

Table of Contents

Editor's Note	vii
Table of Contents	ix
List of Figures	xiii
Acknowledgements and Credits	xxi
Introduction	xxiii
1 Why Do We Need BIM?	1
Drawing Based Construction	1
Virtual Building Model	5
BIM – construction with (effectively) perfect information	5
Manufactured Buildings	6
Guaranteed buildings	6
Managed buildings	7
Transformed construction – Changing roles	7
2 What Is BIM?	9
Simple Outline of Technical BIM	9
Create Design Information & Resolve Design Issues	11
Coordinated Information	12
Bim Concepts	13
Information passing between BIM Elements	18
Image Rendering	22
Collaboration & Sharing the Model concurrently	24
Common Data Environment	24
Design and Engineering	25
Construction Sequencing	25
Operations	25
3 Background to BIM	27
HARNESS	32
ARK-2	32
EdCAAD or SSHA	33
CEDAR	33
GABLE	33
CARBS	33
SPACES	33
RUCAPS	35
GLIDE II	35
CAEADS	36
CALCOMP	36
ARRIS	36
Architron	36
ArchiCAD	37
IBM	37
AES	37
INTERGRAPH/Bentley	37
Computervision	38

Where did the BIM Philosophy Originate?	38
SONATA	38
REFLEX and ProReflex	42
4 Current BIM Systems	43
Current BIM systems	44
REVIT	44
Graphisoft ArchiCAD	45
Vectorworks	46
Bentley OPENBUILDINGS	47
Beck Technology Destini	47
BRICSYS BRICSCAD BIM	49
Nemetschek ALLPLAN	49
Rhino, Grasshopper & VisualARQ	49
BIMObjects	49
Questions for Vendors	50
BIM Directives and Legislation	52
5 Implementing BIM	55
Barriers to BIM	56
Building Delivery Method and BIM	57
Business Models	57
Integrated Project Delivery	58
BIM procurement	58
Applications of BIM	59
Interoperability and Foundation Classes	59
Project Information Modelling	60
Construction Orientated Building Exchange (COBIE)	61
Business Value of BIM	61
Legal Issues arising from BIM	62
Intellectual Property Rights (IPR)	62
Multi-Dimension BIM	63
Level of Development (US)	63
CIC BIM Protocol (UK)	64
Employers Information Requirements (UK)	64
BIM Execution Plan (UK)	64
Health and Safety	65

Early Case Studies

6 Architecture	69
Case Study: Carlton Gate, PRP Architects	77
Case Study: Lloyds Building, Richard Rogers Architects	78
Case Study: The Peak Tower, Farrell Architects	81
Case Study: National Tennis Stadium, Peddle Thorp Architects, Melbourne	81
Case Study Sole Architect and Small Practice: Peter Dew and Associates	83
Architectural animation	86
7 Lighting & Shadow Studies	91
Surfaces and Lighting	91
Shadows	94
8 Early Retail Applications	113
Case Study: Coles (Australia)	115

Case Study: Allied Maples (UK)	117
9 BIM & Engineering	123
Case Study: Parametric Building Core, Kyle Stewart	124
Case Study: Parametric Stadium, Alfred McAlpine and Engineering Technology	126
Case Study: Ting Kau Bridge, Hong Kong Government.	126
Case Study: Heathrow Express, Mott MacDonald & Taylor Woodrow	128
Case Study: Modular Stations, Taylor Woodrow	132
Case Study: Power Plants BNFL	135
Case Study: Millennium Bridge, BRMBZ	135
Case Study: Road and Ground Modelling	139
Case Study: Water Treatment Plant, Wellington City Council	139
Case Study: Industrial Process and Buildings	141
10 BIM & Construction Management	143
Case Study: Smithfield Market, Taylor Woodrow	146
Case Study: Portcullis House Westminster Michael Hopkins and Partners	150
Case Study: Europier Terminal One Heathrow, Engineering Technology.	150
Case Study: Royal Albert Hall, Taylor Woodrow	157
11 Mechanical & Electrical Services	165
Case Study: British Library SVM	167
 Evolution of BIM	
12 Retail Modelling – RIM	177
Retail Model Overview	177
New tools	178
Planogram Recording and Compliance	179
Planogram Generation and Optimization	182
Recording store layouts	183
Virtual Reality Research	186
Product Database	186
Management data	187
RIM Building Blocks	188
Stock taking	188
Customer engagement	188
Mirror Store Shopping	189
Artificial Intelligence	189
Understanding Natural Language	193
Conclusion	194
13 Mirror Cities – CIM	195
Mirror City Objects	196
People, NPC's, and Avatars.	197
Public Health and Safety	200
Water and Waste Management.	200
Transport	201
Extensions to BIM	204
Viewing CIM	205
14 BIM and Manufacturing	207
Improving efficiency within the Construction industry.	207
Automobile industry.	208
Computer Integrated Manufacturing	208

Digital Fabrication and Modular Construction	209
Lean Production	210
15 Future BIM	213
Man-Machines Interfaces	213
Virtual Reality	213
Augmented and Mixed Reality	214
Gaming Engines	215
Voice and Language	215
AI and Cloud-Based GPUs	216
Cloud-Based Physics Engines	218
The Open BIM Engine	218
Plugins	219
Operating BIM Objects and Buildings	220
Finite Object Modelling	224
Sustainable BIM	226
Carbon View	227
Levelized Cost of Carbon	228
Sustainable Design	230
Sustainable Urban Development	231
The Global Impact of BIM	232
16 Conclusion	235
Appendix 1	237
Appendix 2	251
Appendix 3	259
Appendix 4	263
Appendix 5	271
Appendix 6	281
Index	283