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The background of the cover is a composite image. It features a green-tinted photograph of a modern skyscraper with a curved facade, overlaid with a white architectural floor plan. The floor plan includes various rooms, corridors, and structural lines, with some areas labeled with numbers and letters. The overall aesthetic is technical and architectural.

# ENHANCING BUILDING PERFORMANCE

Edited by Shauna Mallory-Hill,  
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# Enhancing Building Performance

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 **WILEY-BLACKWELL**

A John Wiley & Sons, Ltd., Publication

This edition first published 2012 © 2012 by Blackwell Publishing Ltd.

Blackwell Publishing was acquired by John Wiley & Sons in February 2007. Blackwell's publishing program has been merged with Wiley's global Scientific, Technical and Medical business to form Wiley-Blackwell.

*Registered Office*

John Wiley & Sons, Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

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9600 Garsington Road, Oxford, OX4 2DQ, UK

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*Library of Congress Cataloging-in-Publication Data*

Data Available

A catalogue record for this book is available from the British Library.

ISBN 978-0-470-65759-1 (PBK)

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

Set in 10/12.5pt Minion by SPi Publisher Services, Pondicherry, India

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**Rotraut Walden's** major fields of research are architectural psychology and organizational and work psychology. She holds a tenured position at the Institute for Psychology of the University of Koblenz, Germany, and has been a member of the Environmental Design Research Association (EDRA) since 1989. Her research focuses on building performance evaluation, the development of instruments for evaluating schools, universities, office buildings, and hospitals. She has presented her research results at international conferences and is an author, co-author or editor of seven German-language books including: *Psychology and the Built Environment, Architectural Psychology – at Day Care Centers* (2011) and one English-language book: *Schools for the Future* (2009). Her professorial dissertation on *Architectural Psychology: School, University and Office Building of the Future*, was published in 2008.

**Chris Watson's** architectural practice serves government, commercial and private clients. Since 1984 he has developed and applied POE methods in New Zealand, Australia and Europe. He has presented his POE process at schools of architecture and design in Europe, the Americas, Middle East and Australasia, and to industry and the Programme for Education Buildings of the Organisation for Economic Co-operations and Development headquarters in Paris.

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**Paul Wilson** is a senior lecturer at the University of Salford, England. He has a master's degree in Occupational Health and Fitness and is currently completing a professional doctorate in the development of cycle centers to enhance commuting. Paul is able to combine his academic awareness of physical activity behavior and the use of ecological models with his experiences

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# Preface

This book is the result of a long-standing collaboration among the editors, as well as most of the chapter contributors. Going back to 1995, at the EDRA 36 Conference in Boston, the International Building Performance Evaluation (IBPE) consortium was formed by Wolfgang Preiser for the purpose of information exchange, methodological development and building new knowledge in the topic area of building performance. This led to the development of a pragmatic conceptual framework that reflects the building delivery and life cycle and phases in the world of design and construction.

Subsequently, building performance symposia were organized annually at the conferences of the Environmental Design Research Association (EDRA). The first tangible outcome of these symposia was the book *Assessing Building Performance* (Preiser and Vischer, 2005), which showcased the aforementioned conceptual framework for the first time in the context of real world applications and case studies from around the globe. The book subsequently was translated into Chinese, published in 2009 by China Machine Press and is in circulation among practitioners and academicians alike. It spawned a number of masters' theses and doctoral dissertations in such countries as Canada, China, Germany, India, Indonesia, Korea, Saudi Arabia, Sweden, and the UK.

The present book is seen as a sequel to *Assessing Building Performance*. *Enhancing Building Performance* once again brings together practitioners, administrators, academicians, as well as consultants with cutting edge experience in this evolving field of Post-Occupancy Evaluation (POE) and Building Performance Evaluation (BPE) from around the world. They are from such countries as diverse as: Brazil, Canada, Germany, Italy, Japan, New Zealand, Qatar, The Netherlands, the United Kingdom and the United States. Apart from the somewhat modified and further developed conceptual framework for Building Performance Evaluation (BPE), this book has an entirely new set of case studies, as well as information on new evaluation methodologies and the integration of BPE in academic curricula. It is expected that translations into Japanese, Italian and other languages will follow, thus spreading the word about ways of enhancing building performance to all corners of the world.

## The audience for this book

The audience of the book is envisioned as practitioners in the planning, design and construction industries, including consultants, researchers, government

agencies/organizations, facility managers, and design students interested in learning how to understand and learn from building performance.

## **Organization**

This book is organized into five parts. Part I presents the history and process model of building performance evaluation (BPE). Parts II through V each highlight different aspects of BPE research and practice currently underway around the world. Each is explained in more detail below.

### ***Part I***

In Chapter 1 Mallory-Hill, Preiser and Watson describe BPE and trace the history and evolution of BPE from its origins in environment-behaviour research and post-occupancy evaluation, highlighting key milestones of the past 45 years. Chapter 2 provides an updated version of BPE process model.

### ***Part II – Design Processes and Evaluation***

Part II provides the reader with examples of how a critical aspect of BPE design process model, stakeholder participation and feedback, is key to improving building outcomes and identifying best practices. Building evaluation is set within the context of integrative design processes (IDP) for green buildings, commissioning, rating systems and other design tools.

Participatory briefing and design is explored in detail using both rural and inner city case studies. Patterns in occupant requests are noted in post-occupancy evaluation from many building types and pattern language is used to communicate and organize evaluation results.

### ***Part III – Case Studies***

In Part III readers can explore examples of BPE in action, as researchers explore the performance of a wide variety of built environments from individual workstations to entire campus and urban developments. This section may be of particular interest to design practitioners and building owners and managers working with similar typologies.

The case studies address changing meanings of office workspace, technology, flexibility, work styles, activities, communication and freedom of movement. One case study reports on a prototype housing evaluation that reveals three-fold differences in energy-efficiency in identical zero carbon homes. Outdoor university spaces are evaluated to assess their effect on learning and increased student-faculty interaction and heritage values are evaluated to identify.

## **Part IV – Research Methods and Tools**

Performance evaluation involves the comparison between demand criteria and design outcomes. In Part IV authors provide a variety of approaches and techniques for evaluating the performance of built environments. With requirements analysis, performance criteria, data collection, occupant surveys, building representation, BPE practitioners, academics and students interested in undertaking their own investigation will find this section of particular interest.

In Chapter 14 Mallory-Hill and Westlund explore the measurement of the impacts of green building strategies on productivity, well-being and health of occupants in workplace environments. Preiser and Wang demonstrate how geographic information system and building performance evaluation methods are combined to provide a composite and weighted scoring system to evaluate a network of libraries. Schill-Fendl reports on a model with explicit laboratory design decisions. Finch *et al.* provide a method to evaluate designs, ability to increase daily exercise and therefore combat obesity. In Chapter 18, van der Voordt *et al.* identify critical building success factors for new workplace accommodation strategies.

The final two chapters in Part IV explore the role of computer simulation in building performance evaluation. In Chapter 19 Hensen discusses challenges of computational modeling of indoor environments that aims for ensuring occupant comfort and satisfaction. This is followed by Andrews *et al.*, who introduce a simulation-modeling framework that highlights the occupants' influence on building performance, and calibrates the model using post-occupancy evaluation (POE) survey data from a green commercial office building.

## **Part V – Education**

The integration of evidence-based and service-based design into design school curricula is intended to help students provide more hands-on contact with real stakeholders and thereby gain a deeper understanding the issues of the design problems they must address. This section provides several examples of how students are involved in BPE processes.

In Chapter 21 Ornstein *et al.* highlight impact of POE on professional practice is discussed with reference to participatory design in social housing and subway stations. Next, Schramm provides his perspective of how to instruct students in the art of building performance evaluation and Salama reports on the implementation of a series of exercises that highlight the value of evaluation research as a form of experiential learning to invigorate the capabilities of future architects. Walden describes how students are involved in an investigation of how work performance, learning efficiency and well-being are affected by the degree of environmental control that workplaces afford employees. Finally, Pavlides and Cranz describe how ethnographic field research methods are used to assess how residents and other users experience

buildings and spaces and to teach semantic ethnography and photo-elicitation in social-cultural architecture courses.

## ***Part VI – Epilogue***

Frank Duffy reflects on development of building evaluation and argues that architecture needs evaluation now more than ever.

# Acknowledgements

The editors would like to thank all the contributors to this volume for their excellent collaboration in bringing this project to fruition in a timely and professional manner.

We wish to start by recognizing the key facilitating role of the Environmental Design Research Association (EDRA) has had over the past 41 years in bringing together researchers to exchange ideas and advance knowledge in the discipline. Such collaborations have been many and outstanding results were the consequence. EDRA had a defining role in shaping the professional trajectories of many of its members, especially those who are represented in this book.

For example, Preiser's master's thesis at Virginia Tech focused on establishing quality profiles for different generations of dormitories (including those where the horrible shootings took place a few years ago), the results of which were presented at EDRA 1 in Raleigh, North Carolina. Consequently, research projects, consultations and teaching began to deal with Post-Occupancy Evaluation (POE), and later Building Performance Evaluation (BPE), the focus of this book. Along the way, these collaborations resulted in publications and, in many cases, long-lasting friendships. Preiser thanks his mentor, the late cyberneticist Heinz von Foerster, for initiating his interest in feedback, feed-forward and self-regulating control systems, which in turn, gave the impetus for decades of work in topics pertaining to evaluation. Preiser, who was a co-founder of Architectural Research Consultants in Albuquerque, New Mexico, in 1976, wishes to thank the firm for its continued interest and support in matters concerning building performance, master planning, programming and evaluation of projects.

Mallory-Hill, also a long-time EDRA-ite, is an educator and researcher in the areas of universal and sustainable workplace design and design-decision support systems. She wishes to thank her fellow members of the International Building Performance Evaluation (IBPE) research consortium for generously sharing their knowledge and expertise over the years. She is grateful for the ongoing support and encouragement she receives from the staff and students of the Department of Interior Design and the Faculty of Architecture at the University of Manitoba to undertake research and advance knowledge in the area of building performance evaluation.

Watson is a New Zealand architect who has evaluated most types of public buildings and many commercial buildings in order to improve future building programs. He appreciates the guidance and collegiality that Duncan Joiner has generously given over many years and on many projects. He also recognizes

the clients who have employed Post-Occupancy Evaluation as a way of understanding how other people experience buildings.

We thank Beth Edgar, Editorial Assistant at Wiley-Blackwell for her continuing guidance and support in this project.

Last, but not least, we thank our children and spouses/significant others for supporting this and many other efforts in the past and present.

# Foreword

Duncan A. Joiner

If you want to know whether your building is any good or not, it would seem that the obvious thing to do would be to ask the people who use it.

This book is by people who are doing the obvious thing. They ask building users about the buildings they occupy, and use this information to guide the design of new buildings and modifications to existing buildings.

Why is this so remarkable? Asking the users might seem to be the obvious thing to do, but it is easier said than done. Who do you ask? What do you ask them? It takes thought and knowledge about building processes and the social contexts of building delivery, ownership and occupancy to develop ways of asking users for information. That is what the authors of this book have done. It is certainly not simple or straight forward, but this book will help building designers, owners and managers to find out how to do it.

Why is it important to find ways of asking users what they think of their buildings? Because the world is full of buildings which do not meet users' expectations. Most of us live and work in buildings which have unsuitable spaces, poor acoustical and air qualities, and a range of other inconveniences which we negotiate and put up with in our daily lives. If we have the opportunity to influence decisions about the kinds of spaces we use, the situation can become much better. In this book, there are outstanding examples of how involving users in building evaluation and design has achieved buildings which are appreciated by their users, and have even saved money for their owners.

While it might seem obvious and straight forward to ask building users about their buildings, there are a number of reasons why it doesn't happen as much as one might expect. Except for people who are able to engage an architect and builder to make their own house, there are few opportunities for communication between people who provide buildings and the people who use them. Most of the people who use commercial and public work places and facilities will never talk to the architects, engineers, and builders responsible for those buildings. Building users and providers are effectively two different cultures which rarely make contact, hold different values, and often conflict. Users and providers are alike in that they derive some advantage from their connection with the building, but are different in the nature of that advantage. To complicate matters further, building owners can be seen as a third culture. So while building designers will, for example, strive to optimize safety, site

coverage, cost, and a range of physical environmental constraints for an office building, the owner will be measuring the success of the building in terms of maximum tenant occupancy and rental return on capital outlay. None of these things have much to do with the expectations of the building users' for a place to carry out their individual and collective work activities – in short, to live their lives.

Ideally, the expectations of providers, owners and users would be balanced. However, buildings usually satisfy one or the other group preferentially, and often the interests of the providers and owners dominate, because these are people who are accustomed to making decisions about what will be built in their day-to-day work. They know how they want things to be, and they have the resources to bring them about. Users rarely have that advantage, and so are destined to accept things as they are. Without feedback from building users, it is difficult for people who design buildings to know whether their design is as good as it could be, or any good at all from the point of view of the users.

Without feedback from building users, providers use other factors to guide and assess their work. There is an engineering dominance of hard data for structure, air conditioning, power plant and machinery which is guided by theoretical models and calculations, and which can be conclusively related to costs. There are also building laws, standards and regulations for safety and protection of public interest. But standards and regulations do not guarantee comfort and safety, let alone user satisfaction. Because they are generic and relate to all buildings in a jurisdiction, much of what they recommend will be short on knowledge of what people think and do in buildings.

Many of the characteristics of a building which are appreciated by the users are qualitative and subtle. They may have little to do with regulatory requirements for health and safety, and probably will have little to do with cost. There is a complex relationship between the physical reality of buildings and spaces and the expectations of all the people who use them, which could be clarified by listening to the users.

There are characteristics of the building industry which support building design and management systems based on contractual criteria which may not have much to do with users' expectations. In addition to this, conventional forms of engagement of architects can distance them from users. Knowledge about what works, what users like, and what is perhaps not so successful has to be passed on from one project to another. This does not happen often, so tradition, expedience and made up theory, form the basis for decision-making in design.

Buildings are built to order, and as single complex entities, they include hundreds of technical sub-systems and components from a variety of sources. They may take months or even years to make, and when finished, users and owners have to accept them as they are. The designers and providers of buildings do not have the advantages of volume production industries where large resources are devoted to prototyping and testing complete assemblies before commitment is made to final production. There is nothing in the