

Contents

0 Modeling Manufacturing Systems: an Introduction	
<i>P. Brandimarte, A. Villa</i>	1
0.1 Introduction and overview of the contributions	1
0.2 For further reading	3
0.3 References	3
1 From the Aggregate Plan to Lot-Sizing in Multi-level Production Planning	
<i>J.-C. Hennet</i>	5
1.1 Introduction	5
1.2 The planning process	6
1.2.1 The Aggregate Planning Problem (APP)	6
1.2.2 The detailed planning level	10
1.2.3 The multi-stage planning problem	10
1.3 The Lot-Sizing Problem	13
1.3.1 Problem description	13
1.3.2 A decomposed technique for cost evaluation	17
1.4 Example	19
1.5 Conclusion	21
1.6 References	21
2 Shop Floor Scheduling in Discrete Parts Manufacturing	
<i>G.J. Meester, J.M.J. Schutten, S.L. van de Velde, W.H.M. Zijm</i>	25
2.1 Introduction	25
2.2 Basic decomposition approach	28
2.3 Multi-resource scheduling	31
2.4 Set-up times	32
2.5 Convergent and divergent job routings	33
2.6 Further extensions and practical aspects	34
2.6.1 Transportation times	34
2.6.2 Unequal transfer and production batches	35
2.6.3 Open shops	36
2.7 JOBPLANNER	37
2.7.1 Components of JOBPLANNER	38
2.7.2 Practical experiences with JOBPLANNER	38
2.8 Conclusions	39
2.9 References	40
Appendix A: Derivation of set-up jobs	43

3 Integrating Layout Design and Material Flow Management in Assembly Systems	
<i>M.Lucertini, D.Pacciarelli, A.Pacifci</i>	45
3.1 Introduction	45
3.2 Statement of the problem	47
3.2.1 Problem data	47
3.2.2 Decision variables	48
3.2.3 A numerical example	48
3.2.4 Problem statement	51
3.3 Feasibility properties	52
3.3.1 Feasibility graph	52
3.3.2 Feasibility given π	54
3.3.3 Feasibility given λ	54
3.4 Optimization properties	56
3.4.1 Completion time minimization	57
3.4.2 Cycle time minimization	59
3.4.3 Part transfer minimization	59
3.5 Conclusions	60
3.6 References	60
3.7 Appendix: proofs of theorems	62
3.7.1 Proof of theorem 1	62
3.7.2 Proof of theorem 2	62
3.7.3 Proof of theorem 3	62
3.7.4 Proof of theorem 4	63
3.7.5 Proof of theorem 5	64
4 Reactive Scheduling in Real Time Production Control	
<i>E. Szelke, L. Monostori</i>	65
4.1 Reactive operation management - Predictive, reactive and proactive scheduling	65
4.1.1 Objectives of reactive operation management - reactive/proactive scheduling	66
4.1.2 Monitoring - A basis of RS/PS in real-time production control	70
4.1.3 RS problem complexity - IT requirements against solution approaches	75
4.2 Models of reactive and proactive scheduling problems	77
4.2.1 Graphical modelling techniques	79
4.2.2 Simulation	80
4.2.3 Concurrent Modelling Language (CML)	81
4.2.4 Graph theoretic modelling used for RS as a Constraint Satisfaction (CS) problem	82
4.2.5 Neural network models	84
4.2.6 Genetic algorithm based models	85
4.2.7 Stochastic models of proactive scheduling	85
4.2.8 Distributed agent architectures	86
4.3 Solution approaches - methods, techniques, tools	90
4.3.1 AI-based methods and heuristic search techniques of RS	90

4.3.2	Combined methods of reactive scheduling	92
4.4	Conclusions: future research issues in the field	95
4.5	References	97
5	Simulation within CAD-Environment	
	<i>P. Kopacek, G. Kronreif, T. Perme</i>	115
5.1	Introduction	115
5.1.1	Simulation and CAD	117
5.2	Simulation system LASIMCO	119
5.2.1	Formulation of requirements	119
5.2.2	Conceptual solution and applied theory	120
5.2.3	Developed tools	123
5.2.4	Examples	126
5.3	Simulation in robotics – ROMOBIL/SITAR	129
5.3.1	Introduction	129
5.3.2	Simulation system SITAR	131
5.3.3	Modelling of robot cells in ROMOBIL	132
5.3.4	Application example	134
5.4	Conclusion	135
5.5	References	136
6	Model of Material Handling and Robotics	
	<i>C.-Y. Huang, S.Y. Nof</i>	139
6.1	Introduction	139
6.2	Traditional models of material handling and robotics	140
6.2.1	Traditional approaches	140
6.2.2	Concerns with traditional modeling approaches	141
6.2.3	A Comparison of models of material handling and robotics with the tool perspective	141
6.3	Facility Description Language (FDL)	141
6.4	Concurrent Flexible Specifications (CFS) for material handling and robotics	144
6.4.1	CFS using data/control flow diagram and Petri nets	145
6.4.2	Overview of specification software tools	146
6.4.3	Case study application	146
6.4.4	Flexibility of specification	157
6.5	Discussion and conclusion	157
6.6	References	158
7	A Simultaneous Approach for IMS Design: a Possibility Based Approach	
	<i>G. Perrone, S. Noto La Diega</i>	161
7.1	Introduction	161
7.2	The decisional environment for Strategic IMS Design	163
7.3	The Strategic IMS Design Decision-Making Tool: the possibilistic programming theory	166
7.4	The possibilistic framework for strategic FMS design	171
7.4.1	Market	171

7.4.2	Production	175
7.4.3	Redditivity and risk	179
7.4.4	Framework optimisation model	183
7.5	Numerical example	184
7.6	Conclusions	187
7.7	References	188
8	Adaptive Production Control in Modern Industries	
<i>K.N. McKay, J.A. Buzacott</i>		193
8.1	Introduction	193
8.2	Motivation - inherent uncertainty	194
8.3	Applying production control methods - a perspective	195
8.3.1	Production control - 1900-1930	196
8.3.2	Production control - 1945-1965	198
8.3.3	Production control - 1965-1980	200
8.3.4	Production control - 1980-present	201
8.4	Production control concepts for immaturity or uncertainty	203
8.4.1	Organizational design	203
8.4.2	Plan generation	207
8.4.3	Plan execution	209
8.5	Conclusion	210
8.6	Acknowledgments	211
8.7	References	211