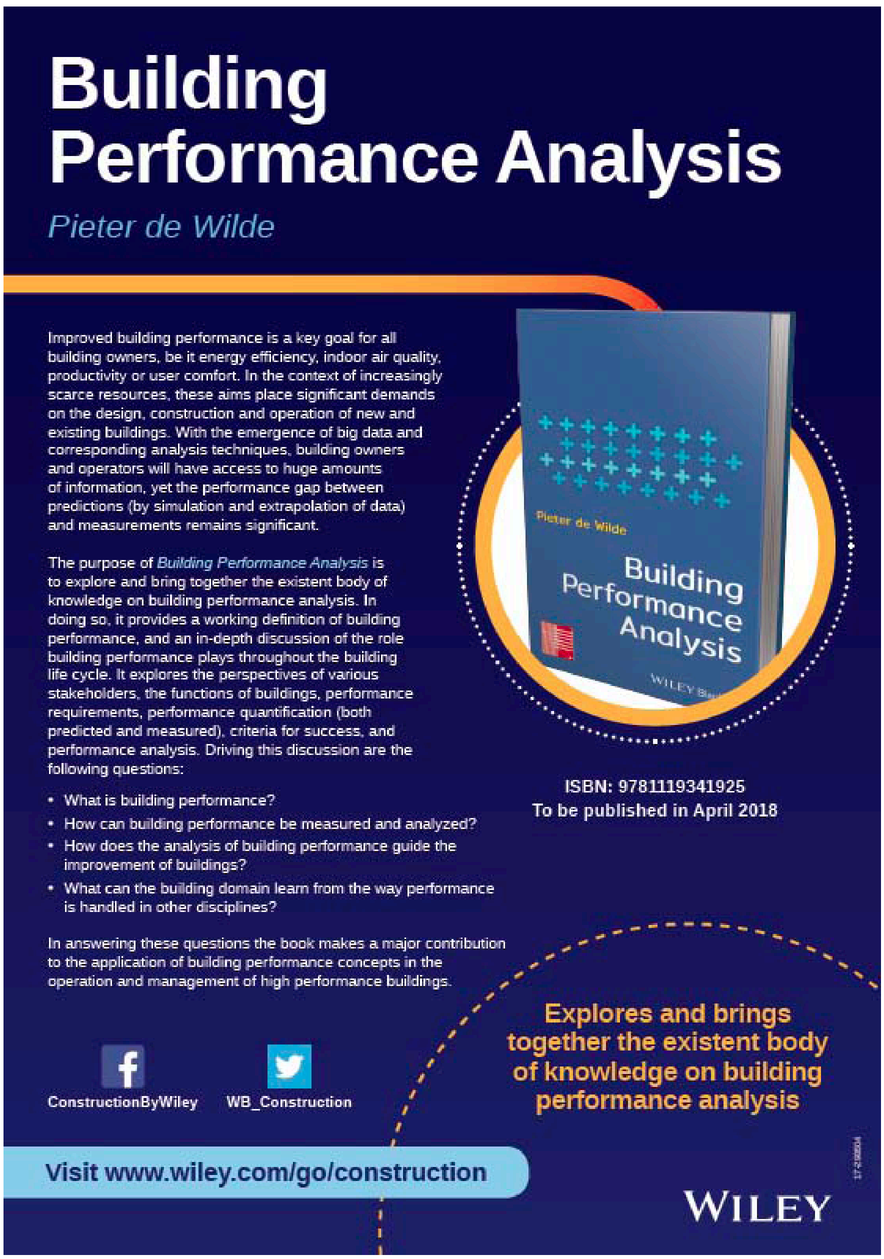
1. It reviews the significant body of knowledge on building performance that already exists, offering a point of entry to this complex subject matter for those who are new to the field.
2. The book emphasizes the fact that building performance deals with a wide variety of performance aspects. In doing so it challenges the community to address some of the aspects that get less prominence in the literature.
3. The book goes beyond simulation as a tool for building performance analysis: it also discusses physical measurement approaches, expert judgment, and stakeholder evaluation. It offers a review of the many analysis approaches available in each of these categories.
4. The emergent theory in the epilogue is intended as a key resource for those wishing to do further work in the field and needing to develop research questions and hypotheses. The emergent theory is very much intended as subject matter for discussion, debate, and deeper exploration.

The book has a foreword by Godfried Augenbroe, long-term mentor of the author. The endorsement by IBPSA is written by Malcolm Cook, chair of the IBPSA Publication Committee. Further endorsements stem from colleagues who have helped by reviewing drafts of the work: Georg Suter, Wei Tian, Cheol-Soo Park, Dru Crawley and Ruchi Choudhary.

Further information is available on the internet through the following resources:

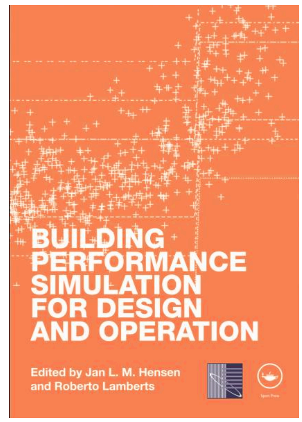
- A webinar specifically about the book, presented by the author on 31 May 2018 and posted on the IBPSA University YouTube channel (**www.youtube.com/watch?v=xPx-oWJ0K3k**)
- The inaugural professorial lecture of Pieter de Wilde, which covers the same subject area of building performance analysis (**www.youtube.com/watch?v=85QpbfwoRQ0**)
- The author's website at **www.bldg-perf.org**.

The book can be purchased directly from the publisher, via the major online retailers, and of course via your local bookseller. For questions and feedback, please email the author at **pieter@bldg-perf.org**. ■



Building Performance Simulation for Design and Operation

Jan L.M. Hensen and **Roberto Lamberts**



Effective building performance simulation can reduce the environmental impact of the built environment, improve indoor quality and productivity, and facilitate future innovation and technological progress in construction. It draws on many disciplines, including physics, mathematics, material science, biophysics and human behavioural, environmental and computational sciences. The discipline itself is continuously evolving and maturing, and improvements in model robustness and fidelity are constantly being made. This has sparked a new agenda focusing on the effectiveness of simulation in building life-cycle processes.

Building Performance Simulation for Design and Operation begins with an introduction to the concepts of performance indicators and targets, followed by a discussion on the role of building simulation in performance-based building design and operation. This sets the ground for in-depth discussion of performance prediction for energy demand, indoor environmental quality (including thermal, visual, indoor air quality and moisture phenomena), HVAC and renewable system performance, urban level modelling, building operational optimization and automation.

Produced in cooperation with the International Building Performance Simulation Association (IBPSA), and featuring contributions from fourteen internationally recognised experts in this field, this book provides a unique and comprehensive overview of building performance simulation for the complete building life-cycle from conception to demolition. It is primarily intended for advanced students in building services engineering, and in architectural, environmental or mechanical engineering; and will be useful for building and systems designers and operators.

Selected Table of Contents

1. The Role of Simulation in Performance Based Building 2. Weather Data for Building Performance Simulation 3. People in Building Performance Simulation 4. Thermal Load and Energy Performance Prediction 5. Ventilation Performance Prediction 6. Indoor Thermal Quality Performance Prediction 7. Room Acoustics Performance Prediction 8. Daylight Performance Predictions 9. Moisture Phenomena in Whole Building Performance Prediction 10. HVAC Systems Performance Prediction 11. Micro-cogeneration System Performance Prediction 12. Building Simulation for Practical Operational Optimization 13. Building Simulation in Building Automation Systems 14. Integrated Resource Flow Modelling of the Urban Built Environment 15. Building Simulation for Policy Support 16. A View on Future Building System Modelling and Simulation

January 2011 |536pp | Hb: 978-0-415-47414-6 | £65.00

About the Authors

Jan L. M. Hensen *(Ph.D. & M.S., Eindhoven University of Technology) has his background in building physics and mechanical engineering. His professional interest is performance-based design in the interdisciplinary area of building physics, indoor environment and building systems. His teaching and research focuses on the development and application of computational building performance modelling and simulation for high performance.*

Roberto Lamberts *is a Professor in Construction at the Department of Civil Engineering of the Federal University of Santa Catarina, Brazil. He is also currently a board member of the IBPSA, Vice-President of the Brazilian Session and Counsellor of the Brazilian Council for Sustainable Buildings.*

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News from IBPSA affiliates

IBPSA affiliates are asked to submit a report to the IBPSA Board each year to keep Board members informed about their activities and membership. These are too detailed to include in ibpsaNEWS, so affiliates have been asked to make their latest annual report available through their web sites, and this section includes only selected, recent news. Other news from affiliates may be available from their websites; the URLs for these are available on the IBPSA Central web site at www.ibpsa.org/?page_id=29.

IBPSA-Argentina

IBPSA - Argentina is pleased to announce the VI South American Congress of Building Performance Simulation, which will be held in the city of Mendoza, Argentina, on 17 and 18 October 2019. This conference is designed to gather practitioners and researchers from Brazil, Chile and Argentina in a regional discussion event in the area of building performance simulation.

The conference will provide a professional, scientific and academic arena for discussion, and aims to foster sharing and information exchange across the field. Its main objective is to promote and disseminate original advances and the results of scientific and technological research on simulation tools, new developments and their applications.

It is aimed at researchers, students, teachers, design professionals and professionals from academia and the construction industry who work in the study, management, research, dissemination and teaching of building performance simulation. Undergraduate and graduate students of disciplines related to renewable energies and the environment are also welcome.

Activities will include discussions with national and international invited experts; round tables; training workshops; presentation of papers and communications; and academic, social and cultural activities.

The official languages will be Spanish and Portuguese. Papers in English will also be accepted when the authors are not from Ibero-American speaking countries. The workshops and training courses will be delivered in the speaker's native language.

Topics and aims

The main topics for the meeting are: energy simulation, ventilation and natural ventilation, thermal comfort, artificial and natural lighting, HVAC, BIM and acoustics.

Key dates

The organisers welcome both full papers and posters. These will all be evaluated by a committee of experts on the subject.

The deadline for submission of complete papers is **14 June 2019**. ■

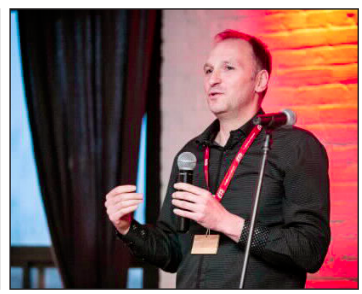
IBPSA-Canada

eSim 2018 – Tenth edition of the IBPSA-Canada building simulation conference

The tenth edition of IBPSA-Canada's building simulation conference, themed Building simulation to support building sustainability, took place on 9-10 May 2018 in Montréal, including a one-day practitioner track. The event was a great success and the workshops were highly appreciated.

The conference attracted national and international participants (including USA, Ireland, Ecuador, Egypt, Japan, Spain and the UK). It was chaired by Danielle Monfet (ÉTS-Montréal) and Karine Lavigne (Hydro-Québec, IREQ), while Michaël Kummert from Polytechnique Montréal chaired the scientific committee. The conference had close to 65 double-blind peer-reviewed papers. Up to three parallel tracks having the following topics contributed to the success of eSim 2018: physical process, building and environment, building envelope, infiltration and ventilation, HVAC systems, occupants, software enhancements, monitoring and calibration, building operation, energy flexibility, case studies, simulation for code compliance and the two sessions for practitioners. A total of ten different workshops addressing modeling and simulation were also highly successful with more than 130 registrations.





Conference banquet (left picture); Conference co-chairs Karine Lavigne and Danielle Monfet (middle picture); Scientific committee chair Michaël Kummert (right pricture).


The conference banquet was held at the beautiful Chateau Saint-Ambroise, a historic building that has witnessed the industrial development of the city of Montréal.

Two invited speakers provided keynote talks on:

- *A brief history of simulation and its future – by a consulting engineer*, given by Roland Charneux, Director at Pageau Moreal et associés inc (picture right, above).
- *Humanizing building simulation: current state and future outlook of modeling occupants*, given by Liam (William) O'Brien, Associate professor in Civil and Environmental Engineering at Carleton University (picture right, below).

The proceedings will be available shortly on the IBPSA website. ■

IBPSA-England

Building Simulation and Optimization (BSO) 2018

IBPSA-England's 4th Building Simulation and Optimization conference took place on 11–12 September 2018 at Emmanuel College, Cambridge University. Intended to provide a forum for presentation and discussion of current developments in building performance simulation, the wide-ranging conference covered topics related to energy demand, supply and control from the building component scale to systems and building stock models.

The conference was well attended, with 127 delegates from 23 different countries worldwide. Approximately 20% of the delegates were from industry, 80% from the academic community. A total of 90 technical papers were presented in three parallel sessions over the two days. Poster presenters were able to introduce their posters on view during the refreshment breaks. It was noticeable that there was a particular emphasis on the analysis of the impact of external factors on human comfort, including analysis of overheating risk and appraisal of the new CIBSE TM59 Methodology. Simulation of operation and control of novel energy systems at scales from individual component to district supply was also explored in depth. A third focus was on the modelling tools themselves, both the mechanics of using the tools including calibration and incorporation of data, and development of the underlying theoretical approaches. Special congratulations are due to Alstan J Jakubiec, winner of the award for best paper (sponsored by Atelier Ten), for his paper *Towards Subjectivity in Annual Climate-Based Daylight Metrics*, and Matej Gustin from Loughborough University, winner of the award for best student paper (sponsored by Envi-Met), for his paper *Prediction of internal temperatures during hot summer conditions with time series forecasting models*.

The programme of technical papers was enhanced by three illuminating and diverse keynote presentations. Professor Ryozo Ooka of the University of Tokyo opened proceedings with an in-depth description of the application of optimization techniques to environmental design, energy systems operation and building shape design, with examples including the optimisation of urban planting for thermal comfort. Dr Penny Carey of Portakabin challenged the conference to consider the obstacles facing the construction industry within Europe. She highlighted the increasing demand for higher performance and lower emissions driven by widespread adoption of near and beyond Passivhaus standards and emphasized the skills shortage, particularly in building physics, that the industry is facing. Professor Joe Clarke of the University of Strathclyde closed the conference with a passionate call for standardisation of approach in simulation using high integrity models. Calling for a more self-critical approach across the simulation community, he stressed the need for resilience testing and outlined a vision of randomised automatic simulation tests packaged with all simulation tools.

The conference benefited from a superb location in central Cambridge and special thanks are extended to the conference chairs, Dr Ruchi Choudhary and Dr Yeonsook Heo, the conference administrators, Jo Griffiths and Lisa Barnett of the Cambridge University Institute for Manufacturing, and the staff of Emmanuel College who contributed in no small way to the overall success of the conference. ■

Pictures from the top:
- a rapt audience
- one of the breaks
- the organising committee
- presentation of the best paper award
- presentation of the best student paper award

IBPSA-Netherlands + Flanders

Workshop on Quality Assurance of Simulations of Buildings and Systems for Design and Operation

Christian Struck, Wim Plokker & Dirk Saelens

A workshop on quality assurance of simulations of buildings and systems for design and operation, organised by IBPSA-NVL, was held at the Saxion University of Applied Science in Deventer, Netherlands on 28 May 2018. The winner of the IBPSA-NVL Best Thesis Award 2017 was also announced at the workshop.

Discussions during a break (left) and presentation by Ron Stet of Coen Energie & Comfort (right)

The aim of the workshop was to explore the challenges that building simulation practitioners face in interacting with governmental policies and commercial parties, with a specific focus on quality. The challenges identified during the workshop will influence IBPSA-NVL's future activities with regard to offering courses, developing project proposals and organizing future events.

During the afternoon, 10 speakers from practice and academia presented their perspective and experience on the subject of quality assurance and related responsibilities in using building performance simulation for design and operation. (The slides can be downloaded from www.ibpsa-nl.org/events/.) There were 36 participants, who contributed to lively discussions on five propositions:

1. Consultancy firms and designers have to fund the building's excess energy bills if their concepts do not perform as designed.
2. Thanks to the rise of BIM and GIS, the cost for building simulations will decrease considerably and the quality of performance predictions will improve.
3. In view of the large differences between calculated and measured building performance, an official agency should work out and apply a method of certification to test calculation methods and results before a building permit is granted.
4. The quality of simulations is difficult to check; a quality label for consultancy firms and designers should guarantee a sufficient level of expertise.
5. The quality of the simulations depends on the simulation environment, but often the rule applies: garbage in = garbage out.

Based on the discussions the following future challenges were identified:

1. Due to the diversity of simulation tools applied in practice (ranging from excel spreadsheets, via commercial codes up to custom made simulation environments) a quality label should be made available to inform clients and authorities.

2 The trend towards guaranteeing a minimum performance for integrated building systems is increasing costs due to the inclusion of safety margins. There is a risk that the total of these costs will be high as they are likely to be applied at each step in the supply chain starting with the developer, through consultants and via the contractor down to component manufacturers.

3 Consultancy firms and designers need continuous education as the ongoing digitalization of the Architecture Engineering and Construction (AEC) sector requires a growing range of capabilities in order to handle new tools and resources such as the interaction of buildings with districts, the use of GIS data to feed building information models and the interpretation of real-time monitored performance data, to name a few.

4 Model-based continuous commissioning requires regular re-calibration of the model to account for performance degradation of system components and changes of space use. ■

IBPSA-Switzerland

Achim Geissler

We hope that the early fall of 2018 will prove to be a turning point for IBPSA-CH. We held a General Assembly where the Board was renewed, and, very importantly, we will have a change of Presidency to a younger professional who is very active in the practical application of building performance simulation. We are optimistic that this will boost IBPSA-CH's goal of reaching out to practitioners and will foster its various activities. Stay tuned!

IBPSA-CH was a scientific partner of the 2018 brenet Status-Seminar held at ETH in Zürich at the beginning of September. As there were a large number of submissions in the general area of building performance simulation, no single dedicated IBPSA-CH session was defined at the conference. Instead, there were three sessions on planning tools, one of which was chaired by IBPSA-CH.

Our membership count has, so far, remained constant. With the new Board, President and DRIVE, we are very optimistic that this number will increase in the near future! ■

IBPSA-USA

Houston Chapter: Performance Huddle

Kapil Upadhyaya, BEMP, Fitwel Ambassador, LEED AP

The Houston Chapter of IBPSA-USA held its second annual event on 21 September 2018: Performance Huddle. This followed years of effort by the chapter in bringing together professionals from diverse fields who apply simulation in everyday practice. This year, as in the previous event, we had planned a little bit of everything.

The first session, *What are the three factors affecting energy optimization in building design?*, was intended for beginners in architectural simulation. It shared case studies exploring workflow for daylighting, solar exposure, and energy analysis to inform the architectural design of retail & institutional projects.

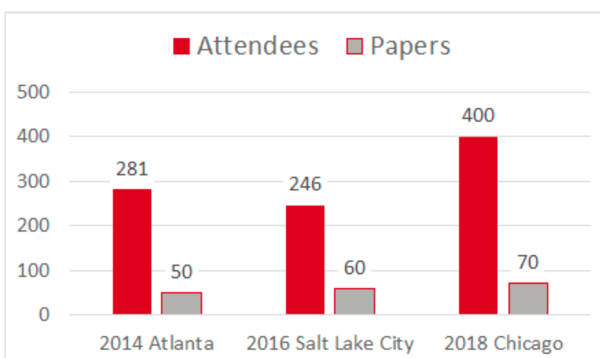
The second session, *The Role of Occupant Behavior in Building Design and Operation*, went into the details of occupant behavior in building simulations and how it leads to a huge gap between simulated and measured energy use.

The third session, *Introducing ASHRAE Standard 209: a new energy modeling framework for building design*, introduced attendees to the various ways that simulations could be used during the design, construction and operation of buildings.

Lastly, *Building Envelope & Simulations PechaKucha* was a set of quick talks about the history of simulations, a net-zero healthcare unit in Uganda, glare control workflows, envelope rules-of-thumb and envelope detailing.

SimBuild 2018 Report

For the third time since 2014, IBPSA-USA held its SimBuild conference as a joint event with ASHRAE. This 2018 edition was convened at the Hilton, Chicago on 26 to 28 September and was the biggest one so far:



The first keynote presenter, Billie Faircloth of the architecture firm Kieran Timberlake Associates spoke on *Yours, Mine and Ours: The Domain of Models and the Dogma of Professions*. She told the story of the evolving relationship between the designers in her firm and energy modelers and lessons learned in the search for an ideal workflow.

Professor Vivian Loftness of Carnegie Mellon spoke about *High Performance Buildings and the Internet of Things*, addressing the need for individual control of indoor environmental quality and the opportunities presented by new technologies.

In the third keynote, Brandon Andow of Front, Inc. addressed facade design considerations for indoor plants and presented a number of interesting case studies.

The conference included two competitions. The Project StaSIO competition (**www.projectstasio.com**) solicited two classes of entries: graphical presentations of simulation results and case studies of the presentation of simulation results.

The full list of conference presentations is available in the program book at **www.ashrae.org/File%20Library/Conferences/Specialty%20Conferences/2018%20Building%20Performance%20Analysis%20Conference%20and%20SimBuild/Program-Book.pdf**

Papers are accessible on the conference website at: **www.ashrae.org/conferences/topical-conferences/2018-building-performance-analysis-conference-and-simbuild/building-performance-analysis-simbuild-papers**

Recorded presentations may be viewed via the virtual conference, which can be purchased on the conference website: **www.ashrae.org/conferences/topical-conferences/2018-building-performance-analysis-conference-and-simbuild/2018-building-performance-analysis-conference-and-simbuild**

Conference sponsors and exhibitors included Autodesk, U.S. Department of Energy, DesignBuilder, IES, Trane, EDSL Tas, CoveTool, Sefaira and Cradle. ■

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For additional information about IBPSA, please visit the Association's web site at **www.ibpsa.org**. For information on joining, contact your nearest regional affiliate.

IBPSA's mailing list has been consolidated into another listserver known as BLDG-SIM, which is a mailing list for users of building energy simulation programs worldwide, including weather data and other software support resources. To **subscribe** to BLDG-SIM, to unsubscribe or to change your subscriber details, use the online forms at **http://lists.onebuilding.org/listinfo.cgi/bldg-sim-onebuilding.org**.

To post a message to all members, send email to **bldg-sim@lists.onebuilding.org**.

The BLDG-SIM list is provided by GARD Analytics. If you have any questions, please contact the list owner Jason Glazer at **jglazer@gard.com** or +1 847 698 5686. ■

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Official journal of the International Building Performance Simulation Association (IBPSA)

EDITORS:
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Jan Hensen, *Eindhoven University of Technology, The Netherlands*

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The ***JBPS*** is an international refereed journal, publishing only articles of the highest quality that are original, cutting-edge, well-researched and of significance to the international community. The journal also publishes original review papers and researched case studies of international significance.

The wide scope of ***JBPS*** embraces research, technology and tool development related to building performance modelling and simulation, as well as their applications to design, operation and management of the built environment. This includes modelling and simulation aspects of building performance in relation to other research areas such as building physics, environmental engineering, mechanical engineering, control engineering, facility management, architecture, ergonomics, psychology, physiology, computational engineering, information technology and education. The scope of topics includes the following:

- Theoretical aspects of building performance modelling and simulation.
- Methodology and application of building performance simulation for any stage of design, construction, commissioning, operation or management of buildings and the systems which service them.
- Uncertainty, sensitivity analysis, calibration, and optimization.
- Methods and algorithms for performance optimization of building and the systems which service them.
- Methods and algorithms for software design, validation, verification and solution methods.

Submissions

Manuscripts will be considered on the condition that they have been submitted only to ***Journal of Building Performance Simulation***, that they have not been published already, and that they are not under consideration for publication or in press elsewhere. All submissions should be in English. Papers for submission should be sent to the Editors at j.hensen@tue.nl. For full submission details, please see the journal's homepage www.informaworld.com/jbps and click on the "Instructions for Authors" tab.

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