Company Index

3M, 121

A&W, 141 Abitibi Consolidated, 4, 352, 595 Acadian Bakers, 114 ACCPAC, 491 AccuRate, 499 AEC Software, 642 AECL, 120 Aerospace Welding, 489 Agricore United, 442, 588 Air Canada, 30, 53, 160, 163, 179-180, 609 Air Terminal Restaurants, 141 Airline Manufacturing, 545 Alberta Wheat Pool, 442, 588 Alcan, 166 Alcan Cable, 326 Alcoa, 166, 284 Algoma Steel, 192 Allen-Bradley, 196 Allied Domecq PLC, 609 Allied Signal, 330 Alt-C Systems Inc., 94 Amazon.com, 621-623 American Express, 330, 338 American Express Canada, 256 American Production and Inventory Control Society (APICS), 5, 399 American Society for Quality (ASQ), 6, 305 AMP Canada, 323-324 Apple Computer, 19, 123 Ariba, 610 Association for Operations Management, 5 AT&T, 338 AT&T Canada, 245 Atlantic Superstore, 52 Ault Foods, 94 Ax and Ryder Grocery Services, 27

B. C. Hot House Foods, 400
Baan, 59
Bank of Boston, 713
Bank of Canada, 84
Bank of Montreal, 621
BASF, 55
Bass PLC, 581–583
Bay, The, 51
BC Hydro, 245
Beatrice Foods, 94, 598
Bell Canada, 245, 706
Bell Company, 691
Bell Telephone Labs, 18, 305

Bike Friday, 442
Black & Decker, 121, 548, 549
Boeing, 205, 330
Boise Cascade, 616
Bombardier, 31, 76, 243, 611
Booz, Allen & Hamilton, 635
British Energy, 169
Browns Restaurant, 581–583
Building Inspection Authority of
New Zealand, 699
Burger King, 31, 46, 141, 183
Burnham Logistics, 598

Cadillac, 31 Cami Automotive, 591 Campbell Soup, 589, 597 Canadian Airlines, 179–180 Canadian Armed Forces, 632 Canadian Centre for Occupational Health and Safety, 255 Canadian Food Inspection Agency, 320 Canadian Operational Research Society (CORS), 6 Canadian Pacific Hotels and Resorts, 315 Canfor, 282 Canon, 338 Cara Operations Ltd., 141, 279, 294-295 Cardiac Care Network, 702 Cargill Limited, 323 Case, 250 Cash & Carry, 52 Catalyst Manufacturing, 393 Caterpillar, 59 Celestica, 4, 525, 528 Chesapeake Decision Sciences, 466 Children's Hospital Medical

Center, 466

CIBC, 283

Circle K, 590

Coca-Cola, 31

Coleman, 121

Commisso's, 26

Compaq Direct, 94

Connaught Labs, 245

Compaq, 254, 627, 631

Cognex Corp., 354

Circles Inc., 287

City of Edmonton, 502

City of Montreal, 245

City of Winnipeg, 245

Clearwater Fine Foods, 621

Colgate-Palmolive Co., 59, 90

Chinook Health Region, 595, 613

Coopers & Lybrand, 200
COSS Manufacturing
System, 489
Costco, 32, 596
Couche-Tard, 590
CP/Delta Hotels, 31
Crystal Reports, 487, 489
Cummins Engine Company,
279–280, 338

DaimlerChrysler Canada, 256
Dairyworld Foods, 245
Dana Corporation, 531
Decision Sciences Institute, 6
Decoma, 243, 256, 257

Dana Corporation, 531 Decision Sciences Institute, 6 Decoma, 243, 256, 257 Dell Computers, 38, 39, 124, 191, 528 Delta Hotels, 256, 305, 315 Deltek (Welcom), 628, 655, 663-664 Digital Payment Technologies Corp., 122 Disney World, 683, 685 Diversicare Canada Management Services, 310 DMD Enterprises, 521 Dofasco Steel, 23, 256 Domino's Pizza, 31 Dow Chemicals, 55 DuPont, 447, 449, 635 DuPont Merck Pharmaceutical Company, 447, 449

EGAD Bottling Company, 481 Electramedia, 642 Eli Lilly Canada, 4, 393 Eli Lilly Company, 269 Ellis-Don Ltd., 638 EMCO, 630 EXE, 27 Exide, 541 Extra Foods, 52

Duracell, 59, 64

Federal Cooperatives Ltd., 208
Federal Express, 333, 598, 599
Federated Co-op, 391
Ferrero, 288
Fleetguard, 279–280
Flex-o-mark, 344–345
Florida Power and Light, 338
Foodland, 26
Food Town, 26
Foothills Hospital, 162
Ford Motor Company, 50,
193, 210, 258, 283–284, 309,
311, 392

Fortino's, 52 Franklin Corp., 239 Futuretek-Bathurst Tool Inc., 485

Ganong Brothers, 286 Garden Market, 26 Garrison Guitars, 126 GDLS-Canada, 628 GE Canada, 120 GE Information Services, 595 General Dynamics, 4 General Dynamics Land System—Canada, 628 General Electric Company, 313, 330, 351 General Motors, 123, 193, 353, 591 Gillette, 121 Globeco, 288 Good Humor Breyers, 4, 598 Good Samaritan Medical Center, 467 Grand & Toy Company, 616 Great Canadian Bagel Company, The, 186, 444 Great Western Brewing Company, 186 Greenbrier Companies, 453 Grocery Gateway, 27, 180

Harley-Davidson, 351, 371 Harvey's, 141, 279, 295 Hawker Siddeley Group, 326-327 Health Canada, 256 Herman Miller Inc., 548, 556 Hershey Canada, 245 Hershey Foods, 338 Hertz, 30 Hewlett-Packard, 120, 124, 129, 338, 589, 601, 609-610, 627, 631 Hi-Bek Precision Spring Company, 184-186 Highliner Foods, 282, 508 Hiram Walker & Sons, 609 Home Depot, 55, 180, 391, 414, 596 Honda Canada Inc., 508 Honda Motor Company, 287, 305, 320, 337 Honeywell, 611 Hudon & Deaudelin, 597 Hudson Bay Mining and Smelting, 245 Hudson's Bay Company. See also Bay, The, 3, 16, 51, 605, 606

H. J. Heinz Co. of Canada, 245

736

Huronia District Hospital, 454 Hydro Quebec, 245

IBM, 31, 123, 528 IBM Canada, 316 IGA, 26, 247 IGA Cybermarket, 27 Ikon Office Solutions, 508-509 Imperial Bondware, 372 Inco, 285-286, 316 Independent, 52 IndustriOS Software Inc., 485 Ingersoll-Rand, 387 Institute of Business Forecasting, 91 Institute of Industrial Engineers, 6 International Harvester, 250 International Olympic Committee, 627 Interuniversity Services Inc., 610 IPSCO Inc., 285

J. D. Edwards, 509 John Deere Co., 121, 193 Jubilee Ford, 238–239

Kenworth, 188 KFC, 36 Kimberly-Clark, 121, 601 Kingsway Financial Services Company, 121 Knechtel, 26 Kodak, 31, 338 KPMG, 287 Kubota, 529

L'eBiz, 605 L.L. Bean, 324, 338 Lands' End, 456 Lawton Drugstores, 26 Lear Canada, 311 Learjet, 611 Les Marchés Boni choix, 26 Lexmark, 550 Lexus, 31 Linamar Corporation, 356 Loblaws Companies Ltd., 3, 26, 30, 33, 52, 391 Lockheed Aircraft, 635 London Drugs, 31 Longo Brothers, 180 Lourdes Hospital, 720 Lucas Industries PLC, 326-327 Lucent, 528 Lucky Dollar Stores, 53

Mac's, 590
MacDonald Dettwiler, 120
Mackie Automotive Systems, 539
MacMillan Bloedel, 282
Macronix International, 561
Manitoba Pool Elevators, 588
Manugistics, 61
MapInfo, 294
Marchés Tradition, 26

INDEX

Maritime Steel and

Foundries, 181 Mark's Work Wearhouse, 443-444 Marriott, 302 Mary Kay Cosmetics, 85 MasterCard, 53 Maxi, 52 McCain Foods, 281 McCormick, 63 McCormick Canada Inc., 141 McDonald's, 31, 33, 141, 183, 191, 198, 219, 548, 570 McDonnell & Miller, 538 McGill University, 617 McGraw-Hill Ryerson, 394 MDKS Infinity, 491 Mercedes-Benz Canada, 642 Merck, 447, 449 Methods Engineering Council, 264 Microanalytics, 294 Microsoft, 605, 642-721, 655-658 Midas Canada, 590 Miller SQA, 548, 556 Mississauga Hydro, 397 Mitsubishi, 167, 550, 611 Molson Breweries, 94, 186 Motorola Corporation, 339 Mountain Equipment Co-op, 613

N. B. Telephone Company, 283
Nabisco, 601
National Quality Institute (NQI), 256, 316
National Steel Car, 453
Natrel, 598
Navistar, 376
NCR, 256
Needs Convenience Store, 26
New Balance Athletic Shoe
Inc., 19
New Zealand Works Consultancy
Services, 699

Inc., 19
New Zealand Works Consultan Services, 699
Nexgen Ergonomics, 254
Nielsen, 64, 90
Nissan, 305
Nortel Networks, 60, 117, 120, 142–143, 525, 601, 720
North Oaks Medical Center, 467

North Shore-Long Island Jewish Health System, 374 North Simcoe Hospital Alliance, 454

Nova Corp., 616 Novartis, 121

Nygard International, 587, 596, 606

Ocean Spray, 59–61, 450 Optical Gaging Products, 353 Oracle, 509 Oregon Freeze Dry, 566–567 Oshawa Foods, 597 Oshawa Group, 26, 247

PACCAR, 188 Paradox Design, 140 Parmalat Canada, 94 PBB Global Logistics, 598, 601 Pechiney, 166 PeopleSoft, 509, 627 Pepsi-Cola, 31 Peterbilt, 188 Petro-Canada, 609 Pfaudler, 558 PHH Fantus Corp., 73 Phoenix Mutual, 699 Pillsbury Company, 320 Pizza Hut, 31 Potash Corporation of Saskatchewan Inc., 37, 161, 196 Pratt & Whitney Canada, 323-324, 539-541 Price Chopper, 26

Price/Costco, 596 Primavera Project Planner, 651, 655, 659–663

Procter & Gamble, 338, 601 Production and Operations Management Society

(POMS), 6 Project Management Institute (PMI), 6

Purchasing Management Association of Canada (PMAC), 5, 614

Provigo, 52

Purolator, 31, 598, 599

Q-Matic, 694 QLogitek, 605 Queen Elizabeth II Health Science Centre, 162

Raymond Industrial Equipment, 540 Real Canadian Superstore, The, 31, 52 Reckitt & Colman Canada, 597 Red Cross, 288 Redpath Sugar Refinery, 189 Relex Software, 152 Remington Rand Corporation, 635 Research in Motion, 121, 129 Reynolds Aluminum, 166 Robert Bowden Inc., 553 Rockwell Collins, 611 Roctel Manufacturing, 356 Rohm & Haas, 55 Rotor Clips Company, 354 Royal Bank, 316 Royal Columbian Hospital, 162 Ryder System, 591

Ryder Trucks, 598

Sanmina Canada, 601 SAP (Systeme, Anwendungen, Produkt), 27, 505, 509 Saskatchewan Crop Insurance, 245 Saturn, 591 SeaQuest, 490 Sears Canada, 596 Sears, Roebuck and Co., 596 Secura Insurance Co., 200 SERCA, 26 Shell Chemical, 466 Shell Refinery, 245 Short Brothers, 611 Shuttle Craft, 285 Six Flags, 683, 692 SKF Canada, 312 SMED International, 508 Sobeys, 3, 26-27, 180, 247, 508, 597 Sony, 31 Source Medical Corporation, 595 Spar Aerospace, 120 St. Mary's Hospital Centre, 617 Standard Aero, 4, 39, 206, 305, 326-327 Statistics Canada, 256 Steelcase Canada, 323-324 Sterling Pulp Chemicals, 59 Stickley Furniture, 186, 521-523 Stone Consolidated, 4, 300-301 Summit Food Services Distributors, 141 Sunrise Spas, 491 Canada (SCL), 5

Sunrise Spas, 491
Supply Chain and Logistics
Canada (SCL), 5
Suzuki, 591
Swiss Chalet, 141, 279, 295
Sylvania Lighting, 198, 201
SynQuest, 557
Sysco, 26

Taichung, 611
Tate & Lyle, 189

Taylor Software, 550 TD Canada Trust, 26 Telus, 256 Tembec Paperboard Group, 639 Tesma, 125 Thought-Works Software Solutions, 572 Tibbett & Britten, 27 Timex Corp., 368 Toronto Transit Commission, 651 Toyoda Gosei Co. Ltd., 537 Toyota Motor Company, 23, 218, 287, 305, 338, 415, 525, 531, 537 Toys "R" Us, 599 TransFreight Inc., 591 TrentonWorks, 453 Trinity Railcar Co., 453

Zontec, 372

U.S. Air Force, 551
U.S. Navy Special Projects
Office, 635
Unigraphics Solutions, 223
United Grain Growers, 588
United Parcel Service (UPS), 598, 599
University of Alberta
Hospital, 338
University of Calgary, 616
University of Toronto, 508
UPD Manufacturing, 443

ste51675_index.qxd 3/13/2008 7:31 PM Page 737

UPS. See United Parcel Service (UPS)

Valmont Industries Inc., 564 Valu-Mart, 52 Victoria's Secret, 598

Wal-Mart, 3, 51, 55, 391, 589, 595, 596, 601, 605 Warburtons Ltd., 588 Warner Air Logistics Center, 551 Waterville TG, 537 WDG Consulting, 280
Welch's, 481
Welcom Software Technology, 628, 655
Wendy's, 183
Wescast, 484, 504
Western Union, 26
WestJet, 30, 31, 33, 53, 123, 137, 160
Weyerhauser, 282
Whirlpool, 603
Whirlpool Appliance, 596

Wilson Machine, 540
Wilson Sporting Goods, 36
Woolco, 51

Xerox Corporation, 31, 324, 338
Xwave, 632

York Central Hospital, 162, 595

Zehrs Markets, 52
Zellers, 3, 51–60

Subject Index

3-Point Estimates method, 645	marginal analysis, 460
See probabilistic time	mathematical techniques,
estimates	464–468
5S principles of housekeeping,	trade-off method, 460
539–540	transportation model, 464-46
5W2H approach, 339	aggregation, 451
80-20 rule, 332	agile manufacturing, 23
	agility, 23
A-B-C classification,	airline capacity, 163
397 –399, 597	Akao, Yoji, 136
acceptance sampling, 351	algorithms, project management
accident prevention, 253-254	and, 639–640
accounting, 9	allowance, 260
action limits, 88	alpha risk, 359
activities, 636	aluminum industry, capacity
activity slack times, 644	in, 166
activity-based costing, 532	andon, 538
activity-on-arrow (AOA), 636,	annual service level, 418
640–642	APICS, 486
activity-on-node (AON),	appointment systems, 568
636 , 642	appraisal costs, 311
additive model, 76	Arnone, J., 284
aggregate (operations) planning	assembly, 4, 187
aggregation, concept of, 451	assembly diagram, 488
basic strategies for uneven	assembly lines, 187, 203
demand, 454	assignable variation, 357
capacity options, 453	associative forecasting technique
capacity, and, 451	correlation, 84–85
chase demand strategy, 455	curvilinear regression
choice of strategy, 455	analysis, 86
company policy and strategy	least squares line, 82
choice, 455	multiple regression
costs and choice strategy, 455	analysis, 86
defined, 448	predictor variables, 81
demand, 451	regression, 81–86
demand options, 452-454	simple linear regression,
disaggregation of aggregate	82–85
plan, 468–469	associative models, 62
general procedure, 456	attributes, control charts for,
inputs, 452	365–367
level output strategy, 455	automated inspection, 353
master schedule, 468,	automation
471–472	advantages of, 192-193
necessity of, 451	Allen-Bradley system, 196
overview, 451	competitiveness and, 192
perspective, in, 448-450	computer-integrated
purpose and scope, 451-455	manufacturing (CIM), 193
rough-cut capacity planning,	defined, 191
468	degree of, 192
services, in, 466	direct numerical control
techniques. See aggregate	(DNC), 194
planning techniques	fixed automation, 193
trial-and-error, 457	flexible automation, 194-195
aggregate planning techniques	flexible manufacturing system
general procedure, 456	(FMS), 195
informal techniques, 456–463	numerically controlled (N/C)

linear programming, 464, 466

```
analysis, 460
tical techniques,
168
method, 460
ation model, 464-468
451
cturing, 23
ity, 163
136
project management
-640
60
59
dustry, capacity
ice level, 418
systems, 568
sts, 311
84
187
agram, 488
nes, 187, 203
ariation, 357
orecasting techniques
on, 84–85
ar regression
sis, 86
ares line, 82
regression
sis, 86
variables, 81
n, 81–86
near regression,
models, 62
ntrol charts for.
spection, 353
es of, 192-193
adley system, 196
iveness and, 192
-integrated
facturing (CIM), 195
191
f, 192
merical control
2), 194
omation, 193
utomation, 194–195
nanufacturing system
), 195
```

machines, 193

```
programmable automation,
       193-194
   robots, 193-194
   services, 192
autonomation, 530
availability, 152
available-to-promise (ATP)
   inventory, 470-472
average, 64
averaging techniques
   exponential smoothing, 69-70
   moving average, 66-68
   weighted moving average,
   68-69
back orders, aggregate planning
   and, 452
backward pass, 642
backward scheduling, 554
balance delay, 214
balance sheet approach, 340
Baldrige Award, 316
Banham, R., 285
bank teller staffing, 684
bar codes, 395, 396
batch inventory systems, 395
batch processing, 186–187
Beddoe, Clive, 53
behavioural approach to job
   design, 243, 244-245
benchmarking, 338
beta distribution, 645
Beversluis, W. S., 480
bill of materials (BOM), 488–491
Billington, C., 603n
bonus, 271
bottleneck, 46, 166, 500, 566
brainstorming, 337
break-even analysis, 170-173
break-even point (BEP), 170
Brown, Dick, 453
BSI OHSAS 18000, 254
Bulfin, R. L., 532n
bullwhip effect, 603-604
Burch, E. E., 480
Burns, D. M., 439n
business organizations
   accounting, 9
   distribution, 9
   distributive competencies, 36
   finance function, 8
   functions, 6-9
   human resources department, 9
   industrial engineering, 9
   maintenance, 9
   management information
       systems (MIS), 9
```

```
marketing function, 8
   mission, 32-34
   mission statement, 32-34
   operations function, 6-8
   public relations, 9
   purchasing, 9
business plan, 449
business strategy, 33
business to business (B2B)
   e-commerce, 599
business to customer (B2C)
   e-commerce, 599
Butler, M. P., 73n
C_p, 372–373
C_{pk}, 373
c-chart, 367-368
c-control charts, 367
Canada Awards for Excellence,
   316, 317
Canadian Centre for Occupational
   Health and Safety, 252, 255
Canadian Environmental
   Protection Act, 126
Canadian Labour Code, 250
capability analysis, 369-373
capacity, 35
   aggregate planning, 451
   aggregate planning, and, 451
   alternatives, 165-167
   aluminum industry, in, 166
   availability of inputs, and, 161
   balance, 166
   bottlenecks, 166
   Canadian hospitals, utilization
      in, 162
   "chunks," 166
   defined, 160
   definitions of, 161-162
   delivery speed, and, 161
   design capacity, 161, 163-165
   determinants of effective
      capacity, 163
   effective capacity, 162, 163
   imbalance, 166
   limitations, 166
   make or buy decisions,
      and, 183
   measurement of, 161
   service capacity, 167-168
   utilization, 161
capacity cushion, 166
capacity options
   aggregate planning, and, 453
   hire and layoff workers, 453
```

inventories, 454

overtime/slack time, 453

part-time workers, 454	company policy, 455	p-chart, 366, 367	cumulative trauma disorders, 255
subcontracting, 454	compensation	plotting errors on, 89	Currie, Richard J., 30, 52–53
capacity planning, 3	bonus, 271	quality tool, as, 333	curvilinear regression analysis, 86
basic questions, 160	group incentive plans, 271	range control charts	customer satisfaction
"big picture" approach, 166	importance in work system	(R-charts), 362–363, 365	quality focus, and, 23
break-even analysis, 170-173	design, 270	sample size, 370	specific goal, as, 323
break-even point (BEP), 170	individual incentive plans,	tails of distribution, 359	customer service, 30
decision theory, 174	271–272	time-ordered plot, 358	inventory management,
development of capacity	output-based (incentive)	Type I error, 359	and, 393
alternatives, 165-167	systems, 270	Type II error, 359	quality, and, 311
financial analysis, 173	profit/gain sharing, 271	upper control limit (UCL), 358	customers
flexibility in systems, 165	skill/knowledge-based pay, 271	variables, 359, 360–363	supply chain management,
importance of capacity	straight piecework, 271	control limits	and, 589
decisions, 160–161	team approach, 271	defined, 359, 370	waiting lines, and, 683
location decisions for	time-based systems, 270	determination of, 360–369	customized output, 11
expansion, 280	competitive benchmarking, 324	variability of process output,	cycle counting, 399
long-term considerations,	competitive bidding, 612	and, 370	cycle stock, 392
163–165	competitive edge, 37	core teams, 117	cycle time, 211
optimal operating level	competitiveness	correlation, 84–85	cycles, 65, 81
identification of, 167	automation, and, 192	correlation coefficient (r^2) , 84	5 11 5 11/25 11/25
rough-cut capacity	defined, 30	cost accounting, and JIT	Dawkins, David "Marty," 521
planning, 468	delivery speed and, 161	systems, 531	decentralized purchasing,
service capacity, 167–168	productivity, and, 41	cost control, 23	612- 613
short-term considerations,	component commentary, 129	costs	decision making
163–165	component scheduling, 525	aggregate planning, and, 455	based on facts vs. opinions, 325
smoothing out capacity	computer aided design (CAD),	appraisal costs, 311	capacity planning, and, 174
requirements, 165–167	127–128	carrying costs, 511	ethics, 16
variability in demand, 166	computer integrated	excess cost, 422	make or buy decisions, 183
waiting line analysis, 174, 702 capacity requirements	manufacturing (CIM), 195	failure costs, 311	models, 14–15, 18–19 operations manager, and, 14–16
planning, 502–504	computer software ERP, 508	fixed, 170	Pareto phenomenon, 15
Carroll, Vince, 651	geographical information	holding costs, 396 information, and inventory	priorities, establishment of, 15
carrying costs, 396	system (GIS), 349	management, 396	project management, in, 629
cash flow, 173	location-analysis, 349	make or buy decisions,	quantitative approaches,
cause-and-effect diagram, 334	process layouts, 223	and, 183	14–15
cell, 206	project management, 655–664	opportunity cost, 453	systems approach, 15
cellular layouts	computer viruses, 45	ordering costs, 396	trade-off analysis, 15
cellular manufacturing, 206	computerized staff scheduling, 572	prevention costs, 312	decision theory. See decision
group technology, 206–207	concept, 117	projects, 627	making
cellular manufacturing, 206	concurrent engineering, 118, 127	quality, of, 311	decoupling operations, 392
central limit theorem, 357	consensus, 340	shortage costs, 396–397, 422	delayed differentiation,
centralized inspection, 355	constant lead time, 420-421	step, 171	124, 605
centralized purchasing, 612-613	consumer surveys, 63	transportation, 220, 282, 605	delivery, fast, 30
centre of gravity method,	continual system, 395	variable, 170	Dell, Michael, 38
292 –294	continuous improvement, 324,	Cote, M. J., 429n	Delphi method, 63
centred moving average, 78	338, 529	CPM (critical path method)	demand, 66
certainty, cash flow estimates,	continuous processing, 188	defined, 635	aggregate planning, and, 452
in, 174	continuous product replenishment	deterministic time estimates,	dependent, 484
chance variation, 356	(CPR) applications, 595	637–638	forecasts, 396
changes, 498	control, 7	network conventions,	independent, 484
chase demand strategy, 455	control chart, 554	636–638	make or buy decisions,
Chato, Paul, 642	alpha risk, 359	network diagram, 636-637	and, 183
check sheets, 331	attributes, 365–367	craft production, 16	timing of, 167–168
Clark Timothy, 335	c-chart, 367–368	crash, 651–654	uneven, 454–455
Clark, Andrew, 335	commonly used, 360	crashing, 651–654	variability, 166
closeness ratings, 222	control limits, 359	critical activities, 637	variable demand, 420–421
collaborative planning,	defined, 88 , 333 , 358	critical control points, 321	demand amplification, 603
forecasting, and	design of, 360–361	critical path, 637	demand options
replenishment (CPFR), 601	individual units, 363–365	Crosby, Philip B., 306, 314–315,	aggregate planning, and,
combination layouts, 206	lower control limit (LCL), 358	314 <i>n</i>	452–454
comfort band, 252	managerial considerations, 369 mean control chart,	cross-docking, 605	back orders, 452 new demand, 453
common variability, 356 community considerations, and	360–361, 365	cross-functional teams, 117	pricing, 452–454
location, 286	moving range charts, 363–365	cross-training, 218, 531 cumulative lead time, 487	promotion, 452
1000011, 200	moving range charts, 303 -303	cumulative icau tille, 40/	Promotion, 152

Deming Prize, 312	external factors, 163	executive opinions, 63	flexible working time
Deming wheel, 327	facilities factors, 163	expert opinions, 63	arrangements, 246
Deming, W. Edwards, 306,	human factors, 163	expertise, and make or buy	flow-shop scheduling, 548
312, 357	operational factors, 163	decisions, 183	flow systems, 548
· · · · · · · · · · · · · · · · · · ·	•		•
dependent demand, 484	product/service factors, 163	Exponential distribution, 687,	flowcharts, 331
depth skills, 271	effectiveness, 4	688–689	following tasks, 215
design capacity	efficiency, 4	exponential double	Food and Drug Acts, 126
defined, 161	defined, 162	smoothing, 74	Ford, Henry, 18
requirements, determination	vs. productivity, 46	exponential smoothing, 69–70	forecasting, 3
of, 163–165	efficiency school of job	export, vs. overseas	approaches, 62
	•		* *
design characteristics, 206	design, 243	manufacturing, 285–286	associative forecasting
design for assembly	efficient consumer response	external failures, 311	techniques, 81–86
(DFA), 129	(ECR), 596		averaging techniques, 66–70
design for manufacturing	electricity supply in Canada, 169	fabrication, 4	computers in, 93
(DFM), 129	electronic data interchange	facility, 35	cost and accuracy, 90
design of experiments, 375	(EDI), 19	factor rating, 291	steps in process, 62
		fail-safing, 325	
design specification, 369	defined, 594	0.	supply chain management,
determinants of quality, 363–364	efficient consumer response	failure, 125	and, 589
deterministic activity durations	(ECR), 596	failure costs, 311	techniques, 15, 90–92
637 –638	quick response, 595-596	Fawcett, B., 271 <i>n</i>	technological forecasting, 64
dimensions of product	elemental times	feed-forward effect, 604	time series analysis. See time
quality, 306	historical, 263	feedback, 7	series models
± • • •	predetermined, 264–266	feedback effect, 604	
dimensions of quality, 306	1		trend techniques, 70–73
direct numerical control	employee	Feigenbaum, Armand, 306, 313	uses of, 59–60
(DNC), 194	motivation, 4	fill rate, 418	forecasts
disaggregation of aggregate	training, 4	finance function, 8	absolute value, 87n
plan, 468–469	employee empowerment, 324	financial analysis, and capacity	accuracy of, 86
distinctive competencies, 36, 37	enterprise resource planning.	planning, 173	associative models, 62
distribution, 9	See ERP (enterprise resource	Fine, C. H., 34 <i>n</i>	common features, 60–61
distribution requirements	planning)	finite loading, 553	consumer surveys, 63
planning (DRP), 596	environmental issues, 23	finite-source queuing models,	control chart, 88, 89
division of labour, 17	environmentally responsible	708–713	control of, 86, 87–90
Dodge, H. F., 305	manufacturing, 23	finite-source situation, 686	defined, 59
drum-buffer-rope pull system,	equivalent interest rate, 174	first-come, first-served (FCFS)	Delphi method, 63
564, 566	ergonomics, 254–255	basis, 690	demand forecasts, 396
· · · · · · · · · · · · · · · · · · ·	=		
Duplaga, E. A., 533n	Erlang, A. K., 683	fishbone diagram, 334	elements of a good forecast, 62
dynamic line balancing, 218	ERP (enterprise resource	Fisher, Marshall, 589n	error, 86
dynamic scheduler, 548	planning), 19	fitness, 126	executive opinions, 63
	ABCs of, 506–507	fitness for use, 307	expert opinions, 63
e-business, 21	configuration of software, 508	fixed automation, 193	high forecasts, 86
e-commerce, 599	costs of, 507	fixed costs, 170	historical analogies, 63
supply chain management, 589	defined, 504	fixed order-interval (FOI)	judgment-based, 62
		` '	
e-procurement, 616–617	described, 484, 506–507	model	judgmental forecasts, 62
early supplier involvement, 616	hidden costs, 507	benefits of, 421	mean absolute deviation
earned value analysis, 654	implementations of,	constant lead time, 420-421	(MAD), 86
economic lot sizes, 392	508-509	defined, 419	mean squared error (MSE), 86
economic order quantity (EOQ)	length of project, 507	described, 395	naive forecast, 66
basic EOQ model, 399–404	performance, and, 507	disadvantages of, 421	salesforce opinions, 63
	=		
defined, 399	errors	order amount, determination	sources of errors, 88
economic production quantity	defined, 86	of, 420–421	time horizon, 61
(EPQ), 404–406	mean squared error (MSE), 86	reasons to use, 419–421	time series models. See time
lot sizing and, 500	predictability of, 89	variable demand, 420-421	series models
planned shortages, 410–412	sources of, 88	fixed-order-quantity/reorder-	uses of, 59-60, 93
quantity discounts, 407–410	Type I error, 359	point model, 395	foreign companies in Canada,
	Type II error, 359		
reorder point (ROP), 412–416	21	fixed-period ordering, 501	287–288
service level, 412, 416–419	ethical behaviour, 23, 30	fixed-position layouts, 206	foreign locations, 284–285
shortage amount, 416–419	ethics	flexibility	forward pass, 642
economic production quantity	decision making, and, 16	building in, 93	forward scheduling, 544
(EPQ), 404–406	product design, 126	defined, 30	Free Trade Agreement (FTA), 22
economies of scale, 16, 167	project management, 631	systems, as capacity	from-to-charts, 220
Edison, Thomas, 17	purchasing, 613	alternative, in, 165	Fulscher, J., 199n
effective capacity	service design, 126	flexible automation, 194–195	functional strategy, 33
defined, 161	events, 636	flexible manufacturing system	functions within business
determinants of, 163	excess cost, 422	(FMS), 195	organizations, 6–9

742

Galbraith, Bill, 453	Hout, Thomas, 38	cycle stock, 392	inventory-transportation cost
Gantt charts, 18, 551, 554, 634	human relations movement, 18	defined, 391	trade-off, 605
Gantt, Henry, 18, 551	human resources, 35	economic lot sizes, 392	irregular variations, 65
Garg, A., 276n	human resources department, 9	formulas, summary of, 426	Ishikawa diagram, 334
Garvin, David, 362n	humidity, 252	functions of, 391–393	Ishikawa, Kaoru, 315
General Agreement on Tariffs	Huse, Edgar F., 277	importance of, 391–393	ISO 14000 , 254, 319 –320
and Trade (GATT), 22	Hustwick, K. B., 440	management of, 4	ISO 9000 , 254, 316 –319, 615
general-purpose equipment, 205		nature of, 391–393	
geographical information	idea generation methods	order cycle, 392	Janssen, J. J., 254
system (GIS), 294	5W2H approach, 339	replenishment cycle, 392	Japan
Gilbreth, Frank, 17, 248, 249	benchmarking, 338	safety stocks, 392	andon, 538
Gilbreth, Lillian, 17, 248, 249	brainstorming, 337	seasonal inventories, 392	Deming Prize, 312
global supply chain, 598	interviewing, 338	supply chain management,	just-in-time systems, 525
globalization	quality circles, 337	and, 589	kaizen, 324
export, vs. overseas	IDEF method, 199–200	vendor-managed, 596	manufacturing, influence
manufacturing, 285–286	illumination, 252	work-in-process inventory, 530	of, 19
foreign locations, 284–285	incentive plans, 45	inventory counting systems,	strategies, 38
supply chain management, 589	incentive systems, 270	395–396	jidoka, 530
trend, 22	incoming shipments, 593–594	inventory management	job design
goals, 33	independence, 648	A-B-C classification, 397–399	behavioural approach,
Gobeli, D. H., 120 <i>n</i>	independent demand, 484	batch systems, 395	244–245
Goldratt, Eliyahu M., 566	independent events, 146	classification system, 397–399	behavioural school, 243
goods, services vs., 11	indicators, 84	continual system, 395	defined, 243
goods-oriented, 6	individual incentive plans,	cost information, 396	efficiency school, 243
Groover, Mikell, P., 218n	271–272	costs of ordering and carrying	factors affecting, 243–244
gross requirements, 493	industrial engineering, 9	inventories, and, 393	Healthy Workplace
	Industrial Revolution, 16–17		
group incentive plans, 271	infinite loading, 553	customer service, and, 393	award, 256
group technology, 206–207, 529	infinite loading, 555	cycle counting, 399 demand forecasts, 396	job enlargement, 244
Grover, Varun, 37n		· · · · · · · · · · · · · · · · · · ·	job enrichment, 245
II-11 I D 544	informal aggregate planning	fixed order-interval model,	job rotation, 244
Hall, J. D., 544	techniques, 456–463	395, 419–421	methods analysis, 246–255
Harris, F.W., 18	information technology, 21–23	fixed-order-quantity/reorder	motion study, 248–250
Harvest Triumphant, 18	information velocity, 602	point model, 395	motivation, 245
Hax, A. C., 34n	Inman, R. R., 532 <i>n</i>	inventory counting systems,	specialization, 243
hazard analysis critical control	input-output (I/O) control, 554	395–396	teams, 246
point (HAACP), 320–322	inspection	lead-time information, 396	working conditions, 250–255
Hazardous Products Act, 126	acceptance sampling, 351	min/max system, 410	job enlargement, 244
Healthy Workplace award, 256	amount of, 353	online systems, 395	job enrichment, 245
Hertzberg, Frederick, 18	automated, 353	periodic system, 395	job flow time, 556
heuristics	centralized, 355	perpetual inventory system,	job lateness, 556
process layouts, 221–222	defined, 351	395	job rotation, 244
product layout, 213	frequency of, 353	point-of-sale (POS)	job shop, 183 –185
hierarchy, 33	inspection points, 355	systems, 396	job-shop scheduling, 551
high-volume systems, and	on-site, 355	reorder point (ROP), 412–416	Johnson's rule, 560
scheduling, 548–549	process control, 351	replenishment models,	Johnson, S. M., 560n
Hill, Terry, 31	Integrated DEFinition method,	395–396	Jordan, H. H., 480
histograms, 332	199–200	requirements for, 394	judgmental forecasts, 62
historical analogies, 63	interchangable parts, 17	requirements for effective	Juran, Joseph M., 306, 313
historical elemental times, 263	intermediate planning.	inventory management,	just-in-time systems
historical evolution of operations	See aggregate planning	394–399	activity-based costing, 532
management	intermediate-volume systems, and	safety stocks, 412	andon, 538
craft production, 16	scheduling, 549	service level, 412, 416–419	autonomation, 530
decision models, 18–19	intermittent processing, 205	shortage amount, 416–419	close supplier relationships, 538
human relations movement, 18	internal failures, 311	single-period model, 421–425	continuous improvement, 532
Industrial Revolution, 16-17	internal rate of return (IRR), 174	systems, 394	cost accounting, 531
Japanese manufacturers,	Internet	two-bin system, 395	cross-trained workers, 531
influence of, 19	business trend, as, 21	Universal Product Code	defined, 525
management science, 18-19	e-business, 21	(UPC), 396	development of, 525
scientific management, 17	e-commerce, 599	warehouse examples, 397	dynamic line balancing,
holding costs, 396	e-procurement, 616-617	when to reorder with EOQ	and, 218
horizontal loading, 544	interviewing, 338	ordering, 412–419	housekeeping, 539-540
horizontal skills, 271	intuitive rules, 213	inventory techniques, 15	inventory storage, 530-531
hourly systems, 270	inventory	inventory turnover, 394	jidoka, 530
housekeeping, 539–540	aggregate planning, and, 454	inventory velocity, 602	JIT deliveries, 597

least squares line, 82

Lee, Hau L., 603n

INDEX **743**

kanbans, 536–537	landiamas	landing desirions	1am malmus anatama and
11	legal issues	location decisions	low-volume systems, and
leadership, 532	product design, 126	capacity expansion, 280	scheduling, 551–554
level loading, 532–533	product liability, 126	city downtown locations, 287	lower control limit (LCL), 358
manufacturing cells, 529	service design, 126	community considerations, 286	M D 11 D (10
manufacturing planning and	level (average), 64	evaluation of alternatives,	MacDonald, Ron, 610
control, 532–541	level capacity loading, 532	288–294	machine shops, 205
mixed-model sequencing, 533	level loading, 532–533	factors affecting, 281–282	Magretta, J., 38
MRP, vs., 525	level output strategy, 455	foreign companies, by,	maintenance
personnel/organizational	life cycle, 122 –123, 190–191, 628	287–288	business organizations and, 9
elements, 531–532	line balancing, 549	foreign locations, 284–285	preventive maintenance, 204,
philosophy, as, 525	balance delay, 214	general procedure, 280–281	539–540
preventive maintenance,	benefits of, 211	labour factors, 283	make or buy decisions, 183,
539–540	cross-training, 218	markets, location of, 282–283	610–611
process design, 527–531	cycle time, 211	nature of, 279–280	makespan, 556
product design, 525–527	defined, 211	necessity, 282	Maknoni, Fardin, 630
production flexibility, 530	dynamic line balancing, 218	need for, 279	Malhotra, Manof K., 37n
pull systems, 535–536	effectiveness measures, 214	objectives of, 280	management
quality and, 527	efficiency of line, 214	perishability, 282	control charts, and, 369
quality improvement, 530	following tasks, 215	raw materials, location of,	just-in-time systems,
setup times, 528–529	guidelines for, 214–216	281–282	and, 532
small lot sizes, 527	heuristic rules, 213	regional factors, 282–284	minimization of scheduling
visual systems, 538–539	human factors, 217	retail, 286–287	problems, 564–565
work-in-process inventory, 530	mixed model line, 219	service, 286–287	project manager, 630–631
workers as assets, 531	other approaches, 217–218	site-related factors, 286–287	quality, and, 323, 366
L 224 529 520	parallel workstations, 217	strategic importance of, 279	waiting lines and, 683
kaizen, 324 , 528, 530	percentage of idle time, 214	supply chain, and, 280	management information systems
kanbans, 536 –537	positional weight, 215	taxes and, 284	(MIS), 4, 8
Kano model, 137	precedence network, 213	transportation costs, 282	management science, 18–19
Kelly, J. E., 727	preceding tasks, 215	utilities, location of,	manning charts, 570, 572
knowledge-based pay, 271	process, 211	281–282, 284	manufacturability, 128
Kyoto agreement, 23	technical considerations, 217	locational break-even analysis,	manufacturing
labour	technological constraints,	289 –290	agile, 23
	214–216	logistics, 9	characteristics, 206
factor in location decision,	linear programming, 14, 464, 466	continuous product	designing for. See product
as, 283	linear trend equation, 71–73	replenishment (CPR)	design
productivity growth, 42	list reduction, 340	applications, 595	environmentally responsible
Lansley, David, 609–610 layout	Little's Formula, 692 load chart, 551	defined, 591	manufacturing, 23
layout		diatailestias sa serimase auto	Innanaga influence of 10
callular layouts 206, 207		distribution requirements	Japanese, influence of, 19
cellular layouts, 206–207	load reports, 503	planning (DRP), 596	overseas, vs. export, 285–286
combination layouts, 206	load reports, 503 loading	planning (DRP), 596 electronic data interchange	overseas, vs. export, 285–286 service operations, vs., 11–13
combination layouts, 206 fixed-position layouts, 206	load reports, 503 loading defined, 551	planning (DRP), 596 electronic data interchange (EDI), 594–596	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems,
combination layouts, 206 fixed-position layouts, 206 general approach to	load reports, 503 loading defined, 551 finite loading, 553	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209 planning need, 203	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553 input-output (I/O) control, 544	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594 JIT deliveries, 597	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier relationships, 538
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209 planning need, 203 process layouts, 205–206,	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553 input-output (I/O) control, 544 load chart, 551	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594 JIT deliveries, 597 movement within a	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier relationships, 538 manufacturing planning and
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209 planning need, 203 process layouts, 205–206, 219–223	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553 input-output (I/O) control, 544 load chart, 551 schedule chart, 544, 551	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594 JIT deliveries, 597 movement within a facility, 593	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier relationships, 538 manufacturing planning and housekeeping, 539–540
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209 planning need, 203 process layouts, 205–206, 219–223 product layouts, 204, 209–219	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553 input-output (I/O) control, 544 load chart, 551 schedule chart, 544, 551 vertical loading, 544	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594 JIT deliveries, 597 movement within a facility, 593 outgoing shipments, 593–594	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier relationships, 538 manufacturing planning and housekeeping, 539–540 just-in-time systems, and,
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209 planning need, 203 process layouts, 205–206, 219–223 product layouts, 204, 209–219 retail layouts, 208	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553 input-output (I/O) control, 544 load chart, 551 schedule chart, 544, 551 vertical loading, 544 location	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594 JIT deliveries, 597 movement within a facility, 593 outgoing shipments, 593–594 supply chain management,	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier relationships, 538 manufacturing planning and housekeeping, 539–540 just-in-time systems, and, 532–541
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209 planning need, 203 process layouts, 205–206, 219–223 product layouts, 204, 209–219 retail layouts, 208 service layouts, 208	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553 input-output (I/O) control, 544 load chart, 551 schedule chart, 544, 551 vertical loading, 544 location defined, 31	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594 JIT deliveries, 597 movement within a facility, 593 outgoing shipments, 593–594 supply chain management, and, 590	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier relationships, 538 manufacturing planning and housekeeping, 539–540 just-in-time systems, and, 532–541 level loading, 532–533
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209 planning need, 203 process layouts, 205–206, 219–223 product layouts, 204, 209–219 retail layouts, 208 service layouts, 208 storage layout, 208	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553 input-output (I/O) control, 544 load chart, 551 schedule chart, 544, 551 vertical loading, 544 location defined, 31 supply chain management,	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594 JIT deliveries, 597 movement within a facility, 593 outgoing shipments, 593–594 supply chain management, and, 590 traffic management, 593–594	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier relationships, 538 manufacturing planning and housekeeping, 539–540 just-in-time systems, and, 532–541 level loading, 532–533 preventive maintenance,
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209 planning need, 203 process layouts, 205–206, 219–223 product layouts, 204, 209–219 retail layouts, 208 service layouts, 208 service layouts, 208 supermarket design, 209	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553 input-output (I/O) control, 544 load chart, 551 schedule chart, 544, 551 vertical loading, 544 location defined, 31 supply chain management, and, 590	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594 JIT deliveries, 597 movement within a facility, 593 outgoing shipments, 593–594 supply chain management, and, 590 traffic management, 593–594 vertical acquisitions and	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier relationships, 538 manufacturing planning and housekeeping, 539–540 just-in-time systems, and, 532–541 level loading, 532–533 preventive maintenance, 539–540
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209 planning need, 203 process layouts, 205–206, 219–223 product layouts, 204, 209–219 retail layouts, 208 service layouts, 208 service layouts, 208 supermarket design, 209 U-shaped layouts, 206–207	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553 input-output (I/O) control, 544 load chart, 551 schedule chart, 544, 551 vertical loading, 544 location defined, 31 supply chain management, and, 590 location alternatives evaluation	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594 JIT deliveries, 597 movement within a facility, 593 outgoing shipments, 593–594 supply chain management, and, 590 traffic management, 593–594 vertical acquisitions and partnerships, 599	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier relationships, 538 manufacturing planning and housekeeping, 539–540 just-in-time systems, and, 532–541 level loading, 532–533 preventive maintenance, 539–540 pull systems, 535–536
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209 planning need, 203 process layouts, 205–206, 219–223 product layouts, 204, 209–219 retail layouts, 208 service layouts, 208 service layouts, 208 supermarket design, 209 U-shaped layouts, 206–207 warehouse layout, 208	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553 input-output (I/O) control, 544 load chart, 551 schedule chart, 544, 551 vertical loading, 544 location defined, 31 supply chain management, and, 590 location alternatives evaluation centre of gravity method,	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594 JIT deliveries, 597 movement within a facility, 593 outgoing shipments, 593–594 supply chain management, and, 590 traffic management, 593–594 vertical acquisitions and partnerships, 599 lot size-inventory trade-off, 603	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier relationships, 538 manufacturing planning and housekeeping, 539–540 just-in-time systems, and, 532–541 level loading, 532–533 preventive maintenance, 539–540 pull systems, 535–536 visual systems, 538–539
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209 planning need, 203 process layouts, 205–206, 219–223 product layouts, 204, 209–219 retail layouts, 208 service layouts, 208 service layouts, 208 supermarket design, 209 U-shaped layouts, 208 lead time, 8, 93, 396	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553 input-output (I/O) control, 544 load chart, 551 schedule chart, 544, 551 vertical loading, 544 location defined, 31 supply chain management, and, 590 location alternatives evaluation centre of gravity method, 292–294	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594 JIT deliveries, 597 movement within a facility, 593 outgoing shipments, 593–594 supply chain management, and, 590 traffic management, 593–594 vertical acquisitions and partnerships, 599 lot size-inventory trade-off, 603 lot sizing	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier relationships, 538 manufacturing planning and housekeeping, 539–540 just-in-time systems, and, 532–541 level loading, 532–533 preventive maintenance, 539–540 pull systems, 535–536 visual systems, 538–539 manufacturing resources
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209 planning need, 203 process layouts, 205–206, 219–223 product layouts, 204, 209–219 retail layouts, 208 service layouts, 208 service layouts, 208 supermarket design, 209 U-shaped layouts, 206–207 warehouse layout, 208 lead time, 8, 93, 396 leadership, and just-in-time	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553 input-output (I/O) control, 544 load chart, 551 schedule chart, 544, 551 vertical loading, 544 location defined, 31 supply chain management, and, 590 location alternatives evaluation centre of gravity method, 292–294 factor rating, 291	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594 JIT deliveries, 597 movement within a facility, 593 outgoing shipments, 593–594 supply chain management, and, 590 traffic management, 593–594 vertical acquisitions and partnerships, 599 lot size-inventory trade-off, 603 lot sizing defined, 500	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier relationships, 538 manufacturing planning and housekeeping, 539–540 just-in-time systems, and, 532–541 level loading, 532–533 preventive maintenance, 539–540 pull systems, 535–536 visual systems, 538–539 manufacturing resources planning (MRP II), 504
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209 planning need, 203 process layouts, 205–206, 219–223 product layouts, 204, 209–219 retail layouts, 208 service layouts, 208 service layouts, 208 supermarket design, 209 U-shaped layouts, 208 lead time, 8, 93, 396 leadership, and just-in-time systems, 532	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553 input-output (I/O) control, 544 load chart, 551 schedule chart, 544, 551 vertical loading, 544 location defined, 31 supply chain management, and, 590 location alternatives evaluation centre of gravity method, 292–294 factor rating, 291 geographical information	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594 JIT deliveries, 597 movement within a facility, 593 outgoing shipments, 593–594 supply chain management, and, 590 traffic management, 593–594 vertical acquisitions and partnerships, 599 lot size-inventory trade-off, 603 lot sizing defined, 500 economic order quantity	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier relationships, 538 manufacturing planning and housekeeping, 539–540 just-in-time systems, and, 532–541 level loading, 532–533 preventive maintenance, 539–540 pull systems, 535–536 visual systems, 538–539 manufacturing resources planning (MRP II), 504 Manufacturing Strategy (Hill), 31
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209 planning need, 203 process layouts, 205–206, 219–223 product layouts, 204, 209–219 retail layouts, 208 service layouts, 208 service layouts, 208 supermarket design, 209 U-shaped layouts, 208 lead time, 8, 93, 396 leadership, and just-in-time systems, 532 lean manufacturing, 525	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553 input-output (I/O) control, 544 load chart, 551 schedule chart, 544, 551 vertical loading, 544 location defined, 31 supply chain management, and, 590 location alternatives evaluation centre of gravity method, 292–294 factor rating, 291 geographical information system (GIS), 294	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594 JIT deliveries, 597 movement within a facility, 593 outgoing shipments, 593–594 supply chain management, and, 590 traffic management, 593–594 vertical acquisitions and partnerships, 599 lot size-inventory trade-off, 603 lot sizing defined, 500 economic order quantity model, and, 501	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier relationships, 538 manufacturing planning and housekeeping, 539–540 just-in-time systems, and, 532–541 level loading, 532–533 preventive maintenance, 539–540 pull systems, 535–536 visual systems, 538–539 manufacturing resources planning (MRP II), 504 Manufacturing Strategy (Hill), 31 marginal analysis, 460
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209 planning need, 203 process layouts, 205–206, 219–223 product layouts, 204, 209–219 retail layouts, 208 service layouts, 208 service layouts, 208 supermarket design, 209 U-shaped layouts, 208 lead time, 8, 93, 396 leadership, and just-in-time systems, 532 lean manufacturing, 525 lean production, 19	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553 input-output (I/O) control, 544 load chart, 551 schedule chart, 544, 551 vertical loading, 544 location defined, 31 supply chain management, and, 590 location alternatives evaluation centre of gravity method, 292–294 factor rating, 291 geographical information system (GIS), 294 location-analysis	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594 JIT deliveries, 597 movement within a facility, 593 outgoing shipments, 593–594 supply chain management, and, 590 traffic management, 593–594 vertical acquisitions and partnerships, 599 lot size-inventory trade-off, 603 lot sizing defined, 500 economic order quantity model, and, 501 fixed-period ordering, 501	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier relationships, 538 manufacturing planning and housekeeping, 539–540 just-in-time systems, and, 532–541 level loading, 532–533 preventive maintenance, 539–540 pull systems, 535–536 visual systems, 538–539 manufacturing resources planning (MRP II), 504 Manufacturing Strategy (Hill), 31 marginal analysis, 460 marketing function, 8
combination layouts, 206 fixed-position layouts, 206 general approach to design, 203 meaning of, 203 office layouts, 209 planning need, 203 process layouts, 205–206, 219–223 product layouts, 204, 209–219 retail layouts, 208 service layouts, 208 service layouts, 208 supermarket design, 209 U-shaped layouts, 208 lead time, 8, 93, 396 leadership, and just-in-time systems, 532 lean manufacturing, 525	load reports, 503 loading defined, 551 finite loading, 553 Gantt charts, 551 horizontal loading, 544 infinite loading, 553 input-output (I/O) control, 544 load chart, 551 schedule chart, 544, 551 vertical loading, 544 location defined, 31 supply chain management, and, 590 location alternatives evaluation centre of gravity method, 292–294 factor rating, 291 geographical information system (GIS), 294	planning (DRP), 596 electronic data interchange (EDI), 594–596 evaluation of shipping alternatives, 594 global supply chain, 598 incoming shipments, 593–594 JIT deliveries, 597 movement within a facility, 593 outgoing shipments, 593–594 supply chain management, and, 590 traffic management, 593–594 vertical acquisitions and partnerships, 599 lot size-inventory trade-off, 603 lot sizing defined, 500 economic order quantity model, and, 501	overseas, vs. export, 285–286 service operations, vs., 11–13 manufacturing cell, JIT systems, and, 530 manufacturing engineering, 9 manufacturing planning and control close supplier relationships, 538 manufacturing planning and housekeeping, 539–540 just-in-time systems, and, 532–541 level loading, 532–533 preventive maintenance, 539–540 pull systems, 535–536 visual systems, 538–539 manufacturing resources planning (MRP II), 504 Manufacturing Strategy (Hill), 31 marginal analysis, 460

lot-for-lot ordering, 494–495, 500 Maslow, Abraham, 18

mass customization, 124, 192

analysis, 288–290

transportation method, 291

master production schedule

(MPS), 468, 486
master schedule
available-to-promise (ATP)
inventory, 470–472
defined, 468
inputs, 469
master production schedule
(MPS), 468, 487
MRP (material requirements
planning), and, 487
outputs, 470–472
stabilization, 473
time fences, 473
material requirements planning, 19
See also MRP (material
requirements planning)
mathematical aggregate planning
techniques, 464–468
mathematical models, 14
matrix organization, 629
maximum line length, 702
Maynard Operations Sequence
Technique (MOST), 250,
266–268 Mayo Eltan 18
Mayo, Elton, 18 McGregor, Douglas, 18
McManus, A. M. C., 320
mean absolute deviation
(MAD), 86
mean absolute percent error
(MAPE), 86
mean control chart,
360 –361, 365
360 –361, 365 mean squared error (MSE), 86
mean squared error (MSE), 86
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149
mean squared error (MSE), 86 mean time to failures (MTTF),
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method,
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method, 246–250
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method, 246–250 basic procedure, 246–248
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method, 246–250 basic procedure, 246–248 defined, 246
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method, 246–250 basic procedure, 246–248 defined, 246 documentation of present
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method, 246–250 basic procedure, 246–248 defined, 246 documentation of present method, 246
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method, 246–250 basic procedure, 246–248 defined, 246 documentation of present method, 246 follow-up, 248
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method, 246–250 basic procedure, 246–248 defined, 246 documentation of present method, 246 follow-up, 248 installation of improved
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method, 246–250 basic procedure, 246–248 defined, 246 documentation of present method, 246 follow-up, 248 installation of improved method, 248
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method, 246–250 basic procedure, 246–248 defined, 246 documentation of present method, 246 follow-up, 248 installation of improved method, 248 new jobs, and, 246
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method, 246–250 basic procedure, 246–248 defined, 246 documentation of present method, 246 follow-up, 248 installation of improved method, 248 new jobs, and, 246 process charts, 246–250
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method, 246–250 basic procedure, 246–248 defined, 246 documentation of present method, 246 follow-up, 248 installation of improved method, 248 new jobs, and, 246 process charts, 246–250 proposal of new methods,
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method, 246–250 basic procedure, 246–248 defined, 246 documentation of present method, 246 follow-up, 248 installation of improved method, 248 new jobs, and, 246 process charts, 246–250 proposal of new methods, 246–250
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method, 246–250 basic procedure, 246–248 defined, 246 documentation of present method, 246 follow-up, 248 installation of improved method, 248 new jobs, and, 246 process charts, 246–250 proposal of new methods, 246–250 selection of operation to
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method, 246–250 basic procedure, 246–248 defined, 246 documentation of present method, 246 follow-up, 248 installation of improved method, 248 new jobs, and, 246 process charts, 246–250 proposal of new methods, 246–250 selection of operation to study, 246
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method, 246–250 basic procedure, 246–248 defined, 246 documentation of present method, 246 follow-up, 248 installation of improved method, 248 new jobs, and, 246 process charts, 246–250 proposal of new methods, 246–250 selection of operation to study, 246 worker–machine chart, 248
mean squared error (MSE), 86 mean time to failures (MTTF), 148–149 mean time to repair, 152 measured daywork systems, 270 medical mistakes, 366 mercantilism, 16–17 merchantability, 126 Merkley, J. W., 440 methods analysis analysis of present method, 246–250 basic procedure, 246–248 defined, 246 documentation of present method, 246 follow-up, 248 installation of improved method, 248 new jobs, and, 246 process charts, 246–250 proposal of new methods, 246–250 selection of operation to study, 246

min/max system, 410

```
mission, 32–34
mission statement
   defined, 32
   strategies and tactics, 32-34
Mitra, Amitava, 382n
mixed model line, 219
mixed-model sequencing, 533
model, 14-15, 19
modular design, 124, 527
Moore, J. S., 276n
Morgan, Jim, 616n
most likely duration, 645
motion economy principles, 249
motion study
   defined, 248
   micromotion study, 249
   motion economy
      principles, 249
   simo chart, 250
   therbligs, 249
motivation, 245
Motor Vehicle Safety Act, 126
moving assembly line,
   introduction of, 18
moving average, 66-68
MRP (material requirements
   planning)
   accuracy, and, 504
   bill of materials (BOM),
      488-491
   capacity requirements
      planning, and, 502-504
   changes, 498
   component-scheduling
      system, 525
   cumulative lead time, 487
   defined, 484
   dependent demand, 484
   exception reports, 499
   independent demand, 484
   inputs, 486-491
   inventory records, 492
   just-in-time systems, vs., 525
   load reports, 503
   lot sizing, 500-502
   master schedule and, 486
   order releases, 498
   outputs, 499
   overview, 484-485
   performance-control
      reports, 499
   planned orders, 499
   planning reports, 499
   primary reports, 498
   processing, 492-498
   safety stock, 499-500
   secondary reports, 499
MRP II (manufacturing
   resources planning), 504
```

MRP processing

described, 492

gross requirements, 492, 493

lot-for-lot ordering, 494-495

lot-size ordering, 496-497

```
net material requirements, 492
   net requirements, 493
   net-change system, 498
   netting, 492
   pegging, 498
   planned-order receipts, 493
   planned-order releases, 493,
       494-495
   projected on-hand, 493
   regenerative system, 499
   schedule receipts, 493
   time-phased requirements, 492
   updating the system, 498
multiple break-even
   quantities, 171
multiple regression analysis, 86
multiple-server model, 695-698
multiple-servers with priority
   model, 704
multiplicative model, 76
Mundel, M. E., 248n
musculoskeletal injuries, 255
Muther, Richard, 222
naive forecast, 66
negotiated purchasing, 612
net requirements, 493
net-change system, 498
network (precedence) diagram,
   636-637
new demand, and aggregate
   planning, 453
newsboy problem, 421
   See also single-period model
noise, 252
normal distribution, 166, 357
North American Free Trade
   Agreement (NAFTA), 22
numerically controlled
   machines, 193
objectives, 33
Occupational Health and Safety
   regulations, 254
office layouts, 209
Oglesby's Simplified MTM
   Table, 265
Ohno, Taiichi, 525
Oliff, M. D., 480
on-site inspection, 355
online inventory systems, 395
operating philosophy, 323
operational planning, supply
   chain management, 591
operations, 30, 33
operations function, 6-8
operations infrastructure, 35
operations management
   careers in, 5-6
   defined, 3
   historical evolution of, 16-21
   job ads, 5
   scope of, 9-10
```

study of, 4-5

```
operations manager
   decision making, and, 14-16
   management process, and,
      13-14
operations plan, 451
   See also aggregate planning
operations strategy, 35
   defined, 34-39
   forecasts, 93
   work system design, and, 243
operations systems
   degree of standardization, 11
   differentiating features, 11-13
   goods vs. service, 11-13
   system design, 10
   system operation, 10
   type of operation, 11
opportunity cost, 453
optimistic duration, 645
order cycle, 392
order of service, 690
order qualifiers, 31
order releases, 498
order winners, 31
ordering costs, 396
organization strategy, 33
organizational culture, and
   TQM, 324
organizations. See business
   organizations
Orlicky, Joseph, 486
Ouchi, William, 18
outgoing shipments, 593-594
output strategy, 453
output-based (incentive)
   systems, 270
outsource, 183
outsourcing, 588
overtime/slack time, 453
p-chart, 366, 367
packaging, and quality, 311
paired comparisons, 340
parallel workstations, 217
parameter design, 125-126
Pareto analysis, 332-333
Pareto phenomenon, 15
Pareto, Vilfredo, 332
part families, 206
part-period model, 501-502
part-time workers, 454
path, 636
path slack, 637
payback period, 173
Payette, S., 271n
pegging, 498
```

performance rating, 259

performance-control

periodic system, 395

perpetual inventory

perpetual tracking, 395

system, 395

personnel, 9

reports, 499

PERT (program evaluation and	probability rules, 145-152	computer-aided design	production/operations, and
review technique)	problem solving, 327–329	(CAD), 127–128	quality, 366
defined, 635	See also decision making	concurrent engineering,	productivity, 30
deterministic time estimates,	process	118, 127	aggregate measures, 41
637–638 network conventions,	type of, 11	delayed differentiation, 124 design for assembly (DFA),	competitiveness, and, 41 computation of, 39–44
636–638	types and technology, 35 process batch, 566	128–129	computer viruses, 45
network diagram, 636–637	process capability	design for manufacturing	defined, 39
usefulness of, 15	C_{p} , 372–373	(DFM), 128–129	efficiency, vs., 46
pessimistic duration, 645	C_{pk} , 373	ethical issues, 126	energy, 40
phase reviews, 117	capability analysis, 369–373	fitness, 126	factors, 44–45
phases of queuing system, 686	control limits, 370	just-in-time systems, 525-527	gains, causes of, 42
physical models, 14	defined, 370	legal issues, 126	growth, 39
picking, 208	process variability, 370	life cycles, 122	improvement, 46–47
plan-do-study-act (PDSA) cycle,	specifications, 370	mass customization, 124	incentive plans, 45
312, 327 –329	variability of process output,	merchantability, 126	labour, 40
planned orders, 499 planned-order receipts, 493	369–375 process charts, 246 –250	modular design, 124, 527 objectives of, 119	labour productivity growth, 42 machine, 40
planned-order releases, 493,	process control, 351, 352	over-the-wall approach,	material, 40
494–495	process design	125–126	measurement of, 12
planning reports, 499	automation question, 192	parameter design, 125–126	measures of, 39–44
Plossl, George, 486	considerations, 196–198	process, 117–118	quality differences, 45
point-of-sale data, 64	described, 196-198	product liability, 126	quality, and, 366
point-of-sale (POS)	IDEF method, 199-220	production requirements, 128	safety, 45
systems, 396	process flowchart,	quality function deployment	scrap rates, 45
Poisson distribution, 687, 688–689	196–198, 202	(QFD), 134–137	service sector, in, 44
poor quality, consequences of,	service process fail safing, 200	quality, and, 366	standardized processes, 45
364–366	process engineers, 9	reasons for, 118	technological advances, 45
positional weight, 215 positioning guide, 572	process flow diagram, 197, 331 process flowchart, 196–198, 202	redundancy, 146 reliability, 125	workspace design, 45 profit/gain sharing, 271
postnonning guide, 372 postponement, 605	process improvement, 329, 335	research and development	profound knowledge, 312
precedence diagram, 636–637	process layouts	(R&D), 120–121	programmable automation,
precedence network, 213	benefits of, 205	reverse engineering, 119	193–194
precedent network diagram,	closeness ratings, 222	robust design, 125	project control, 654
634, 636	computer software, 223	Sales of Goods Act, 126	project execution, 654
preceding tasks, 215	defined, 205	service design, vs., 131	project management
predetermined elemental times,	departmental positioning, 219	sources of ideas, 119	activity slack times, 644
264 –266	effectiveness measures,	standardization, 123–124	computing algorithm,
predetermined price, 612	219–220	product differentiation, 30	639–640, 644
predictor variables, 81	external factors, 219	product failure, 148–150	CPM (critical path method).
present value, 173, 174 prevention costs, 312	heuristics, 221–222	product family, 129 product layouts	See CPM (critical path method)
prevention costs, 312 preventive maintenance, 204,	information requirements, 220 intermittent processing, 205	advantages of, 204	crashing, 651–654
539 –540	problems, 220	assembly lines, 203	critical activities, 637
price	service environments, in, 205	defined, 203	critical path, 637
defined, 30	transportation cost	design of, 204, 209–219	dependent cases, 651
determination of, and	minimization, 220	line balancing, 204, 210-219	deterministic time estimates,
purchasing, 494	process selection	preventive maintenance, 204	637–638
predetermined, 494	automation, 191–196	production lines, 203	ethics, 631
pricing differentials, 452–454	make or buy decisions, 183	U-shaped layouts, 206–207	events, 635
price elasticity, 452	meaning of, 183	product liability, 126	Gantt charts, 634
primary reports, 498	occurrence of, 183	product mix, 35	key decisions in, 629 nature of projects, 628–629
Principles of Scientific Management, The (Taylor), 17	process types, 186–191 technology management,	product quality, 35, 306 product structure tree,	network conventions,
priority rules, 556	196–198	488 –491	636–638
probabilistic activity durations	process strategy, 183	product variety-lot size,	network diagram, 636–637
beta distribution, 645	process types	trade-off, 605	PERT (program evaluation
defined, 637	batch processing, 186–187	production lines, 203	and review technique).
independence assumption, 648	continuous processing, 188	production plan, 451	See PERT
most likely time, 645	job shop, 183–185	See also aggregate planning	probabilistic time estimates,
optimistic duration, 645	repetitive processing, 187	production planning	637, 645–651
path probabilities	process variability, 357, 370	short-range planning, 468	risk management, 632–633
determination of, 648–650 pessimistic duration, 645	procurement, and quality, 366 product design, 9	production, and supply chain management, 590	simulation, 651 software, 655–664
pessimone duranon, 043	product design, /	management, 390	301tware, 033-00 4

technology, 655-664	poor quality, costs of,	Pareto analysis, 332-333	point in time, 145
time-cost trade-offs, 651-654	311–312	run chart, 334	probability rules, 145-152
work breakdown structure	prevention costs, 312	scatter diagram, 333	product failure, 148-150
(WBS), 633	process improvement, and, 23	quality-based strategies, 38	quantification of, 145-152
Project Management Office	productivity, and, 310	quantitative approaches, 14–15	reorder point (ROP), 412–416
(PMO), 629, 630, 631	responsibility for, 310–311	quantity discounts, 407–410	repetitive motion injuries, 255
project manager, 630–631	revolution, 19	queue discipline, 690	repetitive processing, 187
project organization, 629	service, 307	queuing models	replenishment models, 395–396
project planning, 631	six-sigma quality, 373, 375	basic relationships, 691–693	research and development
project scheduling, 634	work life, of, 245	cost analysis, 701–702	(R&D), 120 –121
project scheduling techniques, 15	quality assurance, 4, 12	finite-source models, 708–713	resources, 23
projected on-hand, 493	quality at the source, 325	infinite-source models,	retail industry
projects	quality awards	690–704	layouts, 208
defined, 627	Baldrige Award, 316	maximum line length, 702	locations, 286–287
life cycle, 628	Canada Awards for	multiple server with priority,	quick response, 595
promotion, and aggregate	Excellence, 316, 317	703–708	return on investment (ROI), 391
planning, 452	Deming Prize, 312	multiple-server system,	reverse engineering, 119
psychology, and profound	quality certification	695–698	rework, 311
knowledge, 313	ISO 14000, 319–320	revision of priorities, 706–708	Richards, D., 179n, 351n
public relations, 9	ISO 9000, 316–319		risk
pull system, 535–536	quality circles, 337 quality control	single server, constant service time, 695	alpha risk, 359 project management, and,
pulp and paper mills, and process control, 352	acceptance sampling, 351	single server, exponential	632–633
purchase lead time, 396	defined, 351	service time, 693	stockout risk, 412
purchase planning, 631	inspection, 351–355	symbols for infinite-source	risk management, 632–633
purchasing	process capability, 369–375	models, 691	risk pooling, 589
accounting, 607	statistical process control,	system utilization, 691–693	risk register, 632
centralized purchasing,	351, 355–360	queuing techniques, 15	risk tree, 660
612–613	Quality Control Handbook	queuing theory, 683	Rivas, R., 120 <i>n</i>
decentralized purchasing,	(Juran), 313	See also waiting-line analysis	robots, 193–194
612–613	quality function deployment	quick response, 595–596	robust design
described, 605	(QFD), 117	4	defined, 125
design engineering, 607	defined, 134	random variations, 64, 356	parameter design, 125–126
ethics, 613	house of quality, 134	range control charts (R-charts)	Taguchi's approach, 125
legal department, 606	Kano model, 137	defined, 362	rogue seasonality, 603
make or buy decision,	matrices, 134-136	moving range charts, 363-365	rolling horizon, 498
610–611	quality gurus	using, 365	rolling planning horizon, 451
negotiated purchasing, 612	Armand Feigenbaum, 313	rate of technological change, 123	rolling wave planning, 633
organizations, by, 9	Genichi Taguchi, 315	raw materials, location of,	Romig, H. G., 305
outsourcing, 588	Joseph M. Juran, 313	281–282	Rossetti, C., 620
price determination, 612	Kaoru Ishikawa, 315	recalibration, 260	rough-cut capacity
receiving, 608	Philip B. Crosby, 314–315	redundancy, 146	planning, 468
strategic changes to, 609–610	W. Edwards Deming, 312	regenerative system, 498	run chart, 334
suppliers and, 607	quality management	regression	run size issue, 550
supply chain management,	evolution of, 305–306	correlation, 84–85	
and, 590	process improvement, 329	curvilinear regression	safety
value analysis, 608	total quality management	analysis, 86	accident prevention, 253–254
purchasing cycle, 608	(TQM). See total quality	defined, 81	BSI OHSAS 18000, 254
push system, 535	management	indicators, 84	ergonomics, 254–255
an alter	trilogy, 313	least squares line, 82	Occupational Health and
quality appraisal costs, 311	zero defects, 306 quality of conformance, 309	multiple regression analysis, 86	Safety regulations, 254 productivity, and, 45
conformance, of, 309	quality of design, 308–309	simple linear regression,	worker safety, 253–254
costs of, 311	quality tools, 330	82–85	safety stocks, 392, 412,
defined, 30, 305	cause-and-effect diagram, 334	regulatory action points, 321	499–500
design, of, 308	check sheets, 331	reliability	sales and operations
determinants, 308–309	consensus, 340	defined, 125 , 145	planning, 447
differences, and productivity, 45	control chart, 333	improvement of, 125	Sales of Goods Act, 126
dimensions of, 306	fishbone diagram, 334	independent events, 146	sales, and quality, 311
failure costs, 311	flowcharts, 331	length of service, 145	salesforce opinions, 63
fitness-for-use, as, 313	graphical tools, illustration of	mean time to failures (MTTF),	sample mean control chart, 360
just-in-time systems, 527	use, 334	148–149	sample range control chart, 362
make or buy decisions,	histograms, 332	normal operating	sampling distribution, 357
and, 183	idea generation methods, 337	conditions, 125	Sanders, L. A., 320
			· · · · · · · · · · · · · · · · · · ·

catter diagram, 333	makespan, 556	manufacturing, vs., 11-13	central limit theorem, 357
Schafer, W. B., 568n	performance measures, 556	markets, location of, 282	common variability, 356
chedule chart, 544 , 551, 554	priority rules, 556	multiple resources	control charts. See control
cheduled receipts, 493	sequence-dependence setup	scheduling, 572	chart
cheduling, 4	times, 563–564	productivity, 44	control limits, 359, 360–369
appointment systems, 568	SPT rule, 556–560	scheduling, 548, 567–573	control steps, 355
backward scheduling, 544	two work centres, 560	variability in capacity	defined, 355
computerized staff	workstations, 555–556	requirements, 168	Normal distribution, 357
scheduling, 572	server utilization, 691	workforce scheduling, 568	random variation, 356
cyclical, 568	service capacity, 167–168	setup, 396	sampling distribution, 357
defined, 548	See also waiting-line analysis	shared slack, 645	special variation, 357
difficulties of, 564–565	service design	Sheridan, J. H., 36n	variations and, 356–357
flow-shop scheduling, 548	concurrent engineering, 118	Shewhart cycle, 327	Steele, Daniel C., 37n
forward scheduling, 544	defined, 123	Shewhart, Walter, 305, 335	step costs, 171
high-volume systems,	delayed differentiation, 124	Shingo Prize, 525, 526	Stickley, George, 521–522
548–549	ethical issues, 126	Shingo, Shigeo, 525, 529	Stickley, Leopold, 521–522
intermediate-volume	guidelines, 134	shipping, and quality, 311	stock keeping units (SKU), 64
systems, 549	legal issues, 126	shop floor control, 548	stockout risk, 412
job-shop scheduling, 551 line balancing, 549	life cycles, 123 mass customization, 124	shortage costs, 396, 422	stockouts, 66, 392
e.	modular design, 124	simo chart, 250	stopwatch time study
loading, 551–554 low-volume systems, 551–554	•	simple linear regression, 82–85	cycles timed, 256–257 defined, 256
minimization of problems,	objectives of, 119 overview, 132–134	simulation, 651	normal time, 259
564–565	parameter design, 125–126	simultaneous development, 127	observed time, 259
multiple resources, 572	process, 117–118, 132	Single Minute Exchange of Dies	standard time, 260
part-time employees, 570	product design, vs., 131	(SMED), 529	storage layout, 208
run size issue, 550	quality function deployment	single-period model	straight piecework, 271
schedule chart, 544	(QFD), 134–137	continuous stocking levels,	strategic partnering, 601
sequencing, 555–556	quality, and, 366	422–423	strategies, 30
services, 548, 567–573	reasons for, 118	defined, 421	defined, 32
workforce, the, 568	reliability, 125	discrete stocking levels,	distinctive competencies,
chematic models, 14	research and development	423–425	36, 37
cientific management, 17	(R&D), 120–121	excess cost, 422	flexible factories strategy, 38
cope creep, 654	robust design, 125	shortage costs, 422	focused factories strategy, 38
crap rates, 45, 500	sources of ideas, 119	single-server models, 693–695	formulation of, 31–39
easonal indexes, 76	standardization, 123-124	site-related factors, and location,	Japanese manufacturing
easonal inventories, 392	supply chain management,	286–287	companies, 38
easonal relatives	and, 590	six sigma, 329	low labour cost strategy, 38
central moving average, 78	service design process, 200	six-sigma quality, 373, 375	mission, 32–34
computation of, 78–81	service differentiation, 30	skill/knowledge-based pay, 271	mission statement, 32–34
defined, 76	service flowcharting, 200	Smith, Adam, 17	operations strategy, 34–39
deseasonalize data, 77	service layouts	software. See computer software	order qualifiers, 31
reseasonalize data, 77–78	office layouts, 209	specialization, 244	order winners, 31
use of, 77–78	process layouts, 205	specifications, 370	quality-based strategies, 38
easonal variations, 76	retail layouts, 208	stacked lead time, 487	scale-based strategy, 38
easonality, 64	storage layout, 208	stage-gates, 117	tactics, 33–34
easonality techniques	warehouse layout, 208	Stalk, George Jr., 38	time reduction, 39
additive model, 76	service level, 412 , 416–419,	standard of living, 42	time-based strategies, 39
multiplicative model, 76	422–423	standard operating	subcontracting, 454
seasonal indexes, 76 seasonal relatives, 76, 77–78	service-oriented, 6	procedure, 320	substitutability, 129
seasonal relatives, 76, 77–78 seasonal variations, 76	service process fail-safing, 200 service quality, 307	standard parts, 525, 527 standard time, 256, 260	supermarket design, 209 supplier analysis, 614
econdary reports, 499	service quanty, 507	standard time, 250, 200 standardization	supplier analysis, 614 supplier audits, 615
elf-directed teams, 246	aggregate planning, 466	benefits of, 123	supplier certification, 615
elf-managed teams, 246	appointment systems, 568	defined, 123	supplier management
equencing	automated, 192	degree of, 11	choosing suppliers, 614
average WIP, 556	computerized staff	disadvantages, 123–124	early supplier involvement, 616
CR rule, 556–560	scheduling, 572	lack of, 123–124	supplier analysis, 614
defined, 555	defined, 30	standardized output, 11	supplier audits, 615
EDD rule, 556–560	goods vs., 11	standardized processes, 45	supplier certification, 615
FCFS sequence, 556–560	inspection points, 355	statistical models, 15	supplier partnerships, 616
job flow time, 556	inventory, and, 391	statistical process	supplier relationships, 615
job lateness, 556	location decisions and, 279,	control, 312	supplier partnerships, 616
Johnson's rule, 560	286–287	assignable variation, 357	supplier relationships, 615

748 supply chain broadening of, 30 defined, 22, 587 effective, 600-605 global, 598 location criteria, and, 280 number and type of organizations in, 587 optimization, 602 value chains, 587 supply chain management benefits of effective management, 589 bullwhip effect, 603-604 challenges, 602 collaborative planning, forecasting, and replenishment (CPFR), 601 cross-docking, 605 customers, 589 defined, 590 delayed differentiation, 605 e-commerce, 589, 599 elements of, 590-591 ERP. See ERP (enterprise resource planning) globalization, 589 information velocity, 602 integration barriers, 602 inventory, 589 See also inventory management inventory velocity, 602 just-in-time systems. See just-in-time systems location, 590 logistics, 590, 591-599 maintenance. See maintenance MRP. See MRP (material requirements planning) need for, 588 operating issues, 591 operational planning, 591 optimization of supply chain, 602 postponement, 605 production, 589 purchasing, 590 See also purchasing strategic issues, 590-591 strategic partnering, 601 suppliers, 590 See also supplier management tactical planning, 591 trade-offs, 603-604 transportation, 591 trend, as, 21

uncertainty, 605

variability, 605

design, 10, 165

operation, 10

defined, 15

system

INDEX

system nervousness, 498 systems approach, 15, 602 tactical planning, and supply chain management, 591 tactics, 33-34 Taguchi loss function, 315 Taguchi, Genichi, 125, 315 Tamburro, Nebe, 539 tangible output, 11 Taylor, Frederick Winslow, 17, 243, 257, 305 team approach, 271, 324 teams, 246, 629 teamwork, 22 technological advances management of technology, 196-198 process selection and, 196-198 productivity, and, 45 trends, 21-23 technological constraints, and line balancing, 214-216 technological forecasting, 64 technology, and project management, 655-664 temperature, 252 theory of constraints, 566 therbligs, 249 third party logistics, 598 Tibrewala, R., 569 time, 30 time-based competition, 23 time-based strategies, 39 time-based systems, 270 time-cost trade-offs, 651-654 time fences, 473 time horizon, 61 time measurement units (TMUs), 264-265 time reduction, 22, 39 time series, 64 time series models analysis of time series data, 64 averaging techniques, 66-70 centred moving average, 78 cycle techniques, 81 cycles, 65 defined, 62

exponential smoothing, 69-70

linear trend equation, 71-73

seasonality techniques, 76-81

irregular variations, 65

moving average, 66-68

level average, 64

naive methods, 66

seasonality, 64

trend, 64

plotting the data, 90

random variations, 65

trend techniques, 70-73

trend-adjusted exponential

smoothing, 74-75

68-69 time standards, 256 time study observation sheet, 260-263 time value of money, 173, 174 tolerances, 370 total quality control, 361 Total Quality Control (Feigenbaum), 314 total quality management (TQM) competitive benchmarking, 324 continuous improvement, 324 defined, 323 description of, 324 employee empowerment, 324 fact-based decision making, 325 fail-safing, 325 kaizen, 324 lessons from veterans, 323-324 organizational culture, 324 plan-to-study-act (PDSA) cycle, 327-329 problem solving, 327-329 quality at the source, 325 successful programs, 324 team approach, 324 training, 325 use of term, 23 TQM systems. See total quality management (TQM) trade-off analysis, 15 trade-off method, 460 trade-offs, 603-604 traffic management, 593-594 transfer batch, 566 transformation processes, 7 transportation in supply chain management, 589 transportation costs, 220, 282, 605 transportation model described, 464-468 of linear programming, 345 trend techniques, 70-73 trend-adjusted exponential smoothing, 74-75 trends, 64 continuing trends, 21-23 e-business, 21 environmental issues, 23 globalization, 22 Internet, 21 quality and process improvement, 21 recent trends, 21 supply chain management, 21 technological advances, 21 - 23time-based competition, 23 trust, 245 Tsampalieros, Gabe, 141 Tucker, S. L., 429n

weighted moving average,

two-bin system, 395 Type I error, 359 Type II error, 359

U-shaped layouts, 206-207 uncertainty in supply chain management, 605 Universal Product Code (UPC), 396 upper control limit (UCL), 358 utilization Canadian hospitals, in, 162 defined, 162

value analysis, 608 value chains, 587

See also supply chain value-added, 7

variability demand, in, 166 supply chain management, and, 605 variable costs, 170 variable demand, 420-421 variables

control charts for, 360-363 defined, 359

variances, 416 variety, 30 vendor relations, 35

vendor-managed inventory, **596**-661 ventilation, 252

Vermani, S. K., 386n vertical integration, 35 vertical loading, 245, 544 vertical skills, 271 vibrations, 252 Vieira, P., 284n vision, 32 visual systems, 538-539

Wacker, John G., 520n waiting-line analysis arrival and service patterns, 687-689 capacity planning, and, 174, 702 Exponential distribution, 687 finite-source situation, 686 goal of, 684 infinite-source models. See queuing models infinite-source situation, 686 managerial implications of waiting lines, 683 mathematical approach, 683 multiple-server systems, 686 number of servers, 686 overloaded from micro standpoint, 683 performance measures, 685 Poisson distribution, 687 population source, 686-687 queue discipline, 690

queuing models. See queuing models queuing theory, 683 single-phase systems, 686 single-server systems, 686 structure of system, 686 system characteristics, 685-689 system performance measures, 690 underloaded from macro standpoint, 683 waiting-time perception management, 713 Walker, M. R., 635 warehouse layout, 208 waterfalls diagram, 660 Watt, James, 17 Wealth of Nations, The (Smith), 17

ste51675_index.qxd 3/13/2008 7:31 PM Page 749

weighted moving average, **68**–69 Wheeler, John, 222n Whitney, Eli, 17 Wight, Oliver, 486 Williams, Martin, 609 Work Breakdown Structure (WBS), 629, 633 work breaks, 252-253 work measurement defined, 256 historical elemental times, 263 methods-time measurement (MTM), 264 predetermined elemental times, 264-266 standard time, 256 stopwatch time study,

256-260

work sampling, 268-270 work sampling, 268–270 work system design compensation, 270–272 importance of, 243 job design. See job design key operations strategy, 243 work measurement, 256-260 worker safety, 253-254 worker-machine chart, 248 working conditions accident prevention, 253-254 comfort band, 252 ergonomics, 254-255 government regulation, 250 Healthy Workplace award, 256 humidity, 252

illumination, 25 noise, 252 safety, 253 temperature, 252 ventilation, 252 vibrations, 252 work breaks, 252-253 Workplace Hazardous Materials Information System (WHMIS), 252 workspace design, and productivity, 45 workstation, 555–556 World Trade Organization (WTO), 22 Zeng, A. C., 620

zero defects, 361

Zlotnik, Ted, 397