

**Innovation in the
Built Environment**



SARA J. WILKINSON
HILDE REMØY
CRAIG LANGSTON



Sustainable Building Adaptation

Innovations in Decision-making

WILEY Blackwell

Sustainable Building Adaptation: Innovations in Decision-Making

Sara J. Wilkinson

Associate Professor of Property and Construction
University of Technology
Sydney
Australia

Hilde Remøy

Assistant Professor of Real Estate Management
Faculty of Architecture
Delft University of Technology
The Netherlands

Craig Langston

Professor of Construction and Facilities Management
Bond University
Gold Coast
Australia

WILEY Blackwell

This edition first published 2014
© 2014 by John Wiley & Sons, Ltd

Registered Office

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

Editorial Offices

9600 Garsington Road, Oxford, OX4 2DQ, United Kingdom.
The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom.

For details of our global editorial offices, for customer services and for information about how to apply for permission to reuse the copyright material in this book please see our website at www.wiley.com/wiley-blackwell.

The right of the author to be identified as the author of this work has been asserted in accordance with the UK Copyright, Designs and Patents Act 1988.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, except as permitted by the UK Copyright, Designs and Patents Act 1988, without the prior permission of the publisher.

Designations used by companies to distinguish their products are often claimed as trademarks. All brand names and product names used in this book are trade names, service marks, trademarks or registered trademarks of their respective owners. The publisher is not associated with any product or vendor mentioned in this book.

Limit of Liability/Disclaimer of Warranty: While the publisher and author(s) have used their best efforts in preparing this book, they make no representations or warranties with respect to the accuracy or completeness of the contents of this book and specifically disclaim any implied warranties of merchantability or fitness for a particular purpose. It is sold on the understanding that the publisher is not engaged in rendering professional services and neither the publisher nor the author shall be liable for damages arising herefrom. If professional advice or other expert assistance is required, the services of a competent professional should be sought.

Library of Congress Cataloging-in-Publication Data

Wilkinson, Sara, 1961–

Sustainable building adaptation : innovations in decision-making / Sara J Wilkinson,
Hilde Remøy, Craig Langston.

pages cm

Includes bibliographical references and index.

ISBN 978-1-118-47710-6 (cloth)

1. Sustainable buildings–Design and reconstruction.
2. Buildings–Remodeling for other use.
3. Architecture–Conservation and restoration–Case studies. I. Remøy, Hilde Therese, 1972– II. Langston, Craig A. III. Title.

TH880.W53 2014

690.028'6–dc23

2013030498

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

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

Cover design by Andy Meaden, Meaden Creative

Set in 10/12pt Sabon by SPi Publisher Services, Pondicherry, India

Printed and bound in Malaysia by Vivar Printing Sdn Bhd

Sustainable Building Adaptation



RICS
Research

Series advisors

Carolyn Hayles, University of Bath
Richard Kirkham, University of Manchester
Andrew Knight, Nottingham Trent University
Stephen Pryke, University College London
Steve Rowlinson, University of Hong Kong
Derek Thomson, Loughborough University
Sara J. Wilkinson, University of Technology, Sydney

Innovation in the Built Environment (IBE) is a new book series for the construction industry published jointly by the Royal Institution of Chartered Surveyors and Wiley Blackwell. It addresses issues of current research and practitioner relevance and takes an international perspective, drawing from research applications and case studies worldwide.

- Presents the latest thinking on the processes that influence the design, construction and management of the built environment
- Based on strong theoretical concepts and draws on both established techniques for analysing the processes that shape the built environment – and on those from other disciplines
- Embraces a comparative approach, allowing best practice to be put forward
- Demonstrates the contribution that effective management of built environment processes can make

Books in the IBE series

Akintoye & Beck: *Policy, Finance and Management for Public-Private Partnerships*
Booth, Hammond, Lamond & Proverbs: *Solutions for Climate Change Challenges in the Built Environment*

Boussabaine: *Risk Pricing Strategies for Public-Private Partnership Projects*

Kirkham: *Whole Life-Cycle Costing*

London: *Construction Internationalisation*

Lu & Sexton: *Innovation in Small Professional Practices in the Built Environment*

Pryke: *Construction Supply Chain Management: Concepts and Case Studies*

Roper & Borello: *International Facility Management*

Senaratne & Sexton: *Managing Change in Construction Projects*

Wilkinson, Remøy & Langston: *Sustainable Building Adaptation*

For full details of the *Innovation in the Built Environment* series, please go to <http://eu.wiley.com/WileyCDA/Section/id-811341.html>

We welcome proposals for new, high-quality, research-based books which are academically rigorous and informed by the latest thinking; please contact Madeleine Metcalfe.

Madeleine Metcalfe
Senior Commissioning Editor
Wiley Blackwell
9600 Garsington Road
Oxford OX4 2DQ
mmetcalfe@wiley.com

About the Authors

Dr Sara J. Wilkinson is Associate Professor of Property and Construction at the University of Technology Sydney, Faculty of Design Architecture and Building, Sydney, Australia. She has a combination of professional industry and academic experience spanning more than 30 years. The research described in Part I: Building Adaptation is the result of work undertaken over a 16-year period and has been funded by Jones Lang LaSalle and the Royal Institution of Chartered Surveyors. Sara's research focus is building adaptation within the context of sustainability and represents areas of professional practice prior to becoming an academic. Her PhD examined building adaptation and the relationship to property attributes, whilst her MPhil explored the conceptual understanding of green buildings. Sara is a member of the RICS Oceania Sustainability Working Group. She is the International Federation of Surveyors (FIG) Vice-Chair of Commission 10 'Construction Management & Construction Economics'. Sara is also the author of eight books/book chapters and was awarded the RICS COBRA Conference Best Paper Award in 2012 for her paper 'The increasing importance of environmental attributes in commercial building retrofits', RICS COBRA, Las Vegas, NV, USA. September 2012. <http://www.rics.org/au/knowledge/research/conference-papers/cobra-2012-environmental-attributes-in-commercial-building-retrofits/>

Dr Hilde Remøy is Assistant Professor of Real Estate Management at the Faculty of Architecture, Delft University of Technology, Delft, the Netherlands. She has experience with adaptive reuse from both practice and academia. The research described in Part II: Adaptive Reuse is the result of studies undertaken in the period 2005–2013. Hilde's research focus is adaptive reuse of existing buildings that have lost their original function, related to obsolescence and vacancy of existing buildings and locations. In research and education, she works on studies concerning the influence of physical property characteristics on obsolescence and adaptive reuse potential and studies to define the future value of reused buildings and cultural heritage. Hilde is the author of several books/book chapters.

Dr Craig Langston is Professor of Construction and Facilities Management at Bond University's School of Sustainable Development, Gold Coast, Australia. He has a combination of industry and academic experience spanning more than 35 years. The research described in Part III: Decision-making and

Optimisation is the result of three Australian Research Council (ARC) Linkage Project grants comprising:

- 2009–2012 – Langston, C., Smith, J., Herath, G., Datta, S., Doloi, H. and Crawford, R.H., Making Better Decisions about Built Assets: Learning by Doing, ARC Linkage Project \$180,000 LP0990261 (Industry partners: Williams Boag Architects and Asstetic Australia).
- 2007–2010 – Langston, C., Liu, C., Beynon, D. and de Jong, U., Strategic Assessment of Building Design Adaptive Reuse Opportunities, ARC Linkage Project \$210,000 LP0776579 (Industry partners: Williams Boag Architects and The Uniting Church in Australia).
- 2006–2009 – Crawford, R.H., Datta, S. and Langston, C., Modelling Environmental and Financial Performance of Construction. Sustainability Innovation Feasibility Tool. ARC Linkage Project \$179,000 LP0667653 (Industry partner: Williams Boag Architects).

Craig is the author of five international books. In 2010, he won the Bond University Vice-Chancellor's Quality Award for Research Excellence. He was awarded the Emerald Literati Network Award for Excellence in 2013 for his paper 'Validation of the adaptive reuse potential (ARP) model using *iconCUR*', *Facilities*, 30(3–4), 105–123 (2012).

Preface: The Rise of Building Adaptation

A point has been reached in history when we must shape our actions throughout the world with a more prudent care for their environmental consequences. Through ignorance or indifference we can do massive and irreversible harm to the earthly environment on which our life and well-being depend. Conversely, through fuller knowledge and wiser action, we can achieve for ourselves and our posterity a better life in an environment more in keeping with human needs and hopes... To defend and improve the human environment for present and future generations has become an imperative goal for mankind.¹

It is four decades since these words of forewarning were written, and we should reflect on whether we have heeded the statements. The declaration is a warning and a call to action. The proclamation asserts that humans need to be more prudent in respect of the environment; yet in those 40 years, greenhouse gas emissions have increased, pollution has worsened, and social inequity and injustice around the world has continued to attract global attention. If anything, the environmental legacy for future generations is less than it was in 1972.

The challenge of achieving sustainable development in the twenty-first century will be won or lost in the world's urban centres, and this is due to the contribution that the built environment makes to greenhouse gas emissions and global warming. The challenge is immense and overwhelming, both in terms of its magnitude and potential consequences if humankind does not adapt its behaviours towards the environment. Climate change impacts are occurring, disproportionately affecting developing nations, and are projected to get much worse over time. It is expected that there will be increased variability in climate events, such as harder and more frequent storms, which will lead to changes in climatic averages such as increased water scarcity. Globally as humankind adapts and evolves its behaviours and government strategies and policies, we are transitioning from the 'industrial age' to the 'ecological age'.

The built environment, if upstream emissions from heat and electricity are included, is responsible for around 45% of total global greenhouse gas emissions (GGE). Also there are impacts from water and resources consumption within buildings. As commercial buildings have a life cycle measured in decades or even centuries, the existing stock is of particular interest and consequence. Significantly, our window of opportunity for pre-emptive action to avoid higher levels of climate change and temperature increase is to act decisively up to 2050; time is not on our side. When compared to other sectors, such as transport or waste, the contribution of sustainable building adaptation to climate change mitigation is abundantly clear.

With 1–2% of new buildings added to the total stock annually, humankind needs to adapt its existing buildings, and quickly. While all new construction should adopt sustainability features in design and operation, given typical rates of replacement much of the built environment that will exist in 2050 has already been built. Furthermore, the Inter Governmental Panel on Climate Change (IPCC) concluded that:

Over the whole building stock the largest portion of carbon savings by 2030 is in retrofitting existing buildings and replacing energy using equipment due to the slow turnover of the stock.²

The greatest challenge is the development of successful strategies for adapting existing buildings due to their slow turnover; in other words, effective decision-making for sustainable building adaptation is critical to deliver needed building-related GGE reductions globally. Many cities have acknowledged this need to act and have developed and adopted strategies aimed to deliver carbon neutrality within fixed periods. Local government authorities are encouraging sustainable building adaptation to lower building-related energy consumption and associated emissions.

Sustainable adaptation of existing stock is a universal concern that increasing numbers of local, state and national governments must endeavour to address within the short to medium term. In most developed countries, more is now spent on building adaptation (including maintenance, repair, retrofit and reuse) than new construction, and this represents a gradual but consistent change from decades of investment dominance in new-build projects. There is a need for greater knowledge and awareness of what happens to society's buildings over time and how we might adapt them sustainably. This action includes avoiding premature destruction through finding new uses for buildings that have become unwanted or obsolete. While new development must also be sustainable, there is insufficient time for us to act unless proactive intervention into the performance of existing building stock becomes a priority.

This research-based book contributes significantly to a more informed understanding and management of decisions relating to the sustainable adaptation of existing commercial buildings. This work collectively offers

guidance towards a balanced approach that incorporates sustainable and optimal approaches for effective management of sustainable adaptation of existing commercial buildings. It is divided into three discrete parts concerning building adaptation, adaptive reuse, and adaptation decision-making and optimisation.

Part I has been written by Dr Sara J. Wilkinson. She establishes the definition of adaptation in the context of this book. She reviews and synthesises the key literature, while progressively developing the research questions, hypotheses and a conceptual model towards a knowledge-based approach to sustainable office adaptation. She describes and substantiates her latest research demonstrating how to make a preliminary assessment of adaptation potential using the Melbourne CBD as an illustrative case study. A large focus for this part concerns the connection between sustainability and building adaptation.

Part II has been written by Dr Hilde Remøy. She presents her research conducted into Dutch office change of use adaptations. Adaptive reuse, defined as significant functional change applied to obsolete buildings as an alternative to premature destruction, is her focus. Many exemplars demonstrating application of this approach in the Netherlands are provided and augmented with a number of international case studies. In this part, the relationship of adaptation, retrofitting, alteration and inherent flexibility provided by the initial design solution is explored, including discussion of the practical lessons learned from the underpinning work (as case studies for the practitioner audience) and a clear statement of the theoretical contributions involved.

Part III has been written by Dr Craig Langston. He covers adaptation decision-making and optimisation using multiple criteria. He describes and substantiates his research into how to make a strategic assessment of whether and when to adapt. Cost planning is a key feature of the decision-making process and its integration into a broader financial–social–environmental frame is explored. He also introduces a model to assess new design to ensure that it will deliver adaptation benefits much later in life. Each presented decision/optimisation model is demonstrated via one or more actual case studies.

To sum up, the key issue and motivation for this book is that we need to adapt our existing building stock to reduce its environmental footprint, to aim for higher sustainability, better energy performance and more efficient use of natural resources. We are currently some way from this being standard practice in many urban settlements. Whilst there are an abundance of environmental rating tools to choose from across a range of countries, there is patchy take-up within the real estate markets, especially with lower quality or lower profile stock. Nevertheless, there is an increasing amount of legislation relating to sustainability and evidence that industry practices are improving – but whether the rate of uptake is sufficient to make a meaningful change only time will tell.

As is often quoted, ‘the greenest buildings are the ones we already have’.³

Notes

- 1 Extract from the Declaration of the UN Conference on the Human Environment (1972), available online at <http://www.unep.org/Documents.Multilingual/Default.Print.asp?documentid=97&articleid=1503&cl=fr>. Accessed 19 August 2013.
- 2 Extract from the Intergovernment Panel on Climate Change (IPCC) Fourth Assessment Report (2007), available online at http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch6-ens6-es.html. Accessed 19 August 2013.
- 3 Originally attributed to Jacobs, J. (1961) *The death and life of great American cities*, New York: Random House.

Contents

| | |
|--|-----------|
| <i>About the Authors</i> | xi |
| <i>Preface</i> | xiii |
| Part I Building Adaptation | 1 |
| <i>Sara J. Wilkinson</i> | |
| Chapter 1 Defining Adaptation | 3 |
| 1.1 Introduction | 3 |
| 1.2 Terminology | 4 |
| 1.3 The Significance of Building Adaptation | 4 |
| 1.4 Decision-Making Issues in Building Adaptation | 10 |
| 1.5 Decision Options and Levels of Adaptation | 11 |
| 1.6 Adaptation and Different Land Uses | 13 |
| 1.7 Conclusion | 14 |
| References | 15 |
| Chapter 2 Drivers and Barriers for Adaptation | 18 |
| 2.1 Introduction | 18 |
| 2.2 Building Life Cycle Theory | 18 |
| 2.3 Building Performance Theory | 20 |
| 2.4 Building Adaptation Theory and Sustainability | 21 |
| 2.4.1 Social Factors | 22 |
| 2.4.2 Environmental Factors | 27 |
| 2.4.3 Cost and Economic Factors | 30 |
| 2.5 Other Attributes Associated with Adaptation | 34 |
| 2.5.1 Physical Attributes | 34 |
| 2.5.2 Locational and Land Use Attributes | 36 |
| 2.5.3 Legal Attributes | 37 |
| 2.6 Conclusion | 38 |
| References | 39 |
| Chapter 3 Assessing Adaptation Using PAAM | 42 |
| 3.1 Introduction | 42 |
| 3.2 Preliminary Assessment | 42 |
| 3.3 Principal Component Analysis | 47 |
| 3.4 Preliminary Adaptation Assessment Model | 49 |

| | | |
|-------|---|----|
| 3.5 | Illustrative Case Study | 54 |
| 3.5.1 | Building Description | 54 |
| 3.5.2 | Assessing a Building for 'Alterations' Adaptation | 54 |
| 3.6 | Conclusion | 56 |
| | References | 58 |

Chapter 4 Sustainable Adaptation: A Case Study of the Melbourne CBD **59**

| | | |
|--------|--|----|
| 4.1 | Introduction | 59 |
| 4.2 | The Context for Adaptation | 59 |
| 4.3 | Typical Sustainability Measures Used in Commercial Building Adaptation | 60 |
| 4.4 | Sustainable Adaptation Case Studies | 62 |
| 4.4.1 | 131 Queen Street | 62 |
| 4.4.2 | Alto Hotel (636 Bourke Street) | 64 |
| 4.4.3 | 247 Flinders Lane (Ross House) | 66 |
| 4.4.4 | 490 Spencer Street | 68 |
| 4.4.5 | 500 Collins Street | 70 |
| 4.4.6 | 406 Collins Street | 73 |
| 4.4.7 | 182 Capel Street | 75 |
| 4.4.8 | 115 Batman Street | 77 |
| 4.4.9 | 385 Bourke Street | 79 |
| 4.4.10 | 530 Collins Street | 81 |
| 4.5 | Comparative Analysis of Sustainable Adaptation Measures | 82 |
| 4.5.1 | Owners | 83 |
| 4.5.2 | Age | 83 |
| 4.5.3 | Location | 84 |
| 4.5.4 | Aesthetics | 85 |
| 4.5.5 | Location of Vertical Services | 85 |
| 4.5.6 | Existing Land Use | 85 |
| 4.5.7 | Floor Area | 86 |
| 4.5.8 | Street Frontage | 86 |
| 4.5.9 | Historic Listing | 86 |
| 4.5.10 | Number of Storeys | 87 |
| 4.5.11 | PCA Grade | 87 |
| 4.5.12 | Attachment to Other Buildings | 88 |
| 4.5.13 | Site Access | 88 |
| 4.6 | Conclusion | 89 |
| | References | 90 |

Part II Adaptive Reuse **93**

Hilde Remøy

| | |
|--|-----------|
| Chapter 5 Building Obsolescence and Reuse | 95 |
| 5.1 Introduction | 95 |
| 5.2 Conversion Research Worldwide | 97 |

| | | |
|-------|--|-----|
| 5.3 | Building Lifespan and Obsolescence | 100 |
| 5.3.1 | Technical Lifespan | 100 |
| 5.3.2 | Functional Lifespan | 101 |
| 5.3.3 | Economic Lifespan | 101 |
| 5.4 | Obsolescence and Vacancy | 102 |
| 5.5 | Quality and Obsolescence: User-Based Property Assessment | 104 |
| 5.6 | The Physical Characteristics of Structurally Vacant Office Buildings | 106 |
| 5.6.1 | Structure and Floors | 107 |
| 5.6.2 | Floor Layout, Building Length and Depth | 107 |
| 5.6.3 | Façade | 108 |
| 5.6.4 | Stairs and Elevators | 108 |
| 5.6.5 | Location Characteristics | 108 |
| 5.7 | Selected Adaptive Reuse Projects | 109 |
| 5.8 | Conclusion | 117 |
| | References | 118 |

Chapter 6 Reuse versus Demolition 121

| | | |
|-------|---|-----|
| 6.1 | Introduction | 121 |
| 6.2 | Decision-Making Criteria | 122 |
| 6.3 | Tools, Scans and Instruments | 123 |
| 6.3.1 | The Transformation Meter | 124 |
| 6.3.2 | Programmatic Quick Scan | 127 |
| 6.3.3 | Architectural Value | 127 |
| 6.3.4 | The Architects' Method | 128 |
| 6.3.5 | The ABT Method: An Instrument Developed in Practice | 128 |
| 6.4 | Decisions-Based on Financial Arguments | 129 |
| 6.5 | Durability and Sustainability | 131 |
| 6.6 | Conclusion | 132 |
| | References | 133 |

Chapter 7 Examples of Successful Adaptive Reuse 135

| | | |
|--------|---|-----|
| 7.1 | Introduction | 135 |
| 7.2 | Dutch Conversion Projects (Office to Residential) | 136 |
| 7.2.1 | 'Stadhouder' in Alphen aan den Rijn | 137 |
| 7.2.2 | 'Lodewijk Staete' in Appingedam | 137 |
| 7.2.3 | 'Enka' in Arnhem | 138 |
| 7.2.4 | 'Schuttersveld' in Delft | 139 |
| 7.2.5 | 'Westplantsoen' in Delft | 139 |
| 7.2.6 | 'Wilhelminastaete' in Diemen | 140 |
| 7.2.7 | 'Granida' in Eindhoven | 141 |
| 7.2.8 | 'Residentie de Deel' in Emmeloord | 141 |
| 7.2.9 | 'Twentec' in Enschede | 142 |
| 7.2.10 | 'Eendrachtskade' in Groningen | 143 |
| 7.2.11 | 'Billiton' in Den Haag | 143 |

| | | |
|---|---|------------|
| 7.2.12 | 'Hof ter Hage' in Den Haag | 144 |
| 7.2.13 | 'Churchill Towers' in Rijswijk | 145 |
| 7.2.14 | 'Puntegale' in Rotterdam | 145 |
| 7.2.15 | Westerlaan Tower in Rotterdam | 146 |
| 7.3 | Discussion | 147 |
| 7.3.1 | Data Analysis | 147 |
| 7.3.2 | Conversion Risks | 147 |
| 7.3.3 | Conversion Opportunities | 150 |
| 7.3.4 | Typology | 152 |
| 7.3.5 | Structure and Floors | 152 |
| 7.3.6 | Floor Layout, Building Length and Depth | 153 |
| 7.3.7 | Façade | 153 |
| 7.3.8 | Stairs and Elevators | 154 |
| 7.3.9 | Location | 154 |
| 7.3.10 | Building | 155 |
| 7.4 | Conclusion | 157 |
| | References | 158 |
| Chapter 8 Preserving Cultural and Heritage Value | | 159 |
| 8.1 | Introduction | 159 |
| 8.2 | Historic Heritage | 159 |
| 8.3 | The Value of Heritage | 160 |
| 8.3.1 | The Value of Place | 160 |
| 8.3.2 | Cultural Capital | 161 |
| 8.3.3 | Benefits of Heritage Conservation | 162 |
| 8.4 | Assessing Economic Value of Heritage | 163 |
| 8.4.1 | The Market Value of Heritage | 163 |
| 8.4.2 | Direct Market Value | 164 |
| 8.4.3 | Indirect Value | 164 |
| 8.4.4 | Indirect Value of Heritage Tourism | 165 |
| 8.4.5 | Heritage as a Source of Skills and Competencies | 165 |
| 8.4.6 | Private/Public Value | 166 |
| 8.5 | Heritage Value and Adaptation | 166 |
| 8.6 | Architectonic and Aesthetic Value | 167 |
| 8.7 | Experience Value | 170 |
| 8.7.1 | Familiar Ugliness | 170 |
| 8.7.2 | Cultural–Historical Value | 170 |
| 8.7.3 | Symbolic Value | 171 |
| 8.7.4 | Traumatic Experience Value | 173 |
| 8.7.5 | Value in Use | 174 |
| 8.7.6 | Intrinsic Value (Highest and Best Use) | 174 |
| 8.7.7 | Heritage as a Source of Social Value | 176 |
| 8.8 | Conclusion | 180 |
| | References | 181 |

Part III Adaptation Decision-Making and Optimisation

183

Craig Langston

| | |
|--|------------|
| Chapter 9 Identifying Adaptive Reuse Potential | 187 |
| 9.1 Introduction | 187 |
| 9.2 ARP Model | 188 |
| 9.3 Obsolescence Rates | 191 |
| 9.3.1 Physical Obsolescence | 191 |
| 9.3.2 Economic Obsolescence | 192 |
| 9.3.3 Functional Obsolescence | 193 |
| 9.3.4 Technological Obsolescence | 194 |
| 9.3.5 Social Obsolescence | 194 |
| 9.3.6 Legal Obsolescence | 195 |
| 9.3.7 Political Obsolescence | 196 |
| 9.4 Case Study: GPO Building, Melbourne | 197 |
| 9.5 Discussion | 201 |
| 9.6 Conclusion | 205 |
| Note | 206 |
| References | 206 |
| | |
| Chapter 10 MCDA and Assessing Sustainability | 208 |
| 10.1 Introduction | 208 |
| 10.2 Background | 209 |
| 10.3 A New Approach | 211 |
| 10.3.1 Conceptual Framework | 211 |
| 10.3.2 Value for Money | 213 |
| 10.3.3 Quality of Life | 214 |
| 10.3.4 Sustainability Risk | 215 |
| 10.4 Life-Cost Planning | 215 |
| 10.5 Case Study: Bond University Mirvac School of Sustainable Development (MSSD) Building, Gold Coast | 217 |
| 10.5.1 Method | 217 |
| 10.5.2 Return on Investment | 218 |
| 10.5.3 Energy Usage | 220 |
| 10.5.4 Functional Performance | 220 |
| 10.5.5 Loss of Habitat | 221 |
| 10.5.6 Sustainability Index | 221 |
| 10.6 Discussion | 223 |
| 10.7 Conclusion | 227 |
| Notes | 227 |
| References | 228 |

| | |
|---|------------|
| Chapter 11 Modelling Building Performance Using <i>iconCUR</i> | 230 |
| 11.1 Introduction | 230 |
| 11.2 Visual MCDA | 231 |
| 11.3 <i>iconCUR</i> Model | 232 |
| 11.4 Case Study: 88 George Street, Sydney | 235 |
| 11.4.1 Overview | 235 |
| 11.4.2 Before Intervention | 237 |
| 11.4.3 After Intervention | 239 |
| 11.5 Discussion | 241 |
| 11.6 Conclusion | 247 |
| Notes | 247 |
| References | 248 |
| | |
| Chapter 12 Designing for Future Adaptive Reuse | 250 |
| 12.1 Introduction | 250 |
| 12.2 Rationale | 251 |
| 12.3 <i>AdaptSTAR</i> Framework | 254 |
| 12.4 International Case Studies | 259 |
| 12.4.1 1881 Heritage, Hong Kong SAR (PRC) | 261 |
| 12.4.2 Peranakan Museum, City Hall (Singapore) | 261 |
| 12.4.3 Corso Karlín, Prague (Czech Republic) | 262 |
| 12.4.4 Arsenal de Metz, Metz (France) | 262 |
| 12.4.5 The Candy Factory Lofts, Toronto (Canada) | 263 |
| 12.4.6 Punta Della Dogana Contemporary Art Centre, Venice (Italy) | 263 |
| 12.4.7 Andel's Hotel, Łódz (Poland) | 264 |
| 12.4.8 Sugar Warehouse Loft, Amsterdam (The Netherlands) | 264 |
| 12.4.9 The Powerhouse, Long Island City (USA) | 265 |
| 12.4.10 John Knox Church, Melbourne (Australia) | 265 |
| 12.5 Discussion | 266 |
| 12.6 Conclusion | 268 |
| References | 268 |
| | |
| <i>Index</i> | 273 |