
Contents

Introduction	1
1 Models and Basic Concepts	7
1.1 Temporal Constraints	7
1.1.1 Time-Feasible Schedules	7
1.1.2 Project Networks	9
1.1.3 Temporal Scheduling Computations	11
1.2 Renewable-Resource Constraints	16
1.2.1 Resource-Feasible Schedules	16
1.2.2 Forbidden Sets and Delaying Alternatives	19
1.2.3 Breaking up Forbidden Sets	21
1.2.4 Consistency Tests	23
1.3 Cumulative-Resource Constraints	28
1.3.1 Resource-Feasible Schedules	30
1.3.2 Forbidden Sets and Delaying Alternatives	32
1.3.3 Breaking up Forbidden Sets	35
1.3.4 Consistency Tests	36
2 Relations, Schedules, and Objective Functions	39
2.1 Resource Constraints and Feasible Relations	39
2.1.1 Renewable-Resource Constraints	40
2.1.2 Cumulative-Resource Constraints	46
2.2 A Classification of Schedules	52
2.2.1 Global and Local Extreme Points of the Feasible Region	52
2.2.2 Vertices of Relation Polytopes	53
2.3 Objective Functions	55
2.3.1 Regular and Convexifiable Objective Functions	56
2.3.2 Locally Regular and Locally Concave Objective Functions	60
2.3.3 Preorder-Decreasing Objective Functions	64

3	Relaxation-Based Algorithms	65
3.1	Regular Objective Functions	66
3.1.1	Enumeration Scheme	66
3.1.2	Solving the Relaxations	69
3.1.3	Branch-and-Bound	72
3.1.4	Additional Notes and References	76
3.2	Convexifiable Objective Functions	82
3.2.1	Enumeration Scheme	83
3.2.2	Solving the Relaxations: The Primal Approach	85
3.2.3	Solving the Relaxations: The Dual Approach	94
3.2.4	Branch-and-Bound	97
3.2.5	Additional Notes and References	99
4	Constructive Algorithms	107
4.1	Schedule-Generation Scheme	109
4.2	Local Search	115
4.3	Additional Notes and References	118
5	Supplements	123
5.1	Break Calendars	124
5.2	Sequence-Dependent Changeover Times	128
5.3	Alternative Execution Modes for Activities	131
5.4	Continuous Cumulative Resources	135
6	Applications	141
6.1	Make-to-Order Production Scheduling	142
6.2	Small-Batch Production Planning in Manufacturing Industries	147
6.3	Production Scheduling in the Process Industries	149
6.4	Evaluation of Investment Projects	155
6.5	Coping with Uncertainty	160
	Conclusions	165
	References	167
	List of Symbols	181
	Index	185