Index

4D modeling, 393–419
5D modeling, 398–399

A

Accelerated schedule, 236–237, 360–361
Accelerating projects. See Schedule compression
Activities
adding or deleting from schedule, 168–169
in arrow networks, 24, 25
in bar charts, 16, 19, 20
critical, in precedence diagrams, 96–97, 100, 110–118
critical, in precedence diagrams, 96–97, 100, 110–118
dangling, in precedence diagrams, 104–106
definition of, 16, 20, 63
dummy, in arrow networks, 25–32
durations of, determining in CPM, 51–52
float of. See Float
delaying, in subprojects, 3
interruptible, in precedence diagrams, 97, 100–102, 105, 110–117
splitting, 97, 118, 145, 431
stretching, 115
uninterruptible, in precedence diagrams. See contiguous activities
Activity on arrow (AOA) networks. See Arrow networks
Activity on node (AON) networks. See Node networks
Actual cost, 56, 188, 194, 199–200, 202, 256, 278, 283
Actual cost for work performed (ACWP), 199–200, 202
Adjudication, 358
Arbitration for delay claim resolution, 357–358
Arrow diagraming method (ADM). See Arrow networks
Arrow networks, 24–32, 34–35, 38, 39
dummy activities and, 25–32
event times in, 77–79
logic of, 25, 28, 29
node networks compared with, 38
notation for, 25
redundancies and, 31–32
As-built schedules, 17, 167, 320, 351, 359
As-of date, 160
As-planned schedules, 9, 10, 16–17, 19, 157–158, 167, 350, 360
Auto updating, 165
Autodesk Navisworks, 400

B

Backup plans for presentations, 255
Backward pass, 59–63, 78, 79, 112
Backward resource leveling, 144
Bar charts, 16–21
advantages of, 19–20, 39
disadvantages of, 20–21
effective use of, 39–40
networks versus, 39
Baseline, 8–10, 55, 156
Baseline budgets, 56, 157, 159, 188, 201
Baseline duration percent complete method for determining percent complete for entire project, 185, 189
Beginning-of-day convention, 58
Bid unbalancing, 196
Body language in presentations, 255, 264
Budgeted cost for work performed (BCWP), 199, 202
Budgeted cost for work scheduled (BCWS), 198, 202
Budgets
assigning in computer scheduling programs, 128–129
baseline, 56, 157, 159, 188, 201
Budget spending method for determining percent complete for entire project, 188, 195
Buffer, 318, 320
Calculated finish date, 53, 79, 100, 118, 180
Calendars, 52, 74, 378
resource, 161
Calendar units, 52
Cash flow, 9, 10, 39, 76–77, 82, 148, 230, 238, 350, 390
Central limit theorem, 293
Certification, 11–12
Change orders, 9, 10, 98, 158, 214, 243, 260
delay claims and, 345, 346, 348, 353
risk and, 371, 382
scheduling and, 280–281
Claim Digger, 181
Clarity of communication, 248
Communication. See also Presentations; Reports
good, characteristics of, 248–252
improving for schedule compression, 244
in international environment, 263–264
Comparison schedules, 181, 188, 191, 360
Compensable delays, 344, 347, 349
Concurrent delays, 350, 358
Constraints, 52, 75–76, 81–84, 161, 215, 351, 378
logic, 145, 362
overuse of, 351
resource, 20, 53, 143, 362
Constructability, 98, 216–217, 382, 389
Construction equipment and materials, 146
Construction industry, PERT and, 308
Continguous activities in precedence diagrams, 100, 110–118
Contingency fees, 225, 278
Continuous/Interruptible/Stretched, 323–324
Contract candidate presentations, 253
Contractor-created float, 183
Control of projects, See Project control
Correspondence, 260, 262, 284, 355, 355, 359
Cost accounting, 56, 278
Cost-loaded schedules, 174, 272, 278, 280
Cost ratio method for determining percent complete for individual activities, 185, 188
Cost
actual, 56, 188, 202, 256, 278, 283
actual this period, 172
direct, 224–231, 237, 245
front-end loading, 146, 196, 238
holding, 149
indirect, 224–231, 237, 245, 274
normal, 225–231
order, 149
purchase, 149
shortage (unavailability), 149
total, 149, 188, 228–231, 235, 236, 277, 279
Cost Multipliers, 242–244
Cost/schedule systems criteria (C/SCSC), 197
Cost this period, 167, 172, 196, 259, 280
Cost to complete, 196, 259, 280
Cost to date, 167, 185, 188, 196, 259
Crash cost, 229, 230, 232–237
Crash duration, 229, 230, 232–237
Critical path, 62–63
costs in, 182
definition of, 64
in PERT, 303
Critical path method (CPM), 9, 10, 20, 46, 47, 96, 146, 156, 214, 273, 292, 330, 368
additional steps and, 54–56
beginning-of-day and end-of-day, 58
conventions and, 58
with computer software programs, 62
delay claims and, 350
event times in arrow networks and, 77–79
imposed finish date’s effect on schedule and, 79–81
lags and leads in, 71–74
logic and constraints and, 81–84
logic networks and, 58–61
node diagrams and, 65, 67–68
node format and, 70–71
resource allocation (loading) and leveling and, 56–57
steps required to complete a project and, 47–53
Crystal Ball, 308

D

Daily log, 354, 359
Damages, 478
exemplary, 213
liquidated, 183, 212–214, 386
punitive, 213
Dangling activities in precedence diagrams, 104–105
Database, revising, 56
Data date, 159–162, 166, 167, 172, 175, 179–181, 189, 190, 192, 193, 306, 320, 324
Dates
as-of, 160
calculating with certain level of confidence, 293–295, 306, 376
using PERT, 306–307
crash, 60, 61, 63, 64, 70–71, 75–76, 104, 111–112, 146–147, 285, 353, 361
effect on cash flow, 76–77
finish. See Finish date
late, 61, 63, 64, 70–71, 76–77, 96, 104–105, 111–112, 147, 361
start. See Start date
status, 160
Degressing, 167–168
Delay claims, 9, 70, 344, 350–353, 358–359
change orders and, 345, 346, 348, 350, 353, 359
CPM schedules and, 350–353, 358–359
definition of, 344
float ownership and, 361
prevention of, 353–355
reasons for, 346–348
resolution of, 353–355
types of delays resulting in, 349–350
Demonstration presentations, 253
Design development (DD), 98, 159, 177, 264, 275
Design errors or omissions, delay claims and, 347
Digger. See Claim Digger
Direct costs, 224–231, 237, 245
Dispute review boards (DRBs), for delay claim resolution, 356–357
Distance buffer, 311–312
Documentation, of project schedules, 251, 352–356
double-restricted float, 109
at completion, 179–180, 189, 332, 334–337, 339
base, 242
baseline, 189
crash, 229–230, 238, 238, 237
deterministic, 371
expected, 294, 297, 303–306
fluffed, 288–289
general uncertainty, 371–372
least-cost, 228–230, 238, 237
most likely, 294, 296, 297, 303–306, 372
normal, 213, 225, 228–230, 236
optimistic, 293, 294, 296, 297, 303, 304, 372
optimum, 240
original, 70–71, 167, 168, 172, 177, 178, 190, 192, 335–340
pessimistic, 294, 296, 297, 303, 304, 372
remaining, 71, 160, 165, 172, 175, 177, 179–180, 189, 190, 192, 332, 335–340
risk-adjusted, 376
three-point estimate, 372–373, 379, 383, 385, 389
total, 22, 79, 185, 192–194, 227
uncertainty, 372–373
unrealistic, 352
Duration percent complete method for determining percent complete for entire project, 185, 189, 191, 194
Dynamic Minimum Lag, 330–340
E
Early finish (EF) date, 60, 64, 71, 75–76, 181
Early start (ES) date, 60, 64, 66, 68, 69, 71, 76
Earned value (EV), 197–199, 202
Earned value analysis (EVA), 191, 197–198
S curves and, 202
vs CPM, 202
Earned value management (EVM), 128, 197
Electronic reports. See E-reports
End-of-day convention, 58
Enterprise breakdown structure (EBS), 285, 287
Equipment costs, 275
Equivalent units method for determining percent complete for individual activities, 186–187, 190
E-reports, 262
Estimate at completion (EAC), 56, 202
Estimate-generated schedules, 275–277
Estimate to completion (ETC), 56
Estimating
cost accounting and, 56, 278–279
evolution of cost estimates and, 273–275
scheduling and, 271–278
Events in arrow networks, 24–25, 38
definition of, 64
Event times in arrow networks, 77–79
Excusable delays, 349
Exemplary damages, 213
Expected duration, 294, 297, 303–306
Expected value, 387–388
Eye contact in presentations, 254
Fast tracking, 47, 97–99, 159, 215–216, 230
Feedback, recording, 56, 177
Financial resources, 124
Finish date calculated, 53, 79, 100, 118, 180
determining probability using PERT, 292–296
early, definition of, 63
imposed, 63, 79, 161, 214
late, definition of, 64
Finish milestones, 25, 64
Finish-restricted float, 108–110
Finish-to-finish (FF) relationships, in precedence networks, 95, 101
Finish-to-start (FS) relationships in precedence networks, 95
start-to-start relationships versus, 215
bonus, 79
Index

Float (continued)
contractor-created, 183
double-restricted, 109
event, 79
finish-restricted, 109
forensic, 318
free, 66–72, 75, 104, 112, 320, 361
hidden, 288
independent, 69, 75, 361
interfering (Int. F), 66, 70, 75, 361
management, 288
negative, 79, 181, 249, 288
ownership of, 75, 363, 366
restriced, 108, 113
sequester, 378
single-restricted, 109–110
start-finish-restricted. See Double-restricted
start-restricted, 108–110
total, 61, 64, 66, 68, 69, 71, 72, 75, 76, 79,
104, 109, 112, 181, 236, 256, 287, 318, 361, 378
unrestricted, 101, 109
Force majeure, 214, 348–349, 361
Formality of communication, 250–251
Forward pass, 58–62, 64, 102, 106, 111
Forward resource leveling, 134, 144
Free float (FF), 66–72, 75, 104, 112, 320, 361
Front-end loading the cost, 146, 196, 238

G
Gantt charts. See Bar charts
Gap, 318
General contractors, resource leveling from perspective of,
146–147
General overhead, 224–225
Graphic evaluation and review technique (GERT),
309–310
Graphical math method (GPM), 318–322

H
Hard logic, 53
Holding costs, 149
Holidays, 52, 263, 287, 288
Honesty in presentations, 254
Hub activity, 82
Human resources, 124, 226, 283

I
I-J method. See Arrow networks
Impacted schedules, 360
Imposed finish date, 68, 79–80, 161, 214
Incentives for schedule compression, 8, 219
Incremental milestones method for determining percent complete, 185
Independent float (Ind. F), 69, 75, 361–362
Indirect cost, schedule compression and, 224, 228
Indirect costs, 224–228, 237, 273
Industry standards, communication and, 251
Installed equipment and materials, 124–125, 224
Integrated Project Delivery, 417, 419, 420
Interfering float (Int. F), 66, 69, 75, 361
International Organization for Standardization (ISO), 251
Interruptible activities in precedence diagrams, 97,
100–102, 105, 110–117
Inventory buffer theory, 149

J
Job diary, 354
Job overhead, 224–225, 278
Just-in-time theory, 149

L
Labor, 4, 53, 56–57, 124
Lags in computer software, 74
in CPM networks, 34–35, 71–74
in precedence networks, 95–96, 105
Late dates, late, 61, 63, 64, 70–71, 76, 96, 104–105, 111, 112, 147, 361
Late finish (LF) date, 61, 64, 75
Late start (LS) date, 60, 64, 144, 362
Lazy designer syndrome, 249
Lazy S curves, 17
Leads in computer software, 74
in CPM networks, 34–35, 71–74
in precedence networks, 96, 98, 105
Lean construction, 217, 418–419
Least-cost duration, 228–229, 230, 237
Legibility of communication, 249–250
Level of confidence, 293–295, 305–306, 368, 376, 390
LinearPlus Time Chainage Charts, 317
Linear scheduling method (LSM), 310
software programs for, 317–318
steps for building schedules using, 311
Liquidated damages, 183, 212–214, 386
Litigation for delay claim resolution, 358
Logic constraints and, 81–84
hard, 53
retained, schedule updating and, 118, 164–165, 324
soft, 53
Logical relationships, determining in CPM, 52–53, 311
Logic diagrams, time-scaled, 40–41
Logic loops, 54–55
Logic networks
with CPM, 58–61
CPM and, 62–63
Look-ahead schedule, 256

M

Macromanagement, 286–287
Management float, 288
Management presentations, 253
Manager Space. See Work space
Man-hour ratio method for determining percent complete for individual activities, 185, 188
Manufacturing, 216, 220–223, 417
Master schedule, 53, 146–147, 284–286
Materials costs, 149–151, 277
Materials, 56, 124–125
Materials management, 148–151
Mediation for delay claim resolution, 356
Meeting minutes, 260, 355
Meridian Prolog Manager, 251, 259, 281, 353
Micromanagement, 286
Microsoft (MS) Project activity notes and, 184
combination relationships and, 95, 252
eliminating total float using, 76
GPM and, 320
manual suspension of activities using, 110
node format, 70–71
percent complete lag approach, 96–97
plotting CPM networks using, 62, 259
project name and, 261
risk analysis and, 309
schedule editing in, 181
subactivities and, 186–187
WBS and, 187
Milestone. See Finish milestones and Start milestones
Minimum moment approach, 129
Missing relationships, 54
Model based scheduling, 393–419
Modified/retained/progress override logic, 324
Monitoring
project control and, 10, 55, 156–157. See also Project control
Monte Carlo simulations, 308, 372–379, 383, 385, 388
Most likely duration, 294, 296, 297, 303–306, 372
Multiproject management, 286–287
Multiproject resource leveling, 126–128

N

Near-critical activities, 182
Near-critical path, 284, 306, 379, 389
Needs of client, focus on, 254
Negotiation for delay claim resolution, 356
NetPoint, 320–321
Networks, 24–41
arrow. See Arrow networks
bar charts versus, 39–40
definition of, 24
node. See Node networks
precedence. See Precedence networks
Node format, 70–71
Node networks, 32–38
arrow networks compared with, 38
CPM and, 58–61
drawing, recommendations for, 35–38
lags and leads and, 34–35
Noncompensable delays, 349–350
Nonexcusable delays, 344, 349
Nonworkdays, 52, 263, 287–290
Normal cost, 149
Normal duration, 213, 225, 228–231, 236

O

Optimistic duration, 293–306, 372
Optimum scheduling, 240–244
Oracle. See Primavera Project Manager
Oracle Risk Analysis. See PERTmaster
Order costs, 149
Organizational breakdown structure (OBS), 287
Organization of communication, 250–251
Overhead, 9, 163, 224–225, 228, 272–273, 278
general, 224–225
project (job), 225
Owner’s requirements, changes in, delay claims and, 348

P

Paperless project management, 281
Parallel predecessors, 99–100
Pay requests. See Requests for payment
Pay requisition. See Requests for payment
Payment requests, updating schedules and, 165–167
Payment requisition. See Requests for payment
Percent complete. See Work progress, measuring
Percent complete lag approach, 96–97
PERTmaster, 309, 325, 373
Pessimistic duration, 293–306, 372
Photos of important events, 355
PlaNet+, 317
Plant, 124
Planned shutdown days, 287
Planning
definition of, 2
scheduling related to, 4–5
Portfólio, 3
Portfólio manager, 286
Index

Precedence networks, 92–118
  contiguous activities in, 110–114
  CPM calculations for, 100–117
  definition of, 92
  fast-track projects and, 97–99
  interruptible activities in, 100–110
  parallel predecessors and, 99–100
  percent complete approach to, 96–97
  types of relationships in, 95–96

Preciseness of communication, 249

Predecessors, parallel, 99–100

Presentations
  to field people, bar charts for, 39
  to high-level staff, bar charts for, 40
  power of, 255–257
  reports versus, 252–254
  skills necessary for giving, 254–255

Primavera Contract Manager, 251, 259

Primavera Expedition. See Primavera Contract Manager

Primavera P3e, 285. See also Primavera Project Manager P6

Primavera Project Manager (P6), 11, 57, 75, 260
  activity notes and, 184
  Actual Cost This Period column in, 172
  baselines created by, 159
  dissolve an Activity function of, 168
  EBS and, 285
  listing of activities using, 54, 105
  logic violations and, 164–165
  multi-project management, 286–287
  necking bars, 17, 18
  percent complete approach using, 96–97
  precautions with, 181, 252
  resource distribution and, 145–146
  schedule names in, 261
  suspend activities, 110
  undo function, 260
  updating schedules using, 172, 179–180
  weight within activities and, 187, 190

Primavera Project Planner (P3), 57, 110, 145–146, 252, 285

Primavera SureTrak Project Manager, 184, 265
  printing reports, 266
  reviewing before and after, 257–258
  tips for, 258–259
  Probability density function, 296
  Probability universe, 296
  procurement management, 281–283
  procurement records, 355
  productivity multipliers (PM), 242, 243
  profit, 225
  pro formas, 7
  program, 3
  Program Evaluation and Review Technique (PERT), 292–309
  approach of, 293
  background of, 292
  calculating date of event with certain level of confidence using, 306
  calculations for, 293–295
  concept of, 292–293
  construction industry and, 308
  critical path in, 303
  definition of, 292
  determining probability of certain project finish date (multi-path) using, 307
  graphic explanation of, 296
  most likely versus expected durations and, 303
  project-scheduling software and, 308–309

Progress override, schedule updating and, 118, 164–165, 324

Progress payments, 10, 184, 191, 195–196, 272, 280

Primavera Expedition. See Primavera Contract Manager

Primavera P3e, 285. See also Primavera Project Manager P6

Priority, 280

Program evaluation and review technique (PERT), 292–309

R

Rain days, 52

Recovery schedules, 214, 231, 360–361

Redundancies in arrow networks, 31–32
Redundant relationships, 54, 169, 379

Relationships
  combination, 95–102, 252, 334, 341
driving, 41, 63, 96, 101, 138, 379
  external, 285
  in precedence networks, 92–96
  stair-type, 98

Relationship diagramming method (RDM), 322–325

Relevance of communication, 249

Reports
  e-mailing, 250
  paper versus electronic, 259–262
  presentations versus, 252–254
  reviewing before and after printing, 257–258
  summary, 259
  tips for printing, 258–259

Requests for information (RFIs), 220–221, 260, 281

Requests for payment, 10, 165–167, 195–196, 259, 281

Requests for proposal (RFPs), 260, 345

Resource allocation, 56–57, 115, 125, 143, 272, 361

Resource constraints, 53, 143

Resource-driven schedules, 57, 129, 389

Resource leveling, 57, 75, 77, 125–148
  backward, 144
  budgeting and, 128
  definition of, 125
  example of, 129–143
  forward, 144
  from general contractor’s perspective, 146–147
  multiproject, 126
  reasons for, 125

Resource loading, 57, 125

  categories of, 124–125. See also Equipment; Labor; Materials
  financial, 124
  human, 226, 283
  increasing for schedule compression, 219

Retainage, 165, 196, 264, 279, 355

Retained logic, schedule updating and, 118, 164–165, 324

Retrievability, communication and, 250–251

@Risk, 373

RIB Itwo, 417

Risk Register, 371–378, 382–385, 389

Risk shifting, 376, 379–380

S

Sales presentations, 253

Schedule acceleration. See Schedule compression

Schedule compression, 212
  choosing method for, 225–226
  computers for, 236–237
costs and, 224–231
  techniques for, 215–221
  potential problems with, 237–238
  priority setting and, 213
  process of, 222–223
  reasons for, 213–214
  recovery schedules and, 231

Schedule contingencies, 287

Schedule crashing, 213

Schedule of values, 195, 272, 280

Schedulers, knowledge needed by, 10–12

Schedules
  accelerated, 236–237, 360–361
  as-built, 17–18, 167, 320, 351, 359
  as-planned, 9, 16, 19, 157–158, 167, 350, 360
  common mistakes in, 54–55
  comparison, 181, 360
  cost-loaded, 174, 272, 278, 280
documentation of, 353–356
  estimate-generated, 275–277
evolution of, 273–275
  impacted, 360
  implementing, 55
  imposed finish date’s effect on, 79–81
  linear scheduling method for building. See Linear scheduling method (LSM)
  look-ahead, 256
  master, 53, 146–147, 284–286
  monitoring and controlling, 10, 55, 156–157
  recovery, 214, 231, 360–361
  resource-driven, 57, 129, 389
  reviewing and analyzing, 54–55
  subschedules, 284–286
  summary, 159, 275
  updated, 159–160

Schedule updating, 156
  adding and deleting activities and, 168–169
  auto updating and, 165
  baseline schedules and, 157–159
  changes in critical path and, 182
  contractor-created float and, 183
  data and information and, 184
  data date and, 160
  frequency of, 162–163
  information needed for, 160–162
  need for, 156
  pay requests and, 165–167
  remaining duration, importance of updating, 179–180
  retained logic versus progress override and, 164–165
  steps for, 172–177
  updated schedules and, 159–160

Scheduling
  change orders and, 280–281
  cost accounting and, 278–280
definition of, 4
  estimating and, 271–278
Index

Scheduling (continued)
  planning related to, 4
  reasons for, 8–10
Schematic design, 264
Scope-creep syndrome, 345
Scope definition, 6, 345
S curves
  in earned value analysis, 202
  lazy, 17, 18
Selection Tree, 398, 408–411
Settlements for delay claim resolution, 357
Shortage costs, 149
Simplicity of communication, 248–249
Single-restricted float (SRF), 109–110
Site conditions, delay claims and, 347
Slack. See Float
Soft logic, 53
Software packages. See Microsoft Project; Primavera
  Contract Manager; Primavera Project Manager (P6); Primavera Project Planner (P3); Primavera SureTrak
  Project
Speaking in presentations, 255
Spider Project PM System, 317
Stair-type relationships, 93
Start date, early, 60, 64, 68–70, 75
Start-finish method, for determining percent complete for
  individual activities, 185
Start milestones, 25, 64
Start-restricted float, 108–110
Start-to-finish (SF) relationships, in precedence networks, 96
Start-to-start (SS) relationships
  finish-to-start relationships versus, 215
  in precedence networks, 95–96
Status date, 160
Subcontractors, costs of, 195–196, 224
Submittal records, 354
Submittals, management of, 283–284
Subproject, 3
Subschedules, 146, 284–286
Substantial completion, 8, 25, 64, 82, 293
Successor activities in arrow networks, 25
Summary reports, 259
Summary schedules, 159, 275
Supervision, improving for schedule compression, 220
Supervisor’s opinion method for determining percent
  complete, 185
Support tools for communication, 250

T

Target schedules, 157
Tasks
  in bar charts, 16
  definition of activity, 34–35
  determining work activities, 47
  WBS defined, 49
TILOS, 317
Timberline Project Management, 251, 259, 281, 353
Time buffer, 311
Time contingency, 79, 287–290
Time ratio method for determining percent complete for
  individual activities, 185
Time-scaled logic diagrams, 40–41
Toastmasters International, 255
Total cost, schedule compression and, 228–229
Total float (TF). See Float
TransCon XPosition, 317
Transmittal records, 354

U

Unavailability costs, 149
Uninterruptible activities in precedence diagrams. See
  Contiguous Activities
Units completed method for determining percent complete
  for entire project, 187–191
  for individual activities, 184–187
Unrestricted float, 101, 109
Updated schedules, 159–160

V

Value engineering (VE), 98, 216–217
Vico Control™, 317
Visibility of materials in presentations, 254
Vis à vis major, 349

W

Weather, delay claims and, 348, 349
Weighted units method for determining
  percent complete for individual activities, 185
Work breakdown structures (WBSs), 40, 49–50, 187, 202,
  286, 355–356, 377
Workdays, 52, 161, 263
Workday unit method for determining percent complete for
  entire project, 189–190
Work progress, measuring,
  percent complete determination methods for entire
  project and, 187–191
  percent complete determination methods for individual
  activities and, 184–187
  progress payments and percent complete and, 195–197
Work space, 164–165
Wrong relationships, 54

Z

Z function, 294
ZIP files, 262