

Table of Contents

Acknowledgements	5
Table of Contents	9
1 Introduction	13
1.1 Problem Context	13
1.2 Strategies for Dealing with Demand Uncertainty	16
2 Capacity Decisions in Supply Chains with Independent Agents	21
2.1 Introduction	21
2.2 The Supply Chain Model	31
2.2.1 Nomenclature	36
2.3 The Coordinated Supply Chain	38
2.4 Two Games with a Constant Wholesale Price Per Unit	41
2.4.1 The Exogenous Wholesale Price Game	42
2.4.2 The Wholesale Price Controlled by the Manufacturer	47
2.5 Quantity Premium Price Schedules Controlled by the Manufacturer	51
2.5.1 The Exogenous Wholesale Price Game with a Single Breakpoint Quantity Premium	56
2.5.2 The Wholesale Price and Quantity Premium Controlled by the Manufacturer	60
2.5.2.1 A Single Breakpoint Schedule	60
2.5.2.2 A Schedule with Two Breakpoints	64
2.5.3 A Continuous Quantity Premium Schedule	67
2.6 Games in which the Wholesale Price Schedule is Controlled by the Supplier	71

2.7	The Multiple Supplier Model	75
2.7.1	The Exogenous Wholesale Prices Game	77
2.7.2	The Wholesale Prices Controlled by the Manufacturer	79
2.8	Quantity Premiums when the Manufacturer has Unlimited Capacity	82
2.9	Conclusion	84
3	Process Flexibility in Supply Chains with Multiple Products	87
3.1	Introduction	87
3.2	The Model	93
3.2.1	The Production Planning Problem	95
3.2.1.1	A Lower Bound on the Minimum Shortfall	97
3.2.2	Nomenclature	102
3.3	Supply Chain Inefficiencies	104
3.3.1	Stage-Spanning Bottlenecks	105
3.3.1.1	Probability of Occurrence of a Stage-Spanning Bottleneck	108
3.3.2	Floating Bottlenecks	112
3.4	Performance Measurement	115
3.4.1	Configuration Loss	116
3.4.2	Probability that Supply Chain Shortfall Exceeds Total Flexibility Shortfall	118
3.4.3	Configuration Inefficiency	121
3.5	A General Class of Configurations	123
3.5.1	Stage-Spanning Bottlenecks in g-type configurations	126
3.5.1.1	Existence of Stage-Spanning Bottlenecks	126
3.5.1.2	Probability of Stage-Spanning Bottlenecks	128

3.5.2 Probability of Shortfall Exceeding Total Flexibility in g_{\min} -type Supply Chains	131
3.6 Flexibility Configured in Pairs	133
3.6.1 Supply Chain Inefficiencies	134
3.6.2 Configuration Performance	137
3.7 Flexibility Configured in Chains	139
3.7.1 Supply Chain Inefficiencies	140
3.7.2 Configuration Performance	143
3.7.3 Random Chains versus Replicated Configurations	146
3.7.4 Unequal Capacity Usage	148
3.8 Conclusion	150
4 Capacity Decisions in Supply Chains with Multiple Products	153
4.1 Introduction	153
4.2 The Model	158
4.2.1 Nomenclature	160
4.3 Service Level Criterion	161
4.3.1 Work Center A	162
4.3.2 The Formulation	164
4.3.3 Independent Stage Demands	166
4.3.4 A Bonferroni Inequality	173
4.3.5 Work Center A Results	179
4.4 Expected Shortfall Criterion	186
4.4.1 The Alcalde Job Shop	188
4.4.2 Independent Stage Demands	189

4.4.3 A Scenario Based Stochastic Program	196
4.4.3.1 Results for the Alcalde Job	203
4.5 Conclusion	209
5 Appendices and References	211
5.1 Appendix 1 – Proofs for Chapter 2	211
5.2 Appendix 2 – Proofs for Chapter 3	239
5.3 Appendix 3 – Proofs for Chapter 4	257
5.4 References	265