Index

Note to the Reader: Throughout this index boldfaced page numbers indicate primary discussions of a topic. Italicized page numbers indicate illustrations.

**NUMBERS**

3D BIM, 15, 50–52

3D printers, 30–31, 116

4D BIM. see model-based scheduling

5D BIM. see model-based estimating

A

accuracy, installation, 234

activity tracking, construction, 234, 235

addenda

BIM. see BIM addenda

definition of, 65

AE (architectural and engineering) models, 52, 55

AGC (Associated General Contractors of America), 64, 65

AIA (American Institute of Architects), 64, 65, 66

Alberti, Leon Battista, 46

analysis

building codes for, 179, 179

building rating systems for, 177–178, 178

cement CO₂ emissions, 179–180

data, 27–29

model-based, 74–75

multiple, 358

Seafair for, 182–187, 182–188

software for, 175–176

sustainability, 180–181, 181

animation, scheduling, 221–226, 221–226

Apple Watch, 22

AR (augmented reality) simulations, 115, 115

architect-controlled record models, 264

architects

in ConsensusDocs 301, 65

DB delivery method and, 59–60

new responsibilities of, 344

uses of BIM by, 351

architectural and engineering (AE) models, 52, 55

Architecture 2030, 176–177

artifact deliverables

CAD files, 314–315

cost deliverables and, 315–316

hybrid approach to, 316, 317

overview of, 310–311, 311

PDFs, 311–312, 313

As-builts—Problems & Proposed Solutions

(Pettee), 310

Assemble Systems, intuition and, 286–287, 287–288

Assemble tool, for cost trending, 172–175, 173–175

Associated General Contractors of America (AGC), 64, 65

attention span statistics, 41

augmented intelligence, 359

augmented reality (AR) simulations, 115, 115

Autodesk BIM 360 Field

barcodes/QR codes in, 297–298, 298

commissioning in, 326, 327

equipment database in, 301

features of, 291

mapping equipment to, 291–295, 292–295

to status material, 299–301, 300

uploading information into, 295–297, 296

visualizing equipment in, 301–303, 302–303

Autodesk BIM 360 Glue

email invitation, 159

real-time clash alert, 27, 28

sharing models, 291–292, 292

uploading models to, 159–160, 160–163


Autodesk Navisworks

clash detection in, 205–207, 205–208

Comments tool in, 243–246, 244–246

default units in, 219

features of, 198

field information via, 242–243

importing search sets into, 288–290, 288–290

NWD/NWF file formats, 198, 217, 219
Autodesk Navisworks (continued)
  opening files in, 219
  overview of, 196–198, 197
  punch list coordination in, 328, 329
  Redline Tags in, 248–249, 248–249
  Redlining tool in, 246–247, 247–248
  schedule simulation in, 221–226, 221–226
  scheduling software and, 217–221, 218–220
  search set exercise, 199–205, 200–204
  sequencing clash analysis in, 211–213, 212–213
  Autodesk Navisworks Manage, 301–303, 
  301–303
  Autodesk Revit
  CO₂ emissions and, 179–180
  creating doors in, 284–286, 285–286
  for estimations, 164–169, 165–169
  export formats, 80–81, 81
  fabrication in, 342, 342–343
  schedule discrepancies in, 170–171, 171
  showing design intent, 61
  AutoMark 2.0, 272

B

Ballard, Glen, 125
barcodes, 297–298, 298–299, 299
Batch Link, for digital plan room, 272
behaviors, in successful BIM, 7–8
Bentley Navigator, punch lists in, 327, 328
Big BIM, little bim (Jernigan), 8
Big Data analysis, 27–29
BIM (building information modeling)
  analyzing data in, 27–29
  battle for, 258–261, 259, 261
  as catalyst, 340
  in closeout procedures, 38–39
  in CMAR delivery method, 55–56
  constructability and, 25–26, 25–27
  in construction, 192–193. see also
  construction
  construction management and, 15
  controlling schedules with, 33–34, 34
  cost controls, 34–35, 35
  cost estimation, 23–24, 23–24
  current adoption cycle of, 12
  in DBB delivery method, 50–52, 51
  design for prefabrication, 29–31, 30
  developing intuition in, 284
  education and, 350–351
  enabling behaviors in, 7–8
  equipment tracking with, 38
  facilities management and, 39–40, 40
  factors effecting use of, 12, 13
  future of. see future of BIM
  growth trends of, 9
  improving world situation, 360–361
  increased adoption of, 10, 16
  increasing benefits of, 12, 14
  as informational database, 15
  keys to speaking, 97
  knowledge management and, 41, 41–42
  leadership buy-in, 42–43
  logistics in, 22, 22–23
  managing changes, 35–36
  managing punch lists, 39, 39
  planning for success of, 19
  prefabrication and, 342–343, 342–343
  primary uses of, 69–75
  processes in, 4–5, 356–357
  project pursuit and, 16–19, 18
  results/savings of, 43, 44
  scheduling and, 20–22, 21
  successful platform of, 4
  team engagement in, 16, 17
  technologies in, 5–7
  training. see training
  unification of model data for, 334–337
  value of, 2–4, 8–9
  widespread impact of, 354–356

BIM addenda
agency documents, 65–66
comparison of, 64
development of, 63–64
optimum approach to, 65
summary of, 66–67
unique intent of, 67

BIM and Integrated Design (Deutsch), 83, 148
BIM execution plan
  communication in, 77–79, 78–79
  defining expectations in, 83–85
  history of, 75–77, 76
  information exchange plan in, 81–83, 82
  organizing, 85–88
  overview of, 75
  software and, 79–81, 80–82
  summary of, 89

BIM file maintenance, 329–330
BIM guides, 108

  Information Modeling for Owners, 
  Managers, Designers, Engineers and
  Contractors, 209
BIM kickoff meeting
  bad start to, 137
  collecting right people for, 136–137
  communication/expectation bias at, 139
  creating visions at, 138–139
BIM manager
  creating record BIM files, 318
  evolving role of, 43
  future role of, 351–352
  job requirements of, 352–354
BIM-washing, 93, 93, 99
Bluebeam Revu eXtreme. see digital plan room
Bricklaying System (Gilbreth), 128
Brilliant: The Evolution of Artificial Light (Brox), 176
Brooks Act (1972), 47
building codes and sustainability, 179, 179
building information modeling. see BIM
  (building information modeling)
building rating systems, 177–178, 178
Building the Empire State (Willis), 126
buildingSMART alliance, 345

C
CAD (computer-aided design) files, 314–315, 340
California Commissioning Collaborative, 325
change(s)
  cost of, 51, 51
  management of, 35–36
  resistance to, 258–261
clash detection
  exercise in, 205–207, 205–208
  limitations of, 4–5
  macro to micro focus, 197, 197–198, 208
  model coordination and, 196
  Navisworks and, 196–198, 197
  search set exercise in, 199–205, 200–204
  sequencing conflict in, 211–213, 212–213
  clearance objects, 26
client alignment
  importance of, 117–118
  in marketing BIM, 104–105, 106
closeout. see project closeout
cloud-based model collaboration
  benefits of, 27, 208
  coordinating construction and, 31, 32
  cost estimation via, 24
CMAR (Construction Manager at Risk) delivery method
  advantages/challenges of, 54–55
  BIM in, 55–56
  process of, 52–54, 53
  collaboration
    BIM-related savings and, 44
    with DB delivery method, 58–59
    education fostering, 350
    Empire State Building and, 126
    IPD method promoting, 62
    via web meetings, 236
  co-location, for conflict resolution, 27
color coding systems
  in construction, 228
  project status by, 301–303, 303
Comments, field information in, 243–246, 244–246
The Commercial Real Estate Revolution (Miller, Strombom, Iammarino & Black), 2, 20, 55, 134
commissioning
  definition/value of, 325
  features of, 326–327, 327
  process of, 326
communication
  jobsite offices and, 255
  at kickoff, 139
  between people, 77–79, 78–79
  software systems and, 79–81, 80–81
  comparison, of BIM-enabled projects, 351–352
  composite modeling, 198–199
  computer monitor, for conference room, 253
  computer-aided design (CAD) files, 314–315, 340
  concrete CO₂ emissions, calculating, 179–180
  conference room features, 252–254, 253
  conflict detection/resolution, 26, 26–27
  conflict resolution path, 197
  ConsensusDocs 301, 64, 65
  constant deliverables, 315, 315–317, 316
  constructability, 25–26, 25–27
  constructability review
    Autodesk BIM 360 Glue in, 159–160, 159–163
  details leveraged in, 153–158, 154–157
  overview of, 149–150, 150
  plans leveraged in, 150–153, 151–153
  constructible models, in DB delivery, 60–62
construction activity tracking in, 234, 235
better field information for, 238–239
BIM in, 192–193
changes in, 95
color coding systems in, 228
design and, 139–140, 140
fabrication and, 208–211, 210
feedback loops in, 226–227
field information in, 243–246, 244–246
future trends in, 340–341, 341
installation management in, 228–229
installation verification in, 232–233, 233
managing field issues in, 235–236
model coordination and, 194
safety in, 236–238, 237–238
schedules for, 213–217, 214–215
sequence simulation for, 221–222, 222–226
site coordination and, 194, 194–196
time predictability in, 281
virtual walk-throughs and, 346–349
construction management
BIM and, 15
BIM manager role in, 43
changes and, 35–36
coordination activities in, 31
equipment tracking in, 37–38
future role of, 351–352
history of BIM in, 9–11, 10, 11, 13–14
knowledge management in, 40–42, 41
leadership buy-in of BIM, 42–43
managing facilities, 39–40, 40
materials and, 37
project pursuit in, 16–19, 18
resolving punch lists, 39
scheduling in, 20–22, 21
utilizing mobile devices in, 32, 32–33
value of technology in, 2–4, 9
Construction Manager at Risk method. see CMAR (Construction Manager at Risk) delivery method
construction-ready models, 343–345
contact sheets, 79
contractors
BIM adoption by, 10–11, 10–11, 351
responsibilities of, 344
contracts. see also BIM addenda
design, 319–320
in planning, 19–20
costs
analyzing qualitative, 74–75
BIM-derived estimates of, 23–24, 23–24
controlling, 34–35, 35
of facilities operations, 308, 308–310
of mobile-enabled construction, 33
model-based estimates of. see model-based estimating
of project changes, 51, 51
sharing history of, 171–172, 172
CPM (Critical Path Method) scheduling ineffectiveness of, 33
model-based scheduling and, 282–283
predictability in, 281–282
cross-platform integration, 7
customer-centric service
importance of, 117–118
in marketing BIM, 104–105, 106
customized solution development, 6–7
Cyberwalk omnidirectional treadmill, 346–347
D
data analysis, in BIM, 27–29. see also analysis
daylighting analysis, 184, 186
DB (Design-Build) delivery method
advantages/challenges of, 60
BIM in, 60–62, 61
E-BIMWD addendum for, 65–66
process/features of, 56, 56–60, 59
DBB (Design-Bid-Build) delivery method
advantages/challenges of, 50
BIM in, 50–52, 51
process/features of, 47–50, 48
for record BIM files, 320
DBIA (Design-Build Institute of America), 64, 65–66
DD (Design Development) phase
incremental information for, 140–142, 141–142
timing of information in, 143–145, 144
default settings
custom settings vs., 206
in Navisworks, 219, 222, 222
Defining BIM—What Do Owners Really Want? (Reed), 119
delivery methods
comparison of, 58
Construction Manager at Risk,
52–56
definition of, 46
Design-Bid-Build, 47–52, 48, 51
Design-Build, 56, 56–61, 59, 61
development of, 46–47
expected change in use of, 57, 95
Integrated Project Delivery, 62, 62–63
for record BIM files, 320
team selection and, 96
dependencies, DSM Matrix and, 145–148, 146–148
design
contracts, 319–320
estimating during, 171–175, 172–175
future developments in, 358–359
prioritizing information for, 145–148, 146–148
scheduling, 139–145, 140–142, 144
time predictability in, 281
Design Development phase. see DD (Design Development) phase
Design Development Quality Management Phase Checklist (AIA), 141
Design Management Guide for the Design-Build Environment (Pankow Foundation), 149
Design Structure Matrix. see DSM (Design Structure Matrix)
Design-Bid-Build delivery method. see DBB (Design-Bid-Build) delivery method
Design-Build delivery method. see DB (Design-Build) delivery method
Design-Build Institute of America E-BIMWD, 64, 65–66
Detailed Analysis Plan, 83
details in constructability review, 153–158, 154–157
developing tool, BIM as, 99–101
digital documents, in construction, 32
digital plan room
extracting files in, 274–275, 275
hyperlinking documents in, 275–276, 276
hyperlinking RFI s in, 277–278, 277–278
page labels for, 272–274, 273–274
slip-sheeting in, 278–279, 279–280
tool belt for, 272
direct replacement strategy in selecting technologies, 7
document control
2D information and, 270–272, 271
digital plan room for. see digital plan room
document coordination, 69–71
documents, artifact deliverables as, 310–311, 311
doors, creating
Assemble Systems and, 286–287, 287–288
importing search sets for, 288–290
intuition in, 284–286, 285–286
material status for, 299–301, 300
summary of process, 304, 304
uploading information/barcodes for, 295–298, 296–298
visualizing equipment status for, 301–303, 301–303
Draft Day (movie), 94–95
drones, for safer construction, 237–238
DSM (Design Structure Matrix)
dependency sequence and, 147–148
elements/mapping in, 146
utilizing, 145–148
Dubler, Craig, 84, 139, 259

E

E-BIMWD documents (DBIA), 64, 65–66
education, future of BIM and, 349–351
EERE (Office of Energy Efficiency & Renewable Energy), 180
efficiency in scheduling, 215
Empire State Building
builders of, 125
collaboration and, 126
innovations and, 126–129, 127–128
planning/prefabrication of, 129–132, 130–131
Empire State Building: The Making of a Landmark (Tauranac), 125
enabling behaviors, in successful BIM, 7–8
energy analysis. see also sustainability
Sefaira for, 182–187, 182–188
team input into, 84–85
generated (ETO) components, 209
Entering the Brave, New World (Larson & Golden), 63
environmental delays, 29
equipment
mapping to BIM 360 Field, 291–295, 292–295
tracking, 37–38
estimating
Assemble Systems in, 286–287, 287–288
during design, 171–175, 172–175
discrepancies in, 170–171, 171
model-based, 164–169, 164–169
traditional methods, 163–164
ETO (engineered-to-order) components, 209
Evans, Richard L., 176
expectation bias, 83, 139
expectations, 83–85
extracting files by label, 274–275, 275

F
fabrication with BIM, 208–211, 210
facilities management, 39–40, 40
artifact deliverables in, 310–311, 311, 313, 314–315
benefits of BIM in, 323–325
BIM training for, 332–333
defining LOD in, 321
details, 300, 300
hybrid approach to, 315–317
information management for, 316
life cycle logistics in, 330–332
maintaining BIM files in, 329–330
model maintenance in, 333–334
model-based, 73, 73–74
uploading information for, 295–297
facility operating costs, 308, 308–310
fast delivery, via DB delivery method, 58
feedback loops, 226–227
field issue management
better information for, 238–239
overview of, 235–236, 291
field personnel, BIM training for, 261–262, 263
field-controlled record models, 264–265
file extraction by label, 274–275, 275
file links
  generating, 296, 296
  for video embedding, 250–251, 250–252
file naming conventions, 87–88
five-dimensional BIM. see model-based estimating
flat-panel television, for conference room, 253
flow-line schedule, 282, 283
folder structure, 86–87
Ford, Henry, 124, 128, 132
four-dimensional BIM. see model-based scheduling
Friedman, Thomas L., 258
Fuller, George A., 126
future of BIM
  BIM teamwork and, 354–356, 355
  construction manager role in, 351–354
  education and, 349–351
  industry trends and, 340–341, 341
  interoperability in, 345
  new process in, 356–357
  opportunities in, 97, 357–358, 357–359
  past predictions and, 340
  prefabrication and, 342–343, 342–343
  relationships in, 359–360
  roles/responsibilities in, 343–345
  virtual walk-throughs and, 346–349, 346–349
  future owner challenges, 322, 323

G
G201/G202 documents, 66
Gantt bar scheduling method, 21, 34
Gates, Bill, 240
GBXML (Green Building XML Schema), communication via, 80
glazing, energy analysis of, 182–184, 183–184
Gleason, Duane, 171
Glue application. see Autodesk BIM 360 Glue
GMP (guaranteed maximum price), CMAR delivery and, 53
Goals and Use/Objectives chart, 76, 76
Golden, Kate, 63
Gourley, Sean, 359
Green BIM (Krygiel & Nies), 181
guides, for BIM planning, 19
H

hard bid jobs, integrated projects vs., 96
hardhat barcoding, 37–38
Hardin, Sy, 67
Hoffer, Eric, 7
How Buildings Learn: What Happens After They’re Built (Brand), 359
Howell, Greg, 125
hyperlinked documents, 275–276, 276
hyperlinked RFIs, 277–278, 277–278

I

iMRI (intraoperative magnetic resonance imaging) installation, 265–270
incremental dilemma, 143–145
increments, design
  DD checklist for, 142
  information for, 140–142
  schedule, 141
  timing of information for, 143–145, 144
in-field videos, 236
information
  amount/compilation of, 331–332
  chaos, 144
  Comments for, 243–246, 244–246
  delivery of needed, 336–337
  early exchange of, 17
  future processing of, 359–360
  increased sharing of, 15
  potential methods for, 242, 243
  for record BIM files, 320–321
  Redline Tags for, 248–249, 248–249
  Redlining tool for, 246–247, 247–248
  required for DD, 140–142, 141–142
  risk of too much, 15
  timing of, 143–145, 144
  traditional relaying of, 239–240
information analytics, 27–29
information backbone, 335, 335
information exchange plan
  adoption of, 332
  in BIM execution plan, 81–83, 82
informational database, BIM as, 15
information-centric innovations, 94
innovation
  at AEC Hackathon, 100, 100
  BIM as tool for, 99–101
  challenge of, 101
  creating change, 5
  Empire State Building and, 126–129, 127–128
  growing need for, 352
  importance of, 18–19
The Innovation Paradox (Phillips), 260
installation
  accuracy in, 234
  coordination, 69–71
  management, 228–229
installation verification
  in construction, 210
  laser scanning for, 265–270
  methods for, 232–233, 233
instance properties, 166–167, 167
Integrated Practice in Architecture (Elvin), 2, 254
Integrated Project Delivery method. see IPD (Integrated Project Delivery) method
integrated projects
  BIM for fabrication as, 210
  George A. Fuller Company and, 126
  hard bid jobs vs., 96
integrated teams
  in BIM construction management, 2–3
  in DB delivery method, 61–62
  importance of, 95–96
interoperability
  future role of, 345
  of model data, 334–337
  of technologies, 10, 12
interrelationships, data, 359–360
intraoperative magnetic resonance imaging (iMRI) installation, 265–270
intuition in BIM
  Assemble Systems and, 286–287, 287–288
  creating doors and. see doors, creating development of, 284
  mapping equipment and, 291–295, 292–295
  in visualizing equipment status, 301–303, 301–303
inventory management, 37
IPD (Integrated Project Delivery) method
  advantages/challenges of, 62–63
  BIM in, 63
  process/features of, 62, 62

J

Jackson, Barbara J., 46–47
JIT (just-in-time) approach to material management, 37
job trailer
  as communication hub, 255
  conference room in, 252–254, 253
  plans/specifications hub in, 254
  as server, 254–255
  setting up, 255–256
Jordani, David, 322
JVs (joint ventures), 8

K
kaizen, in creating change, 5
kickoff meeting. see Bim kickoff meeting
knowledge gap, bridging, 261, 261
knowledge management platforms, 40–42, 41

L
labels, page
  creating, 272–274, 273–274
  extracting files by, 274–275, 275
  large computer monitor, for conference room, 253
Larson, Dwight, 63
laser scanning
  BIM overlay and, 35
  installation verification with, 232–233, 233, 265–270
  phased for quality control, 319
lateral brace frame, 70
LBS (location-based scheduling)
  features of, 282, 283
  lean practices and, 229–231
  model-based scheduling and, 282–283
LCI (Lean Construction Institute), 125
Leading Change (Kotter), 138
lean practices
  Empire State Building and. see Empire State Building
  features of, 124, 124–125
  LBSs and, 229–231
LED/LCD flat-panel screen, for conference room, 253
LEED (Leadership in Energy and Environmental Design), 178, 178
Leroy Lettering tool, 134–135, 135
life-cycle building costs, 73, 73
life-cycle information for doors, 76
line-of-balance schedule view, 21
Links tool, 250–251, 250–252
location-based scheduling. see LBS
  (location-based scheduling)
LOD (level of development)
  analysis and, 74–75
  in BIM addenda, 64, 64
  coordination and, 69–70
  cost estimation and, 72
  dangers of undefined, 70–71
  definition of, 68
  facilities management and, 73–74, 321
  level descriptions, 68–69, 70
  matrix, 71
  scheduling, 72, 148–149, 149
logistics
  BIM and, 22–23
  for facilities management, 330–332
The Long Term Costs of Owning and Using Buildings (Evans, Haryott, Haste & Jones), 308
Looking at Type: The Fundamentals (Martin), 284
Luckey, Palmer, 347

M
MacLeamy curve, 51, 51, 141
manufacturing industry, 36, 358
marketing BIM
  client alignment in, 104–105, 106, 117–118
  core deliverables in, 105–107, 107
  demonstrating value, 98–99
  evolution of, 92–94, 93
  guidelines/tips for, 118–120
  innovative proposals in, 118
  key factors in, 97–98
  showing results, 102, 103
  stage of adoption and, 99–101, 100–101
  summary of, 121
  team selection in, 94–96
material management
  overview of, 37
  process of, 228–229, 231–232
  Vico Office for, 232
MATs (multiple analysis test beds), future implementation, 358–359
Max Planck Institute, 346–347
Mazria, Ed, 176
McConahey, Erin, 360
media richness theory, 78
memorandum of understanding (MOU), 20
metrics, justifying ROI, 102, 103
Microsoft Word, 79–80, 80
Miller Act (1935), 47
mobile-enabled construction
  benefits of, 32, 32–33
  controlling schedules with, 33–34
model coordination review, 25
model links, managing field issues, 236
model maintenance, 333–334
model origin, 86
model storage, 86
model-based analysis, 74–75
model-based coordination, 69–71, 70–71
model-based estimating
  discrepancies in, 170–171, 171
  evolution of, 164
  overview of, 72
  process of, 164–169, 165–169
model-based facilities management, 73, 73–74
model-based scheduling
  overview of, 21–23, 72
  simulations, 116, 116–117, 118
  value of, 281, 281–283, 283
modeling
  advanced training, 263–265
  basic training, 263
  composite, 198–199
models
  evolution of, 341
  fabrication of, 208–209
  record, 263–265
  uploading to Glue, 159–160, 159–163
Moore, Rex, 229–231
MOU (memorandum of understanding), 20
multiple analysis test beds (MATs), future implementation, 358–359
Musk, Elon, 35

N
Navisworks. see Autodesk Navisworks
Navisworks Manage, 301–303, 301–303
*The New Quotable Einstein* (Calaprice), 310
NIBS (National Institute of Building Sciences), 336
*Notes on the Construction of the Empire State*, 126–128
NRCA (National Roofing Contractors Association), 153
*The NRCA Roofing Manual: Membrane Roof Systems*, 153, 158

O
object-based parametric modeling technologies, 9–10, 51, 341
OCR (optical character recognition), 272
Oculus Rift AR headset, 115, 347–349
Office of Energy Efficiency & Renewable Energy (EERE), 180
omnidirectional treadmills, 346–348, 346–349
Onuma System, 24, 24
open source programming, 335
opportunities, for BIM, 357–358, 357–359
organizational behaviors, in successful BIM, 8
origin, model, 86
overlays
  installation verification with, 232–233,
  233
  phased for quality control, 319
owners
  benefits of BIM, 317–318, 323–325
  BIM performance and, 260
  challenges for future, 322, 323
  record BIM files for, 318–320, 319
*The Owner’s Dilemma: Driving Success and Innovation in the Design and Construction Industry* (Bryson), 117–118

P
page labels
  creating, 272–274, 273–274
  extracting files by, 274–275, 275
parametric modeling, 11, 51, 341
Parkinson, Robyn Thaxton, 65–66
PDF (Portable Document Format) files
  as artifact deliverables, 311–312, 313
  smart, 116
Penn State BIM Project Execution Planning Guide, 75–77, 84
people, communication between, 77–79
phone calls, 79
photogrammetry, 237–238, 320
pile on method in selecting technologies, 5–6, 10
plan views, 150–153, 151–153
plans
job trailer for specifications and, 254
site logistics and, 188, 188–190, 194, 194–195
using contracts in, 19–20
preconstruction
analysis and. see analysis
BIM kickoff for, 136–139
constructability and. see constructability review
DSM and, 145–148, 146–148
estimates and. see estimating
lean practices and, 124, 124–125
meetings, 136
new technology and, 132–134, 133
planning design in, 139–145, 140–142, 144
planning LOD in, 148–149, 149
site logistic plans in, 188, 188–190
use of BIM in, 134–136, 135
predictability, in construction, 281, 281–282
prefabrication
with BIM, 29–31, 342–343, 342–343
for Empire State Building, 129–132, 130–131
leveraging models for, 357, 357
“The Stack” project, 30
preinstallation meetings, 137
The Principles of Scientific Management
(Taylor), 282, 305
process first strategy in selecting technologies, 6–7
processes
future, 356–357
in successful BIM, 4–5, 5
professionals, value of, 360
Profitable Partnering for Lean Construction
(Cain), 31
project closeout
artifact/constant deliverables in, 329
commissioning in, 325–327, 326–327
overview of, 39–40
punch lists in, 327–329, 328–329
project construction feasibility, 149–150
project management schedules, 20–22
project pursuit
augmented reality simulations, 115, 115
images, in RFP response, 110, 111–112
virtual reality simulations, 113–114
project schedule, team selection and, 96
project visualization, 16, 18
proven tool, BIM as, 99–101
Pull Plan software, 34, 234, 235
punch lists
BIM and, 327–329, 329
managing, 39
model callout, 39
purpose of, 327
in technology comparison, 103
Q
QR codes
BIM 360 Field and, 297–298, 298
comparison of, 299
potential of, 341
R
radio-frequency identification tags. see RFID tags
Real Time Analysis, 182, 183
record BIM files
creating, 318
features of, 318
integrating, 320–321
part of design contract, 319–320
record models
architect-controlled, 264
creating, 263–264
field-controlled, 264–265
third party-controlled, 265
Redline Tags, 248–249, 248–249
Redlining tool, 246–247, 247–248
relationships, future, 359–360
remodeling facilities, future, 359–360
The Republic of Technology: Reflections on Our Future Community (Boorstin), 15
request for proposal response. see RFP (request for proposal) response
requests for information. see RFIs (requests for information)
resource-loaded schedule view, 21
responsibilities
contractor/architect, 344
subcontractors, 344–345
results, of implementing BIM, 102, 103
return on investment (ROI), 102, 107
Revit. see Autodesk Revit
Rex Moore’s production system, 229–231
RFID (radio-frequency identification) tags
comparison of, 299
in construction, 195, 324
in facilities management, 324
RFIs (requests for information)
DBB method and, 49–50
document control of, 270–272, 271
hyperlinking, 277–278, 277–278
limitations of, 239–240
technology comparison, 102, 103
RFP (request for proposal) response
BIM-derived images in, 110, 111–112
other marketing tools in, 116
showing BIM capabilities in, 108–110, 109
simulations in, 112–113, 114
tailor-fit proposals in, 116, 116–117
virtual/augmented reality simulations in,
113–115, 115
RIBA (Royal Institute of British Architects), 345
risk-reducing strategies, 101, 101
ROI (return on investment), 102, 103

S
safety
hardhat barcoding for, 37–38
improving with BIM, 22–23, 236–238, 237–238
Santa Maria Novella, 46, 46
schedule(s)
BIM and, 20–22, 21
class detection with, 211–213, 212–213
collaborative, 34
controlling with BIM/mobile tools, 33–34, 34
creating, 172–175, 172–175
exporting to text file, 171–172, 172
simulations. see simulations
team selection and, 96
scheduling. see also model-based scheduling
animation, 221–226, 221–226
construction, 213–217, 214–215
design, 139–145, 140–142, 144
LOD, 148–149, 149
search sets
creating/attaching, 223–224, 223–224
creating/saving, 286–287, 287–288
importing, 288–290, 288–290
intuitive uses of, 290
Navisworks exercise with, 199–205, 200–204
security cameras, 195–196
Sefaira, for sustainability analysis, 182–187, 182–188
selection bias, 83
The Selection of Communication Media as an
Executive Skill (Lengel & Daft), 77–79
selection sets, 199
sequenced clash detection, 211–213, 212–213
sequencing simulations
in construction scheduling, 216–217
Navisworks creating, 221–226, 221–226
server, job trailer as, 254–255
The 7 Habits of Highly Effective People (Covey), 138
Shreve, Lamb & Harmon, 126
Simpson, Scott, 7
simulations
class detection with, 211–213, 212–213
in RFP response, 112–113, 114
sequencing, 216–217, 221–226, 221–226
virtual/augmented reality, 113–115, 115
site coordination, 194, 194–196
site logistics
BIM and, 22, 22–23
plans, 188, 188–190, 194, 194–195
Skyscrapers and the Men Who Build Them
(Starrett), 129, 135
slip-sheeting, digital, 278–279, 279–280
smart PDFs, 116
SmartMarket reports, 33
BIM use, 150
lean practices, 124–125
Project Delivery Systems, 56
Smith, Al, 125
software systems
communication via, 79–81, 80–81
construction scheduling, 217–221, 218–220
information via, 336
integration/consolidation, 345
learning about, 350
new BIM process and, 356–358
The Spirit of Kaizen: Creating Lasting Excellence One Small Step at a Time (Maurer), 5
The Stack project, 30
Starrett Brothers & Eken collaboration of, 126
Empire State Building and, 125
innovations of, 126–129
planning/prefabrication of, 129–132
Sterner, Carl, 188
Steward, Don, 145
storage, model, 86
subcontractors
BIM performance and, 260
CAD fabrication model by, 61
new responsibilities of, 344–345
sustainability analysis of, 180–181, 181
building codes and, 179, 179
building rating systems and, 177–178, 178
Sefaira analysis of, 182–187, 182–188
swap out method in selecting technologies, 6

tablet devices, in construction, 32, 32
takeoff, model-based estimating as, 72
Taylor, Frederick Winslow, 281–282
team engagement, 16, 17
team integration
in BIM construction management, 2–3
in DB delivery method, 61–62
importance of, 95–96
team selection
future importance of, 351, 354–356
for marketing BIM, 94–96
technical expertise, 96
technology(ies)
adopting new, 132–134, 133
client’s requirements, 96
in construction management, 2–4
contractors adopting, 10–11, 10–12, 13
innovators, 352
selecting proper, 17–18
in successful BIM, 5–7
wearable, 22
templates, in BIM planning, 19

third party-controlled record models, 265
three-dimensional BIM, 15, 50–52
three-dimensional printers, 30–31, 116	hree-dimensional tools, 15
three-legged stool of BIM, 4
time predictability in construction, 281
To Sell Is Human (Pink), 117
Today and Tomorrow (Ford), 124, 128, 132
tool belt, for digital plan room, 272
tools, for BIM planning, 19–20
touch-screen LED TV, in conference room, 253
The Toyota Way (Liker), 133–134
TPS (Toyota Production System), 133–134
training
advanced, 263–264
basic, 263
facility managers, 332–333
field personnel, 261–262, 263
uses of BIM, 265
trending, cost, 172–175, 173–175
Triumph of the Lean Production System (Krafcik), 124
trust, DB delivery method and, 58–59, 59
2010 Buildings Energy Data Book (Dept. of Energy), 176, 177
The 2030 Challenge, 176–177
type properties, in Revit schedules, 165–167, 166–167

Umstot, David, 104–105, 108
USGBC (United States Green Building Council), 178, 178

value, demonstrable, 98–99
VDC (virtual design and construction) BIM, 209–210, 210
VDE (virtual desktop environment) solutions, 341
video embedding, links for, 250–251, 250–252
Virtual Builders certification, 360–361, 361
virtual construction manager. see BIM manager

*Virtual Design and Construction: New Opportunities for Leadership* (Bedrick), 319

virtual modeling, 68–69
virtual walk-throughs, 346–349, 346–349
Virtuix Omni’s omnidirectional treadmill, 348, 348–349

visions, creating, 138–139

VR (virtual reality) simulations, 113–115, 115

**W**

waterproofing details in design, 153–158, 154–157

WBS (work breakdown structure), 230

*The World Is Flat: A Brief History of the Twenty-first Century* (Friedman), 159

worry-free owners, in DB delivery method, 57–58