Table of Contents

1. Introduction **1**
1.1 The problem 1
1.2 Terminology and data representation 4

2. Algorithms / Policies **9**
2.1 The canonical form: order-based and inventory-based policies 9
2.2 Examples 14
2.3 Anticipative (commitment-based) policies 17
2.4 Flexible commitment policies 20
2.5 Policies for queuing systems and traffic flow 21

3. Algorithmic Properties **25**
3.1 Properness 25
3.2 Steady-state properties 28

4. Stability and Monotonicity Requirements **35**
4.1 Types of stability 35
4.2 Stability analysis 38
4.3 Interpretation and examples 42
4.4 Some additional properties of linear, order-based policies 49
4.5 Duality: Serial queues and "push chains" 52

5. Strongly Stable Policies: The Act Method **55**
5.1 The kinematic wave target 55
5.2 Discrete-time approximations of the KW target 63
5.2.1 General Results for Linear Targets 63
5.2.2 The ACT family 67
5.2.3 Properties of the linear ACT policy: linear case and JIT systems 73
5.2.4 Properties of the ACT policy: non-linear case 74

6. Cost Estimation and Optimization **79**
6.1. Autonomous user-optimal operation with flexible commitments 80
6.2. Coordinated "system-optimum" operation: Optimization 85
6.2.1 Rigid operation: JIT systems 85
6.2.2. Flexible operation with "system-optimum" bounds 87

7. Discussion **99**
7.1 Extensions: Multi-commodity networks 99
7.2 Application issues 101

References **103**

Appendix A: Stability via Control Theory **107**

Appendix B: Kinematic Wave Theory Revisited **111**
B.1 Preliminaries 111
B.2 The KW Theory Revisited 112
B.3 Properties of the procedure 121