Contents

1 Introduction 1
1.1 Intro 1
1.2 A Manufacturing Control Model 5
1.3 Book Layout 10
References 15

Part A Fundamentals of Manufacturing Control

2 Logistic Objectives 19
2.1 Logistic Performance 20
2.1.1 Delivery Time 20
2.1.2 Delivery Lateness and Delivery Reliability 24
2.1.3 Service Level 27
2.1.4 Throughput Time 29
2.1.5 Lateness and Schedule Reliability 29
2.2 Logistic Costs 33
2.2.1 Inventories 33
2.2.2 Output Rate and Utilization 36
2.2.3 Delay Costs 37
References 38

3 Modeling the Logistic Objectives 41
3.1 Modeling the External Logistic Objectives 42
3.1.1 Delivery Time 42
3.1.2 Delivery Lateness and Delivery Reliability 45
3.1.3 Service Level 49
3.2 Modeling the Internal Logistic Objectives 52
3.2.1 Funnel Model and Throughput Diagram 52
3.2.2 Logistic Operating Curves 62

3.3 Conclusions from the Modeling 78
3.3.1 Correlations Between the Logistic Objectives 78
3.3.2 Guiding Principles for Designing Manufacturing Control Methods 81
References 84

4 Production Planning Tasks 85
4.1 Key Tasks of Production Planning 85
4.1.1 Production Program Planning 86
4.1.2 Production Requirements Planning 88
4.1.3 In-House Production Planning 92
4.2 Cross-Sectional Tasks of Production Planning and Control 95
4.2.1 Order Coordination 96
4.2.2 Storage 96
4.2.3 PPC Monitoring 96
References 97

5 Key Manufacturing Characteristics 99
5.1 Manufacturing Principles 99
5.2 Types of Production 101
5.3 Part Flow 102
5.3.1 Lot-Wise Transportation 102
5.3.2 One-Piece Flow 103
5.3.3 Overlapped Manufacturing 105
5.3.4 Batch Production 106
5.4 Number of Variants 107
5.5 Complexity of the Material Flow 108
5.6 Fluctuations in Customer Demands and Capacity Requirements 109
References 110

6 Supply Chain Management (SCM) 113
6.1 Definition 113
6.2 Bullwhip Effect 114
6.2.1 Clarification and Consequences 115
6.2.2 Causes 116
6.2.3 Counter-Measures 124
6.3 Methods 130
6.3.1 Fundamental Principles 130
6.3.2 Vendor Managed Inventories 133
6.3.3 Collaborative Planning, Forecasting and Replenishment 134
References 135

Part B Methods for Generating Orders

7 Fundamentals of Generating Orders 139
7.1 Type of Trigger 140
7.1.1 Make-to-Order Productions 140
7.1.2 Make-to-Stock Productions 142
7.2 Scope of the Order Generation 143
7.2.1 Single-Level Order Generation 144
7.2.2 Multi-level Order Generation 144
7.3 Trigger Logic 147
7.3.1 Periodic Order Generation 147
7.3.2 Event Oriented Order Generation 147
7.4 Classifying Methods for Generating Orders 148
7.5 Considering Lot Sizes 149
7.6 Considering Capacity Restrictions 150
References 152

8 Order Point System 153
8.1 Process Description 153
8.1.1 Basic System 154
8.1.2 Period Batch System 158
8.1.3 Order Point System with Variable Lot Sizes for Orders 159
8.1.4 Order Point System with Reserved Stock 160
8.2 Discussion of the Procedural Rules 161
8.3 Determining the System Parameters 163
8.3.1 Safety-Stock 164
8.3.2 Replenishment Time 170
8.3.3 Parameters Dependent on the Output Lot Size 171
8.3.4 Order Lot Size 172
8.3.5 Parameters for the Period Batch System 174
8.3.6 Dynamically Adjusting Method Parameters 175
8.4 Implementing the Order Point System Across the Supply Chain 176
8.5 Application 177
8.5.1 Case Study: Applying the Order Point System in a Mechanical Engineering Firm 178
8.5.2 Implementing the Order Point System Without EDP 180
References 181

9 Kanban 183
9.1 Method Description 184
9.1.1 One-Card-Kanban 184
9.1.2 Two-Card-Kanban 188
9.1.3 Visual Kanban 190
9.1.4 Bin Kanban 190
9.1.5 Minimal Blocking 192

9.2 Comparison of Kanban and the Order Point System 196
9.3 Discussion of the Procedural Rules 197
9.4 Pull Principle Versus Bring Principle 200
9.5 Setting the Method's Parameters 201
9.5.1 Lot Size and Bin Contents 201
9.5.2 Number of Kanbans 205
9.6 Implementing Kanbans Across the Supply Chain 210
9.7 Application 214
References 215

10 Capacity Oriented Materials Management 217
10.1 Method Description 217
10.2 Discussion of the Procedural Rules 224
10.3 Setting the Method's Parameters 226
10.4 Implementing CORMA Across the Supply Chain 227
10.5 Application 227
References 227

11 Synchro MRP 229
11.1 Method Description 229
11.2 Discussion of the Procedural Rules 234
11.3 Setting the Method's Parameters 236
11.4 Implementing Synchro MRP Across the Supply Chain 236
11.5 Application 237
References 237

12 Hybrid Kanban/CONWIP Control 239
12.1 Method Description 240
12.2 Discussion of the Procedural Rules 243
12.3 Setting the Method's Parameters 248
12.3.1 Number of Conventional Kanbans 248
12.3.2 Number of Finished Goods Kanbans 249
12.4 Implementation Across the Supply Chain 252
References 253

13 Cumulative Production Figures 255
13.1 Method Description 256
13.1.1 Definition of Cumulative Production Figures 256
13.1.2 Production Program and Material Requirements Planning 258
13.1.3 Estimating the Capacity Requirements Based on Planned Cumulative Production Figures 262
13.1.4 Production Control with Cumulative Production Figures 262
13.1.5 Example 265

13.2 Discussion of the Procedural Rules 273
13.3 Setting the Method's Parameters 275
13.4 Implementation Across the Supply Chain 278
13.5 Application 279
References 279

14 Base Stock 281
14.1 Method Description 281
14.2 Discussion of the Procedural Rules 285
14.3 Setting the Method's Parameters 288
14.3.1 Planned Stock Levels 289
14.3.2 Base Stocks 290
14.4 Implementation Across the Supply Chain 294
14.5 Application 294
References 294

15 Production Authorization Cards 295
15.1 Method Description 295
Reference 302

Part C Methods for Releasing Orders

16 Fundamentals of Order Release 305
16.1 Criteria 305
16.1.1 Immediate Order Release 306
16.1.2 Due Date Based Order Release 306
16.1.3 WIP Regulating Order Release 308
16.1.4 Order Release with a Workstation Specific Load Balance 312
16.2 Degree of Detail 314
16.3 Trigger Logic 316
16.4 Classifying Order Release Methods 318
References 319

17 Due Date Based Order Release 321
17.1 Method Description 321
17.2 Discussion of the Procedural Rules 324
17.3 Setting the Method's Parameters 326
17.4 Application 326
17.4.1 Manufacturing Control at Circuit Boards Ltd 326
17.4.2 Case Study Analysis 329
17.4.3 Deriving Measures for Improvement 331
References 333

18 Constant Work in Process 335
18.1 Method Description 335
18.2 Discussion of the Procedural Rules 339
18.3 Setting the Method's Parameters 341
18.3.1 Number of CONWIP Cards (Operational Method) 341
18.3.2 Number of CONWIP Cards (Model Based Procedure) ... 343
18.3.3 Advance Release Window 344
18.4 Implementation Across the Supply Chain 345
18.5 Application 345
References 346

19 Bottleneck Control 347
19.1 Method Description 348
19.1.1 Basic Method 348
19.1.2 Bottleneck Control with Multiple Bottlenecks 349
19.1.3 Starvation Avoidance 351
19.2 Discussion of the Procedural Rules 352
19.3 Setting the Method's Parameters 355
19.3.1 Basic Method 356
19.3.2 Starvation Avoidance 357
19.4 Implementation Across the Supply Chain 358
19.5 Application 358
19.6 Exkursus: Theory of Constraints 359
References 363

20 Workload Control 365
20.1 Method Description 366
20.1.1 Basic Method 366
20.1.2 Method Variations 370
20.2 Discussion of the Procedural Rules 373
20.3 Setting the Method's Parameters 375
20.4 Implementation Across the Supply Chain 380
20.5 Application 380
References 381

21 Load Oriented Order Release 383
21.1 Method Description 384
21.2 Discussion of the Procedural Rules 388
21.3 Setting the Method's Parameters 391
21.3.1 Advance Release Window 392
21.3.2 Discounting Factor 393
21.3.3 WIP Limit 394
21.3.4 Setting the Discounting Factor According to Bechte 397
21.3.5 Emulating Other Manufacturing Control Methods by Setting the Parameters 398

21.4 Implementation Across the Supply Chain 399
21.5 Application 399
References 400

22 Order Release with Linear Programming 403
22.1 Method Description 403
22.2 Discussion of the Procedural Rules 408
22.3 Setting the Method's Parameters 411
22.3.1 Planned WIP for the Workstations 412
22.3.2 Weighting Factor for Underload and Overload 412
22.3.3 Definition of the Weight Function 413
22.3.4 Upper and Lower Limits for the Work Content to be Released for the Entire Production 415
22.3.5 Upper Limit for the Work Content to be Released for Individual Workstations 417
22.4 Implementation Across the Supply Chain 418
22.5 Application 418
References 418

23 POLCA Control 419
23.1 Method Description 420
23.2 Discussion of the Procedural Rules 424
23.3 Setting the Method's Parameters 426
23.3.1 Number of POLCA Cards 427
23.3.2 Release Date 431
23.4 Implementation Across the Supply Chain 432
23.5 Application 432
References 433

24 Decentralized WIP Oriented Manufacturing Control 435
24.1 Method Description 435
24.1.1 Basic Method 435
24.1.2 WIP Regulated Throughput Control 442
24.2 Discussion of the Procedural Rules 443
24.3 Setting the Method's Parameters 445
24.3.1 WIP Limits 445
24.3.2 Position Numbers 449
24.4 Implementation Across the Supply Chain 451
24.5 Application 451
References 451

Part D Sequencing

25 Sequencing 455
25.1 Sequencing Rules for Increasing the Delivery Reliability 456
25.1.1 First In – First Out (FIFO) 457
25.1.2 Earliest Planned Start Date (ESD) 457
25.1.3 Earliest-Operation-Due-Date (EODD) 458
25.1.4 Least Slack 458
25.2 Sequencing Rules for Increasing the Service Level 459
25.3 Sequencing Rules for Increasing the Output Rate 461
25.3.1 Setup Time Optimizing Sequencing 461
25.3.2 Extended Work in Next Queue (XWINQ) 462
25.4 Shortest Processing Time (SPT) 464
25.5 Sequencing Compliance 467
References 469

Part E Controlling Capacities

26 Fundamentals of Capacity Control 473
26.1 Characteristics for Classifying Capacity Controls 474
26.1.1 Criteria 474
26.1.2 Degree of Detail 477
26.1.3 Trigger Logic 478
26.2 Capacity Flexibility 478
26.2.1 Definitions and Fundamentals 479
26.2.2 Flexibility of Machinery Capacities 480
26.2.3 Flexibility of Workforce Capacities 481
26.2.4 Resulting Capacity Flexibility of a Production 484
26.3 Principles of Capacity Control 486
26.4 Employee Allocation 487
26.4.1 Criteria for Allocating Employees 488
26.4.2 Trigger Logic 488
26.4.3 Locality of the Employee Allocation 489
References 489

27 Backlog Control 491
27.1 Method Description 491
27.2 Measuring the Backlog 495
27.2.1 Method Independent Fundamentals of Measuring the Backlog 495
27.2.2 Method Dependent Backlog Measurement 497

27.3 Selecting Measures 501
27.3.1 Determining the Duration and Magnitude of the Capacity Adjustment 501
27.3.2 Deriving Measures for Adjusting Capacities 504
27.4 Discussion of the Procedural Rules 505
27.5 Setting the Method's Parameters 507
27.6 Application 507
References 509

28 Further Methods for Controlling Capacity 511
28.1 Plan Oriented Capacity Control 511
28.1.1 Method Description 512
28.1.2 Discussion of the Procedural Rules 514
28.1.3 Application 514
28.2 Due Date Oriented Capacity Control 514
28.2.1 Method Description 515
28.2.2 Discussion of the Procedural Rules 519
28.2.3 Comparison with the Backlog Control 520
28.2.4 Determining the Lateness Limits 521
28.2.5 Application 522
28.3 Output Rate Maximizing Capacity Control 522
28.3.1 Method Description 523
28.3.2 Discussion of the Procedural Rules 527
28.4 Inventory Based Capacity Control (INCAP) 529
28.4.1 Method Description 530
28.4.2 Discussion of the Procedural Rules 533
28.4.3 Application 534
References 535

Part F Configuring the Manufacturing Control

29 Configuring the Manufacturing Control 539
29.1 Introduction 540
29.2 Selecting an Order Generation Method 541
29.3 Selecting an Order Release Method 543
29.3.1 Selecting a Method Class 544
29.3.2 Selecting a Method 547
29.3.3 Combinations of Methods for Releasing Orders 548
29.4 Selecting Sequencing Rules 549
29.5 Selecting a Capacity Control Method 551
Available Capacity Flexibility 552
No Capacity Flexibility 552
Temporary Capacity Flexibility 553

29.6 Case Studies 553
29.6.1 Manufacturing Control in a Make-to-Stock Production .. 553
29.6.2 Manufacturing Control in a Mixed Production 558
29.6.3 Manufacturing Control in a High Volume Make-to-Stock Production 563
29.7 Implementing a Configuration 567
29.8 Conclusion 570
References 571

Index 573

http://www.springer.com/978-3-642-24457-5

Handbook of Manufacturing Control
Fundamentals, description, configuration
Lödding, H.
2013, XXV, 577 p., Hardcover
ISBN: 978-3-642-24457-5