EBC
Energy in Buildings and Communities Programme

IEA EBC Annex 66

Definition and Simulation of Occupant Behavior in Buildings

Operating Agents

Dr. Da Yan, Tsinghua University, China

Dr. Tianzhen Hong, Lawrence Berkeley National Laboratory, USA

Newsletter No. 2 July 2015 www.annex66.org

Annex 66 Overview

Energy-related occupant behavior in buildings is difficult to quantify yet critical to our understanding of total building energy consumption. Often a disproportionate amount of attention is directed towards upgrading system or technological efficiency, while ignoring the human dimension, resulting in inappropriate, overly simplified, behavioural assumptions that lead to inaccurate expectations of building energy performance. As a result, current occupant behaviour models suffer from inconsistencies. To address this the International Energy Agency (IEA), Energy in Buildings and Communities (EBC) Programme Annex 66, Definition and Simulation of Occupant Behavior in Buildings, aims to establish a standard occupant behavior definition platform and a quantitative modeling methodology to simulate occupant behavior in buildings. Annex 66 brings together leading experts in the field (Figure 1) from universities, national labs, research institutes, architectural and engineering firms, utilities and government agencies of more than 20 countries. Annex 66 develops deep collaboration with professional societies such as ASHRAE and IBPSA, which helps promote and disseminate outcomes of Annex 66 to broad audience. The success of Annex 66 will provide data, tools, and case studies for researchers, practitioners, policy makers and stakeholders to improve building design, operation and retrofit to reduce energy use and carbon emissions. Annex 66 is making great progress in a series of activities that will achieve the annex goals and contribute to the final report.

Figure 1: Participants at the Annex 66 meetings in Berkeley, California, USA, March 30-April 1, 2015.

Forums & Expert Meetings:

Preparation Phase: 2013-2014
(1) 1st Expert Meeting in the Preparation Phase; March 12-14, 2014 in Taikoo Palace, Hong Kong, China

(2) 2nd Expert Meeting in the Preparation Phase; August 4-6, 2014 in Nottingham, United Kingdom

Working Phase: 2014-2017
(3)1st Expert Meeting in the Working Phase; March 30- April 1, 2015 in Berkeley, California, USA

(4) 2nd Expert Meeting in the Working Phase; August 3-5, 2015 in Karlsruhe, Germany

International Technical Forum and 1st Expert Meeting in the Working Phase Summary:

After two highly successful preparation phase meetings in Hong Kong and Great Britain, the IEA EBC Annex 66 formally met again on March 30, 31 and April 1 2015 at LBNL in Berkeley, CA, USA (Figure 2). The three-day event, included an International Technical Forum, a symposium that allowed leading researchers to present their latest work, followed by two-days of annex meetings to discuss research plan and progress.

The International Technical Forum included a kick-off introduction by LBNL Staff Scientist, Richard Diamond and co-operating agents, Tianzhen Hong and Da Yan. This was followed by a Department of Energy (DOE) panel on "Envisioning future occupants: A discussion panel for the DOE Buildings of the Future project" and a moderated session entitled "What role might the U.S. government play in supporting occupant behavior research?" This was followed by 8 invited oral presentations from presenters in industry and academia, including engineering and social sciences and from the U.S., Japan, Germany and Austria. Major categories of topics included occupant modelling approaches, comfort studies, occupant behavior implementation strategies, and case studies. A second annual Symposium on Occupant Behavior, (OB-15) is planned to take place in Germany in August of 2015 in conjunction with the Annex 66 2nd Expert Meeting of Working Phase.

Following the International Technical Forum, 72 researchers, from 16 countries (i.e. the Netherlands, USA, Denmark, Hungary, Norway, China, UK, France, Italy, Canada, Austria, Portugal, New Zealand, Germany, Japan, and Brazil) met for an intensive two-day meeting. This was the first meeting in which all the subtask leaders were in attendance. On the first day of the Annex meetings, 34 short presentations were given including overviews of the progress of each subtask and presentations on each activity. On the second day five subtasks met in break-out sessions. During the break-out sessions, researchers presented on work applicable to the subtask topic. In addition, discussions on the current status of the field and challenges were addresses. In several cases, Annex participants have arranged to work across subtasks on different activities, with the subtask leaders acting mainly as champions for activity completion. The activities include documentation and standards on data collection, modelling methodologies, and model verification. Other ongoing activities within Annex 66 include: the development of an occupant behavior data repository and outreach and dissemination to the research and construction communities through workshops and conferences.

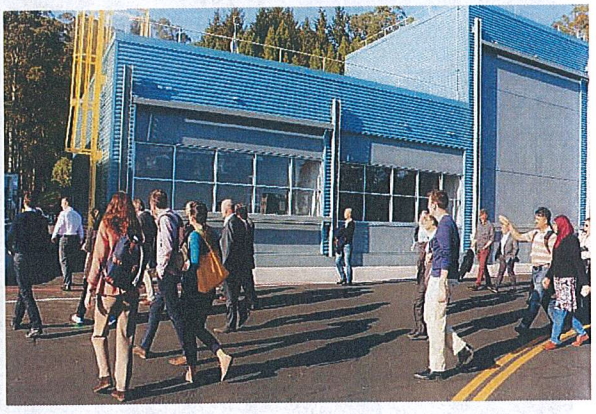


Figure 2: Annex attendees during the International Technical Forum (left); tour of LBNL FLEXLAB (right)

Karlsruher Institut für Technologie

Upcoming Meetings:

2nd Expert Meeting in the Working Phase
Karlsruhe, Germany
August 3-5, 2015
Host: Andreas Wagner, KIT

3rd Expert Meeting in the Working Phase
Vienna, Austria
March 30 - April 1, 2016
Host: Ardeshir Mahdavi, Vienna University of Technology

Subtask A: Occupant movement and presence models in buildings

Leader: Andreas Wagner, Germany
Co-leader: Bing Dong, USA

From the LBNL meeting, the Subtask A breakout session was attended by 12 participants. First seven short reports were given on individual projects. These were:

- Clinton Andrews: Campus as a Living Lab for occupant behavior research
- David Shipworth: Longitudinal Energy Survey (LUKES)
- Marilena De Simone, Dafni Mora: Monitoring of the real occupancy profiles by using surveys and smart technologies
- Chuang Wang: Validation of a two-level occupant movement model
- Mikkel Kjærgaard: On a Categorization Framework for Occupancy Sensing Systems
- Bruce Nordman: Implicit Sensing at LBNL
- Bing Dong: Modeling results from San Antonio test-bed

All reports included information which is valuable for the activities hosted by Subtask A (mostly 4.1, 4.2 and 5.5). Referring to the general question 'what kind of data is needed at what level of accuracy to answer which question?' David Shipworth introduced a matrix which could serve as a tool for experimental design not only in terms of structuring questions and the necessary approach, but also for deciding on sensors and accuracy level. The matrix can also help with decisions on modeling approaches. It was decided to take it as the basis for a new cross-sectional activity on 'Systematic Approach for Experimental Design and Modeling', led by David Shipworth and Mikkel Kjærgaard. This work will also contribute to the guidebook (activity 4.2) with a chapter on 'experimental design'

Work plan for the next 6 months:

a. Initiate new activity on 'Systematic Approach for Experimental Design and Modeling' (lead by Shipworth, UCL, and Kjærgaard, USD);

b. Activity 3.2 and 5.5 (lead by Chuang, Tsinghua University): Collect information on existing occupancy presence data and models;

c. Activity 4.1 (led by Dong, UTSA): 1st draft on existing data collection techniques;

d. Activity 4.2 (led by O'Brien, Wagner and Dong): Identify leading authors & 1st draft;

Subtask B: Occupant action models in residential buildings

Leader: Darren Robinson, UK
Co-leader: Henrik Madsen, Denmark

Subtask B, focused on occupant action models in residential buildings, has a number of activities being conducted as summarized below.

(1) A new method for the indirect classification of occupancy behaviour using inhomogeneous hidden Markov models (HMMs) is being implemented in R and tested on three different residential apartments, with varying number of occupants. Some results of these models show similar daily probability profiles as the global decoding of the homogeneous HMMs, but currently they are purely determined by the model. The final version of the software implemented in R will be reported on in more detail in August in Karlsruhe, Germany. This work also ties with the initiatives of Subtask D and E.

(2) Progress has been made in the next version of the Annex 66 related software for semi-physical - or greybox – modelling, with a new version of the User's Guide in the process to be released soon.

(3) The IEA 66 related Summer School on Grey-box modelling proves to be a great success, contributing to the outreach activities of A66. One measurement of success is enrollment where the maximum number of students (30 students) has been reached. Further development of the contents for the Summer School will ensue.

(4) Work continues to advance on the integration, with a GUI front end, No-MASS (Nottingham - Multi Agent Stochastic Simulation) with DesignBuilder.

(5) Collaboration with Chien-fei Chen on a new Annex 66 activity has begun. This will include the design of experiments to investigate group decisions in occupants' behaviours. This will contribute to Activity 5.3: Investigation of thermal comfort, psychology and sociology in occupant behavior research.

(6) A data repository is being created in collaboration with Subtask D. This repository will house OB data sets for research and development. This is a part of Activity 4.3: General database for monitoring data.

(7) Lastly, two collaborative efforts are being conducted (DTU and Politechnico Torino; DTU and RWTH in Aachen, Germany) focused on the verification/validation of window opening models and the analysis of a large dataset from a residential building to investigate drivers for window opening behaviour, respectively. This task also overlaps with Subtask E objectives. These studies will contribute to Activity 5.1: Guideline to different modeling approaches for occupant behavior in residential buildings.

Subtask B is participating in Activity 5.5: Methodologies of modelling occupants' operation on other devices. If you are interested in contributing to Subtask B activities please contact Darren Robinson or Henrik Madsen.

Subtask C: Occupant action models in commercial buildings

Leader: Ardeshir Mahdavi, Austria
Co-leader: Liam O'Brien, Canada

Subtask C has identified and is addressing major research needs that are focused on both occupant monitoring, modelling, and model valuation for behaviour in commercial buildings. The primary proposed activities include:
(1) Review of different modeling approaches for occupant behavior in buildings (D'Oca, Gunay et al.). This activity involves reviewing the literature for modelling approaches – both in the field of occupant behaviour and elsewhere – in order to provide a critical assessment of their suitability to various domains of the current field.
(2) Approaches to address occupants' behavior diversity in model development (O'Brien, Mahdavi et al.). This activity involves investigation into how different diversity modeling techniques (e.g. clustering and continuous probabilistic distributions) could affect repeatability of predictions.
(3) Recommendations for evaluation of building occupants' presence and behavior models: A blueprint (Mahdavi et al.). This activity shall provide guidelines and standards for how occupant behavior models should be assessed to ensure proper scientific rigor and reasonable occupant model accuracy. Statistical indicators shall be developed to assess model quality.
(4) Test of occupant action models (Wang et al.).

The objective of this activity is to assess existing occupant models and compare them to monitored occupants.

Subtask C is also heavily involved in several cross-subtask activities. First, a comprehensive occupant monitoring guideline is being developed that will serve to inform researchers of best practices for occupant monitoring campaigns. Select topics include: experimental design, data management, sensor types and application, and ethical issues. This activity is jointly led by Subtasks A, B, and C. Second, Subtask C researchers are working with others to develop understanding and guidelines for how occupant behavior modeling and simulation are used in building design practice.
As always, Subtask C welcomes volunteers to assist in the timely completion of high quality work towards the above activities.

Subtask D: Integration of occupant behavior tools

Leader: Tianzhen Hong, USA
Co-leader: TBD

Subtask D designs five activities based on the scope and objectives of the subtask. Main outcome from each activity will feed to the final report of Annex 66. The five activities are:

7.1 Review of occupant behavior simulation in current BEM programs
This activity reviews literature and documentation of current BEM programs on how energy-related occupant behavior in buildings is represented.

LBNL is leading the activity. Participants include Tsinghua University, China.

7.2 Standard description and protocols of occupant behavior in simulation: This activity develops an ontology and XML schema (obXML) to represent occupant behavior in buildings. The XML schema enables interoperability of occupant behavior modeling between researchers and BEM programs. It can integrate with Building Information Modeling in the future. LBNL is leading the activity, with Tsinghua University and Politecnico di Torino as participants. The obXML is the deliverable.

7.3 Development of the occupant behavior modeling tool: This activity develops an occupant behavior modeling tool (obFMU). The tool builds upon the occupant behavior schema obXML and enables co-simulation using the Functional Mockup Interface. LBNL and Tsinghua University are co-leading the activity. The obFMU is the deliverable.

7.4 Integration of the obFMU with BEM programs: This activity integrates the developed occupant behavior modeling tool obFMU with BEM programs, EnergyPlus, DeST, and ESP-r. LBNL, Tsinghua University and University of Strathclyde are co-leading the activity.

7.5 Test for simulation repetition and pseudo-random algorithms: This activity develops methods of tests for random number generators and determination of adequate repetition of occupant behavior simulation. Tsinghua University is leading the activity. The deliverable is a summary report on recommended random number generators and best practice of occupant behavior simulation.

LBNL and Tsinghua University started a task force on Activities 7.2, 7.3 and 7.4 during the winter of 2014 and 2015.

A webinar was conducted in July 2015 to present and demonstrate the in-progress occupant behavior modeling tooling including the obXML schema and the modeling tool obFMU (Figure 3). Participants include Annex 66 members, U.S.-China CERC-BEE researchers, industry partners, and USDOE managers.

During the Annex 66 Expert Meetings at LBNL, the five activities were introduced and progress of activities were presented at the breakout sessions, including (1) OB ontology and schema by Sarah Taylor-Lange of LBNL, (2) OB modeling tool by Tianzhen Hong and Yixing Chen of LBNL, (3) Selected issues modeling OB with BPS by Eric Vorger of MINES ParisTech. Jared Langevin of USDOE, Andrew Cowie of University of Strathclyde, and Shuqin Chen of Zhejiang University participated in the discussions. LBNL and Tsinghua teams are packing the obXML and obFMU for review and trials by the interested parties in Annex 66. Progress on all five activities will be presented at the Second Experts Meetings at KIT Germany in August 2015.

Subtask E: Applications in building design and operations

Leader: Khee Poh Lam, USA
Co-leader: Cary Chan, China

The activities proposed for subtask E include: 8.1. Review of the current status and demand for occupant behavior simulation in buildings, 8.3 Documentation of current practices for models in commercial buildings, 8.4 Levels of adaptability of modelling in applications, 8.5 Guidelines to practical presentation and deployment of conventional and probabilistic simulation results, 8.6 Case studies in engineering and industry, 8.7 Micro-sensing research and development, 8.8. Hostel environmental training and 8.9 Green building initiatives and new meter online service.

The end goal of subtask E is to help solve the energy problem by demonstrating the impact of OB behavior on building energy consumption. This task will try to remain simple and focus on case studies to prove the outcome of results. This task will focus on the validity of the methods and findings developed in the previous tasks. Discussions in the last meeting included how to differentiate from predicting behavior vs. changing behavior and how this fits into the objectives of the Annex. (continue to page 8).

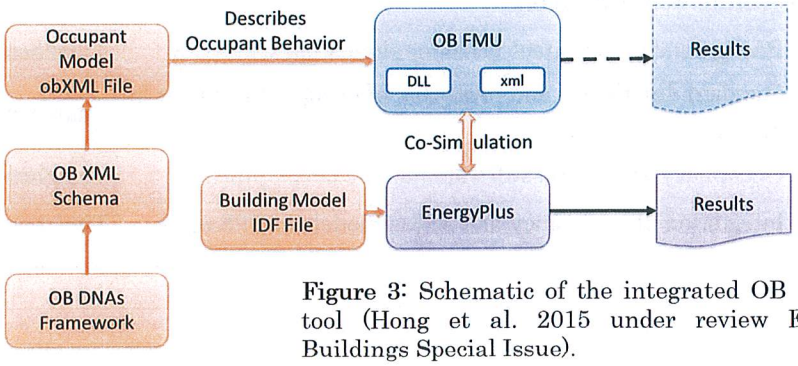


Figure 3: Schematic of the integrated OB modelling tool (Hong et al. 2015 under review Energy & Buildings Special Issue).

The subtasks all contribute collectively to the list of activities which will formulate the final report delivered in 2017. The table provides a description of the current activities and proposed leader of each activity.

Table 1: The activity, description, proposed leader and assigned subtask of the activity.

No.	Activity	Proposed Leader(s)	Subtask Lead
1	**Introduction to Annex 66**		
2	**Definition and framework**		
3	**State-of-the-art**		
	3.1. Occupant behavior related literature database	Bing Dong, Sarah Taylor-Lange	A
	3.2. Investigation of occupant presence data and models	Bing Dong, Tianzhen Hong, Chuang Wang	A
4	**Data collection**		
	4.1. Current data collection techniques	Bing Dong, Andreas Wagner	A
	4.2. Occupancy and occupant behavior data collection protocol	Liam O'Brien, Andreas Wagner, Bing Dong, Darren Robinson	A
	4.3. General database for monitoring data	Darren Robinson	B
5	**Modelling**		
	5.1. Guideline to different modeling approaches for occupant behavior in residential buildings	Darren Robinson	B
	5.2. Guideline to different modeling approaches for occupant behavior in commercial buildings	Burak Gunay, Liam O'Brien, Darren Robinson	C
	5.3. Investigation of thermal comfort, psychology and sociology in occupant behavior research	Darren Robinson	B
	5.4. Approaches to address occupants' behavior diversity in model development	Liam O'Brien, Ardeshir Mahdavi, Farhang Tahmasebi, Burak Gunay, Darren Robinson	C
	5.5. Methodologies of modelling occupants' operation on other devices	Yohei Yamaguchi	B
6	**Evaluation of models**		
	6.1. Recommendations for evaluation of building occupants' presence and behavior models: a blueprint	Ardeshir Mahdavi, Farhang Tahmasebi, Darren Robinson	C
	6.2. Test of occupant action models	Chuang Wang	C
	6.3. Integration of social psychological and group dynamic analysis of occupant behavior in buildings	Chien-fei Chen	
7	**Integration with BPS tools**		
	7.1. Background on occupant behavior simulation with BPS	Tianzhen Hong, Da Yan	D
	7.2. Standard description and protocols of occupant behavior in simulation	Tianzhen Hong, Clinton Andrews	D
	7.3. Occupancy and action software module development	Tianzhen Hong, Da Yan	D
	7.4. Integration of occupancy and action models in BPS tools	Tianzhen Hong, Da Yan	D

Table 1 (continued): The activity, description, proposed leader and assigned subtask of the activity.

No.	Activity	Proposed Leader(s)	Subtask Lead
8	**Applications**		
	8.1. Investigation of current demand for occupant behavior simulation in buildings	Khee Poh Lam	E
	8.2. Documentation of current practices for models in commercial buildings	Liam O'Brien, Sara Gilani	E
	8.3. Levels and adaptability of modelling in applications	Jan Hensen, Pieter-Jan Hoes	E
	8.4. Guideline to practical presentation and deployment of conventional and probabilistic simulation results	Sara Gilani, Liam O'Brien, Ardeshir Mahdavi, Farhang Tahmasebi	E
	8.5. Case studies in engineering and industry (Several groups)	Khee Poh Lam	E
	8.6. Micro-Sensing Research & Development Project	Martha Hao	E
	8.7. Hostel Environmental Training	Cary Chan	E
	8.8. Green Building Initiatives and New Meter Online Service	Simon Lam	E
	8.9 Considering occupant behavior in building design and retrofit	Tianzhen Hong, Sarah Taylor-Lange	E
9	**Publicity**		
	9.1. Annex 66 newsletter and EBC articles	Tianzhen Hong, Da Yan, Sarah Taylor-Lange, Xiaohang Feng	Management
	9.2. Website management	Sang Hoon Lee	Management
	9.3. Annex 66 meetings (ExCo Meetings, Expert Meetings, Calls)	Tianzhen Hong, Da Yan, and subtask leads	Management
	9.4. Topical journal issues	Andreas Wagner, Bing Dong; Tianzhen Hong; Da Yan	Management
10	**Outreach**		
	10.1. Meeting information management	Sebastian Wolf	
	10.2. Outreach - ASHRAE handbook and seminars	Tianzhen Hong, Da Yan, Bing Dong, Clinton Andrews, Sarah Taylor-Lange	
	10.3. Outreach – CIBSE	Darren Robinson, (Pieter de Wilde contacted)	
	10.4. Outreach – REHVA	Stefano Cognati	

Building Simulation Applications, 2nd IBPSA-Italy Conference: Proceedings Available

Following Prof. Ardeshir Mahdavi's Annex 66 talk at LBNL many participants requested a related publication. Information can be found at: Building Simulation Applications BSA 2015 Proceedings. 2nd IBPSA-Italy conference, Bozen-Bolzano 4th-6th February 2015 (a link is posted on the Annex 66 website).

ASHRAE Seminar Updates

1st Seminar at 2014 ASHRAE Annual Meeting, Seattle.
Chair: Tianzhen Hong / Clinton Andrews
Attendants: **105**

2nd Seminar at 2015 ASHRAE Winter Meeting, Chicago
Chair: Bing Dong
Attendants: **170**

3rd Seminar at 2015 ASHRAE Annual Meeting, Atlanta
Chair: Bing Dong
Attendants: **108**

Subtask E Activity Spotlight:

Project COORDICY

COORDICY is a strategic DK-US interdisciplinary research project for advancing ICT-driven research and innovation in energy efficiency of public and commercial buildings.

To reduce the environmental impact of buildings, their energy-performance has to be significantly improved. However, improvement of buildings' energy-performance is challenged by the fact that monitoring of real energy use in buildings certified accordantly to energy efficiency standards, like ENERGY Star, LEED and Green Globes, frequently shows a gap with respect to the predicted energy performance. Hence, energy-performance issues are not isolated to conventional buildings, but apply also to modern buildings.

To address this challenge COORDICY will facilitate ICT-driven research and innovation in advancing the energy-performance of newly built energy-efficient and existing conventional public and commercial buildings. This will be achieved by developing a holistic ICT-centered approach to coordinate the actual energy-performance of building systems' operation to meet the original intent of building design and presumably advance it beyond, without compromising occupant comfort and efficiency.

COORDICY will do so by providing the theoretical and technological means for benchmarking, diagnosing, and controlling building operation, considering relevant factors such as occupant behavior, weather forecast, construction typologies, thermal properties, building systems and controls, and their complex interactions. Diagnostics of energy-performance gaps will support decision-making and advancing the intelligence of building control systems.

The project thereby contributes to the Danish goals of achieving a 75% reduction in energy consumption in new buildings by 2020 and a 50% reduction in existing buildings by 2050, and the United States' goal of doubling its energy productivity by 2030.

The project will contribute to Annex 66 subtask A with knowledge about experimental collection of occupancy data and case studies for subtask E.

More Information about COORDICY Contact: Mikkel Baun Kjærgaard (mbkj@mmmi.sdu.dk)

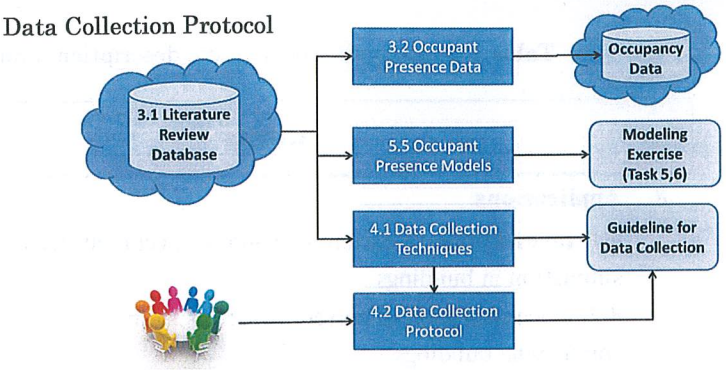
Notable Annex 66 Activities:

(1) Literature Database

A searchable database posted on the annex66.org website.

A collection of 400+ Journal articles, conference papers and technical reports on OB.

This is Activity 3.1 led by Bing Dong (UTSA) with contributions from LBNL, Tsinghua, and Carleton University.

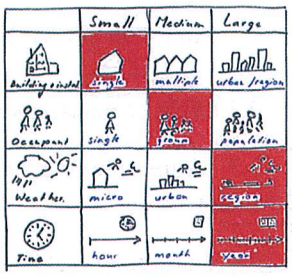


(2) Integrated OB Modeling Tool

An OB XML schema to generate an xml file for an OB FMU which co-simulates with EnergyPlus.

This advances occupant behavior modeling and simulation and is part of Subtask D.

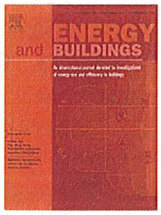
(3) Levels of adaptability of modeling in application



1. National energy standard

(4) OB Survey

A group of about ten IEA EBC Annex 66 members are developing a comprehensive survey to better understand current occupant modeling practice and to assess receptiveness for more advanced occupant modeling approaches. The objective is to inform researchers and simulation software developers of industry needs and attitudes. We anticipate that the final survey will be online by September 2015 and that it will attract responses several hundred simulation users around the world. The results will be presented and made publicly available in mid-2016; they will also be submitted to a scientific journal.



Special Issues (SI):

Journal: Energy & Buildings

SI: Advances in Building Energy Modeling and Simulation

Topics:

- Advances and applications in building energy modeling and simulation
- Actual research projects or activities

Guest Editor: Tianzhen Hong

Paper submission
by June 30, 2015
Review process
by October 30, 2015
Production
by December 31, 2015

SI: Occupancy Behavior in Buildings: Modeling, Simulation and Applications

Topics:

- Occupancy data collection techniques and experimental design
- Modeling approaches and methods
- Psychological approaches for modeling occupant behavior
- Integration of occupant behavior models into simulation tools
- Real building applications

Guest Editors: Andreas Wagner and Bing Dong
Abstract submission (to GEs) deadline: July 1, 2015
Full-length article submission starts: August 1, 2015
Full-length article submission deadline: November 30, 2015
Publication process finished: summer 2016

Archival Journal Publications

[1] Roetzel, Astrid (2015), Occupant behaviour simulation for cellular offices in early design stages - Architectural and modelling considerations, Building simulation, 8 (2), 211-224.

[2] D'Oca S and Hong T (2015) Occupancy schedules learning process through a data mining framework. Energy and Buildings, 88, 395-408.

[3] D'Oca S., Fabi V, Corgnati SP, Andersen RK, (2015) Effect of thermostat and window opening occupant behavior models on energy use in homes, Building Simulation, 7(6), 683-694.

[4] Hong T, D'Oca S, Turner WJN, Taylor-Lange SC, (2015) An ontology to represent energy-related occupant behavior in buildings. Part I: Introduction to the DNAs framework, Building and Environment, 92, 764-777.

[5] Ren X, Yan D, Hong T. (2015) Data Mining of Space Heating System Performance in Affordable Housing. Building and Environment, 89, 1-13.

[6] Feng X, Yan D, Hong T. (2015) Simulation of occupancy in buildings. Energy and Buildings, 87, 348-359.

[7] D'Oca S., Hong T. (2014) A data-mining approach to discover patterns of window opening and closing behavior in offices, Building and Environment, 82, 726-739.

[8] Roetzel, Astrid, Tsangrassoulis, Aris and Dietrich, Udo 2014, Impact of building design and occupancy on office comfort and energy performance in different climates, Building and environment, 71, 165-175.

Factsheet

Official Country Participation

China, Canada, Denmark, Italy, Netherlands, New Zealand, Norway, Poland, Republic of Korea, Spain, United States

Demographics of Contributors

Government/National Labs: **9%**
University/Institutes: **71%**
Industry: **20%**
Total number of participants: **93**

Dissemination Outlets

29 Archival Journal Publications
19 Conference Proceedings
ASHRAE: Seminars, Handbook
IBPSA: Newsletter
REHVA: Guidebooks, Newsletter, Journal papers
CIBSE: Guidelines

Notable Conferences

6th IBPC Conference, Turin, Italy (June 14-17, 2015)
ISHVAC-COBEE 2015, Tianjin, China (July 12-15, 2015)
Making Comfort Relevant, Windsor, England, 2016

Website Info.

(January 2014 to July 2015)
6,803 Users,
32,955 pageviews
37.6% new visitors;
62.4% returning visitors
Top countries viewing the webpage: USA, UK, China, Germany, Brazil, Italy, France, Canada

www.annex66.org

Archival Journal Publications Continued...

[9] Li C., Hong T., Yan D. (2014) An insight into actual energy use and its drivers in high-performance buildings, Applied Energy, 131, 394-410.

[10] de Wilde, P. (2014) The gap between predicted and measured energy performance of buildings: A framework for investigation. Automation in Construction, 41, 40-49.

[11] Wei S., Jones R., de Wilde P. (2014) Driving factors for occupant-controlled space heating in residential buildings. Energy and Buildings, 70, 36-44.

[12] Zhao J., Lasternas B., Lam K.P., Yun R., Loftness V. (2014) Occupant behavior and schedule modeling for building energy simulation through office appliance power consumption data mining. Energy and Buildings, 82, 341-355.

[13] Sun K., Yan D., Hong T., Guo S. (2014) Stochastic Modeling of Overtime Occupancy and Its Application in Building Energy Simulation and Calibration, Building and Environment, 79, 1-12.

[14] Zhou X., Yan D., Hong T., Ren X. (2015) Data analysis and stochastic modeling of lighting energy use in large office buildings in China, Energy and Buildings, 86, 275-287.

[15] Ren X., Yan D., Wang C. (2014) Air-conditioning Usage Conditional Probability Model for Residential Buildings, Building and Environment, 81 172-182.

[16] D'Oca S., Fabi V., Corgnati S.P., Andersen R.K. (2014) Effect of thermostat and window opening occupant behavior models on energy use in homes, Building Simulation: An International Journal, 7,

[17] Gulbinas R. and Taylor J. (2014) Effects of Real-time Eco-feedback and Organizational Network Dynamics on Energy Efficient Behavior in Commercial Buildings, Energy and Buildings, 84, 493-500.

[18] Jeong S., Gulbinas R., Jain R. and Taylor J. (2014) The Impact of Combined Water and Energy Consumption Eco-Feedback on Conservation, Energy and Buildings, 80, 114-119.

[19] Wang Q. and Taylor J. (2014) Energy Saving Practice Diffusion in Online Networks, Energy and Buildings, 76, 622-630.

[20] Jain R., Smith K., Culligan P. and Taylor J. (2014) Forecasting Energy Consumption of Multi-Family Residential Buildings Using Support Vector Regression: Investigating the Impact of Temporal and Spatial Monitoring Granularity on Performance Accuracy, Applied Energy, 123, 168-178.

[21] Xu X., Taylor J. and Pisello A. (2014) Network Synergy Effect: Establishing a Synergy between Building Network and Peer Network Energy Conservation Effects, Energy and Buildings, 68A, 312-320.

[22] Gulbinas R., Jain R., Taylor J., Peschiera G., and Golparvar-Fard M. (2014) Network Eco-Informatics: Development of a Social Eco-Feedback System to Drive Energy Efficiency in Residential Buildings, ASCE Journal of Computing in Civil Engineering, 28(1): 89-98.

[23] Cholewa T. and Siuta-Olcha A. Long term experimental evaluation of the influence of heat cost allocators on energy consumption in a multifamily building. Energy and Buildings, 2015 (accepted).

[24] Kjærgaard M.B., Blunck H. (2014) Tool support for detection and analysis of following and leadership behavior of pedestrians from mobile sensing data. Pervasive and Mobile Computing, 10, 104-117.

[25] Ruiz A.J., Blunck H., Prentow T.S., Stisen A., Kjærgaard M.B. (2014) Analysis methods for extracting knowledge from large-scale WiFi monitoring to inform building facility planning. PerCom, 130-138.

[26] Gunay H.B., O'Brien W., Beausoleil-Morrison I., Huchuk B. (2014) On adaptive occupant-learning window blind and lighting controls, Building Research & Information, 1-18.

[27] Gunay H.B., O'Brien W., Beausoleil-Morrison I., Goldstein R., Breslav R., Khan A. (2014) Coupling Stochastic Occupant Models to Building Performance Simulation using the Discrete Event System Specification (DEVS) Formalism, Journal of Building Performance Simulation, 7, 457-478.

[28] O'Brien W. and Gunay H.B. (2014) The contextual factors contributing to occupants' adaptive comfort behaviors in offices: A review and proposed modeling framework, Building and Environment, 77, 77-87.

[29] Dong B. and Lam K.P. (2014) A real-time predictive control for building heating and cooling systems based on the occupancy behavior pattern detection and local weather forecasting, Building Simulation, 7(1) 89-106.

If you don't see your publication listed, please e-mail the citation to Sarah Taylor-Lange (SCTaylorlange@lbl.gov) to have it included.

Annex 66

Definition and Simulation of Occupant Behavior in Buildings

OPERATING AGENTS

(1) China **Da Yan**
School of Architecture
Tsinghua University, China
Phone: +86-10-62789761
Fax: +86-10-62770544
E-mail: yanda@tsinghua.edu.cn

(2) USA **Tianzhen Hong**
Building Technology and Urban Systems Division
Lawrence Berkeley National Laboratory, USA
Phone: +1-510- 4867082
Fax: +1-510-4864089
E-mail: thong@lbl.gov

PARTICIPATING COUNTRIES

More detailed contact information can be found at annex66.org

(3) CANADA **William (Liam) O'Brien**
Architectural Conservation and Sustainability Eng.
Carleton University
Phone: +1-613- 520-2600 ext. 8037
E-mail: Liam.OBrien@carleton.ca

(4) DENMARK **Bjarne W. Olesen**
Civil Engineering,
Technical University of Denmark
Phone: +45-452-54029
E-mail: bwo@byg.dtu.dk

(5) ITALY **Stefano Paolo Corgnati**
Politecnico Di Torino
Phone: +39-0110904507/4507
E-mail: stefano.corgnati@polito.it

(6) NETHERLANDS **Peter Op't Veld**
Huygen Engineers and Consultants
Phone: +31-6 -21884253
E-mail: p.optveld@huygen.net

(7) POLAND **Karol Bandurski**
Poznan University of Technology
Phone: +48-665-2534
E-mail: karol.bandurski@put.poznan.pl

(8) SPAIN **Stoyan Danov**
CIMNE- UPC Campus Terrassa
Phone: +34-937-398987
E-mail: sdanov@cimne.upc.edu

(9) NEW ZEALAND **Manfred Plagmann**
BRANZ Ltd.
E-mail : manfred.plagmann@branz.co.nz

(10) REPUBLIC OF KOREA **Jung Hyun Yoo**
Land and Housing Research Institute
E-mail: jhyoo@lh.or.kr

(11) NORWAY **Vojislav Novakovic**
Norwegian University of Science and Technology
Phone: +47-735-93868
E-mail: vojislav.novakovic@ntnu.no

SOON-TO-BE-PARTICIPANTS

(1) UNITED KINGDOM **Darren Robinson**
University of Nottingham
Phone: 0115-74-84012
E-mail: Darren.Robinson@nottingham.ac.uk

(2) GERMANY **Andreas Wagner**
Karlsruhe Institute of Technology (KIT)
Phone: +49 (0)721 608-4-2178
E-mail: wagner@kit.edu

(3) AUSTRIA **Ardeshir Mahdavi**
Vienna University of Technology
Phone: +43 (1) 58801-27003
E-mail: amahdavi@tuwien.ac.at

(4) FRANCE **Anders Hall**
European Solar-Shading Organization (ESSO) & Somfy Inc.
Phone: +46 707 64 44 77
E-mail: Anders.HALL@somfy.com

EBC

Newsletter Editors:
Sarah Taylor–Lange, Xiaohang Feng