URBAN TRANSIT: OPERATIONS, PLANNING, AND ECONOMICS

Vukan R. Vuchic





JOHN WILEY & SONS, INC.

CONTENTS

Preface	
Acknowledgment	ts

xiii xv

PART I TRANSIT SYSTEMS OPERATIONS AND NETWORKS

1 TRANSIT OPERATIONS AND SERVICE SCHEDULING	 1.3.4 Passenger Volume Analysis and Serv Capacity Determination, 37 3 1.3.5 Characteristics of Travel on a Transit 	
 1.1 Basic Operating Elements, 4 1.1.1 Line, Network, Stop, and Station, 4 1.1.2 Vehicles, Transit Units, and Fleet Size, 6 1.1.3 Usage of Service: Passenger Flow an Volume, 6 	1.4 Scheduling of Service, 44 1.4.1 Components of the Scheduling	
 1.1.4 Operating Elements: Headway and Frequency, 7 1.1.5 Capacity, Work, and Utilization, 11 1.1.6 Travel Times, 14 1.1.7 Speeds, 18 	 1.4.3 Scheduling Procedure, 51 1.4.4 Procedure Summary, Examples, and Numerical Schedules, 52 1.4.5 Graphical Presentations of Transit 	
 1.2 Information Files and Data Collection: Surveys and Counts, 22 1.2.1 Organization of Surveys, 23 1.2.2 Transit Speed-and-Delay Survey, 24 1.2.3 Passenger Volume and Load Count, 		
 1.2.4 Passenger Boarding and Alighting Counts, 25 1.2.5 Other Types of Surveys, 28 1.3 Transit Travel Characteristics, 28 	2 CAPACITY, SPEED, ACCELERATED AND SPECIAL OPERATIONS	7
 1.3.1 Factors Influencing Transit Travel, 30 1.3.2 Spatial Distribution of Transit Travel, 31 1.3.3 Temporal Variations of Transit Travel, 34 	2.1 Transit Line Capacity, 78 2.1.1 Elements of Line Capacity, 79 2.1.2 Capacity Computations, 87 2.1.3 Systems Approach to Transit Line Capacity, 91	

2.1.4 Capacities of Different Modes, 93

3.3.1 The Mathematical Modeling

2.2	Increase of Transit Speed, 98	Procedure, 166
	2.2.1 Desirability of Speed Increase, 98	3.3.2 Models for Optimization of Rolling
	2.2.2 Possible Measures for Speed	Stock, 167
	Increase, 99	3.3.3 Models for Analysis of Operations, 173
	2.2.3 Sensitivity of Transit Speeds to	3.4 Applications of Simulation Methodology, 178
	Elements of Cycle Time, 104	3.5 Evaluation of Systems Analysis and
	2.2.4 Evaluation of Measures for Speed	Operations Research in Transit, 179
	Increase, 108	
2.3	Stops and Stopping Regimes, 114	•
	2.3.1 Definitions and Relationships, 114	4
	2.3.2 Stopping Regimes and Stops, 115	TRANSIT LINES AND NETWORKS 185
	2.3.3 Practical Values of Stop Spacings, 116	
2.4	Accelerated Rail Transit Operations with	4.1 Planning Objectives, Principles, and
	Fixed Stopping Schedules, 118	Considerations, 186
	2.4.1 Skip-Stop Operation, 119	4.1.1 Passenger Attraction, 186
	2.4.2 Zonal Operation, 128	4.1.2 Network Operating Efficiency, 188
	2.4.3 Express/Local Operation, 131	4.1.3 Network-City Interactions, 190
	2.4.4 Comparison of All-Stop, Skip-Stop,	4.2 Geometry of Transit Lines, 191
	Zonal, and Express/Local	4.2.1 Spacing of Parallel Lines, 191
	Operations, 135	4.2.2 Line Lengths, 193
	2.4.5 Methodology for Selection of	4.2.3 Line Alignments, 195
	Accelerated Operations, 138	4.2.4 Independent versus Integrated
2.5	Scheduling of Single-Track Lines, Circle	Lines, 195
	Lines, and Trunk Lines with Branches, 140	4.3 Types of Transit Lines and Their
	2.5.1 Single-Track Lines, 140	Characteristics, 201
	2.5.2 Circle Lines, 145	4.3.1 Radial and Diametrical Lines, 201
	2.5.3 Trunk Lines with Branches, 146	4.3.2 Tangential, Circumferential, Circle, and
		Loop Lines, 204
3		4.3.3 Trunk Lines with Branches and
	DELING AND OPTIMIZATION IN	Feeders, 206
	ANSIT SYSTEMS ANALYSIS 158	4.3.4 Rights-of-Way in Special
		Alignments, 213
3.1	Application of Systems Analysis in	4.4 Transfers in Transit Networks, 215
	Transit, 159	4.4.1 Classification of Transfers by Headway
	3.1.1 Introduction of Methodology, 159	Length, 216
	3.1.2 Classification of Applications, 161	4.4.2 Classification of Transfers by Type of
3.2	Conceptual Models, 162	Line, 217
	3.2.1 The Conceptual Modeling	4.4.3 Metro Station Layouts and Schedules
	Methodology, 163	for Simultaneous Transfers, 220
	3.2.2 Representative Applications of	4.4.4 The Importance of Transfers, 223
	Conceptual Models, 163	4.5 Timed Transfer System Networks, 224
3.3	Mathematical Modeling Procedure and	4.5.1 Timed Transfer System Scheduling, 225
	Applications, 166	4.5.2 Multifocal Networks, 228

5.2 Passenger Travel Time, 269

5.2.1 Two Trade-offs, 269 **5.2.2** The Model, 270

Boarding, 274

Boarding, 276

5.2.3 Case a: Uniform Passenger Distribution, 273

5.2.4 Case b: Uniform Cumulative

5.2.5 Case c: Variable Cumulative

5.2.6 Case d: Variable Boarding and

4.5.3 Graphical Presentation of Synchronized

4.6.1 Networks of Modes with Different

Right-of-Way Categories, 234

4.6.2 Rail Transit Network Types and Their

4.6.3 Review of Transit Network Types, 245

Schedules, 233

Characteristics, 234

4.6 Transit Network Types and Their

Characteristics, 235

4.7 Analysis of Metro Network Geometric	5.2.6 Case d: Variable Boarding and
Forms, 248	Alighting, 276
4.7.1 Classification of Metro Network	5.2.7 Application of Theoretical Analysis to
Measures and Indicators, 249	Rapid Transit Station Planning, 276
4.7.2 Network Size and Form, 249	5.3 Other Objectives in Station Location
4.7.3 Network Topology, 252	Selection, 278
4.7.4 Application to Network Analysis, 254	5.3.1 Area Coverage, 278
4.7.5 Relationship of Metro Network to the	5.3.2 Attraction of Passengers, 280
City, 254	5.3.3 Cost of Stations, 280
4.7.6 Measures of Offered and Utilized	5.3.4 Auto-Transit Interface, 281
Service 258	5.3.5 Local Objectives and Requirements, 283
477 Selection of Evaluation Items for	5.4 Integration of Objectives, 283
Specific Analysis, 258	5.5 Addition or Closing of a Station, 285
Specific littlesis, 250	5.6 Area Coverage versus Operating Speed, 285
	5.6.1 Conventional Approaches to Planning of
5	Stations, 285
PLANNING OF RAIL TRANSIT STATION	5.6.2 Use of Skip-Stop Services to Improve
LOCATIONS 268	Area Coverage, 287
	5.7 Station Spacings on Actual Rail Transit
5.1 Objectives in Station Location Planning, 268	Networks, 289
PART II TRANSIT AGENCY ECO 6 TRANSIT AGENCY OPERATIONS,	6.3 Transit System Statistics, Performance, and Economic Measures, 308
ECONOMICS, AND MARKETING 299	6.3.1 Transit Service Area and Its
ECONOMICS, AND MARKETING 299	Characteristics, 308
6.1 Organizational Structure of Transit	6.3.2 Transit System and Services, 309
Agencies, 299	6.3.3 Transit Usage, Work, and
6.1.1 Board of Directors, 300	Productivity, 312
6.1.2 Organizational Setup, 301	6.3.4 Revenues, Costs, and Operating
6.2 Management and Personnel, 303	Ratio, 313
6.2.1 Management Organization, 303	6.3.5 Indicators of Efficiency, Utilization, and
6.2.2 Personnel and Labor Unions, 304	Consumption, 314
A ALDOING MICH DAUGI CINCID, 50 1	Commission, D. I.

6.4	Trans	it Agency Operations, 315
		Attitudes toward Transit Users, 315
	6.4.2	Organization and Control of
		Operations, 318
	6.4.3	Applications of ITS/Telematics
•		Technology, 319
	6.4.4	Rail Rolling Stock/Bus Fleet
		Maintenance and Replacement, 325
	6.4.5	Safety, Legal Suits, and Security, 331
6.5		it System Full Accessibility, 340
		The Problem of Mobility and Its
	-,-,-	Solutions, 340
	6.5.2	Accessibility of Different Transit
		Modes, 343
	6.5.3	Accessibility for Different User
		Categories, 347
	6.5.4	Results and Significance of Full
		Accessibility, 348
6.6	Infor	mation System for Passengers, 350
		Planning a Transit Information
		System, 350
	6.6.2	Classification of Present and Potential
		Users, 351
	6.6.3	Information Items: Their Contents and
		Forms, 352
	6.6.4	Locations of Information, 353
		Common Causes of Deficiencies in
		Information Systems, 358
	6.6.6	Planning, Testing, and Maintenance of
		the Information System, 359
6.7	Mark	eting and Public Relations, 360
	6.7.1	Definition and Purpose, 361
	6.7.2	Marketing Strategies, 361
	6.7.3	Marketing Activities, 362
	6.7.4	Public Relations, 367
	6.7.5	Conclusions, 368
7		
TR/	ANSIT	FARES 374
7.1	Objec	ctives in Transit Fare Determination, 374
		Collection, 376
_		Times, Locations, and Methods of Fare
		Collection and Control, 376
	7.2.2	Forms of Payment, 378

7.2.3 Self-Service Fare Collection

7.2.4 Automated Fare Collection (AFC), 383

(SSFC), 380

	7.2.5	Evaluation of Fare-Collection
		Systems, 384
7.3	Fare	Structures, 384
	7.3.1	Flat Fare, 385
		Graduated Fares, 386
	7.3.3	Comparison of the Three Basic Fare
		Structures, 387
	7.3.4	Transfer Fares, 388
7.4	Speci	al Higher and Lower Fares, 389
		Fares for High-Quality Services, 390
		Peak/Off-Peak and Commuter
		Fares, 391
	7.4.3	Child, Family, and Student Fares, 391
		Fares for Senior Citizens and Disabled
		and Low-Income Persons, 392
	7.4.5	Night, Group, Family, and Other Special
		Fares, 393
	7.4.6	Use of Special Fares, 393
7.5		Level, 394
	7.5.1	Influencing Factors, 394
		The Range and Domains of Fare
		Level, 394
	7.5.3	Fare Elasticity of Transit Demand, 395
		Characteristics of Different Fare Level
		Domains, 398
	7.5.5	Selection of Fare Level, 399
8		•
FIN	ANCI	NG OF TRANSIT 403
8.1	Princ	iples and Trends in Financing Transit
		ces, 403
	8.1.1	Government Participation in
		Transportation Financing, 403
	8.1.2	Funding of Different Transportation
		Modes in the United States, 405
	8.1.3	Principles in Allocating Transportation
		Funds, 405
	8.1.4	Sources of Funds for Public
	٠.	Services, 408
	8.1.5	Relationship of Transit Fare Levels and
		Public Financing, 409
	816	Roles of Different Government

Levels, 411

Transit, 413

8.1.7 Summary Review of Public Policies in

Transit Financing, 412

8.2 Sources of Local and State Funds for

8.2.1 Taxes Dedicated to Trans	
8.2.2 Characteristics of Differe	
Taxes, 414	9.2.1 Private Transit Companies, 435
8.2.3 Transit Organizations with	
Powers, 418	9.2.3 Regional Transit Agencies, 436
8.2.4 Structure of Local-State-	
Funding, 419	Different Operators, 438
8.3 Federal Funding of Transit, 41	
8.3.1 Development of the Fede	
Transit, 419	Federation, 439
8.3.2 Trends in Federal Funding	ng, 420 9.4 Regulation of Transit Services, 440
8.3.3 Criteria for Capital Fund	
Allocation, 421	Categories by Subject, 440
8.4 Improving the Efficiency of Tra	ansit 9.4.2 The Role and Importance of Transit
Agencies, 423	Regulation, 444
8.4.1 Requirements for Efficien	ncy, 423 9.5 Unregulated Transit Services, 445
8.4.2 International Efforts to Ir	
Efficiency, 424	Countries, 445
9	9.5.2 Deregulation Experiments in Developed
TRANSIT OWNERSHIP, REGULA	ATION, Countries, 448
AND ORGANIZATION	9.5.3 Transit Deregulation in Other
	Countries, 454
9.1 Private Transit Companies and	Public 9.6 Evolving Forms of Transit Ownership,
Takeover, 429	Organization, and Management, 454
9.1.1 Transit Origins and the N	Need for 9.6.1 Organizational Problems and Their
Government Control, 430	Causes, 454
9.1.2 The Problems with Priva	te 9.6.2 Reevaluation of Transit Agency
Companies, 431	Structures, 456
9.1.3 Public Takeover of Trans	9.6.3 Privatization and Other Forms of Trans
Companies, 432	Reorganization, 459
- -	

TRANSIT SYSTEMS PLANNING AND MODE

469

10.1	Purpos	se and Organization of Transit
	Planni	ng, 469
	10.1.1	Short- and Long-Range Trans
		Planning, 469
	10 1 2	Need for Comprehensive

TRANSIT SYSTEMS PLANNING

10

Planning, 470

10.1.3 Legal and Administrative Aspects, 471

10.1.4 The Initial Set of Comprehensive Transportation Plans, 474 10.1.5 Evolution and Trends in Urban Transportation Planning, 477

10.2 Planning Procedure and Methodology, 479 10.2.1 The Basic Steps in a Transportation Planning Process, 479

> 10.2.2 Transit System Planning Procedure, 480

10.2.3 Setting Goals, Policies, Objectives, and Standards, 483

		10.2.4 Data Collection and Evaluation of the Present System, 486	11.4.4 An Example of the Mode-Comparison Procedure: Lindenwold Rail Line and
	10.3	Travel and Transit Demand Forecasting, 487	Shirley Busway, 547
		10.3.1 Introduction to Four-Step and Other Demand-Estimation Models, 488	12 PLANNING AND SELECTION OF
		10.3.2 Trip Generation, 490	MEDIUM- AND HIGH-PERFORMANCE
		10.3.3 Trip Distribution, 491	TRANSIT MODES 553
		10.3.4 Modal Split, 493	IRANSII MODES 333
	•	10.3.4 Modal Spirit, 493 10.3.5 Trip Assignment, 497 10.3.6 Alternative Methods to Four-Step Model, 498	12.1 Basic Elements of Transit Modes, 553 12.1.1 Right-of-Way Categories and Their Significance, 553
	10.4	Transit Plan Development, Evaluation, and	12.1.2 Transit System Technology, 558
	10.4	Selection, 500	12.1.3 Types of Network and Service, 562
		10.4.1 Planning Procedure, 500	12.1.4 Interdependence of ROW and
		10.4.2 Examples of Long-Range Transit	Systems Technology, 563
		Planning, 505	12.1.5 Review of Technological and
	10.5	Review of the Process and Trends in Transit	Operational Features, 565
		Planning, 512	12.2 Medium-Performance Transit Modes, 568
		10.5.1 Planning Process and Its	12.2.1 Bus Rapid Transit (BRT), 569
		Components, 512	12.2.2 Light Rail Transit (LRT), 577
	·	10.5.2 Trends in Transit Planning, 514	12.2.3 Automated Guided Transit (AGT), 582
	11		
			12.24 Comparisons of Medium Performance
		LYSIS, EVALUATION, AND	12.2.4 Comparisons of Medium-Performance Modes 587
•		LYSIS, EVALUATION, AND ECTION OF TRANSIT MODES 519	Modes, 587
	SEL	ECTION OF TRANSIT MODES 519	Modes, 587 12.3 High-Performance Transit Modes, 592
•	SEL	Evaluation and Selection of Public 519	Modes, 587
•	SEL 11.1	ECTION OF TRANSIT MODES 519	Modes, 587 12.3 High-Performance Transit Modes, 592 12.3.1 Light Rail Rapid Transit (LRRT)
	SEL 11.1	ECTION OF TRANSIT MODES 519 Evaluation and Selection of Public Projects, 519	Modes, 587 12.3 High-Performance Transit Modes, 592 12.3.1 Light Rail Rapid Transit (LRRT) Modes, 592 12.3.2 Rail Rapid Transit (Metro), 594 12.3.3 Rubber-Tired Rapid Transit
	SEL 11.1	Evaluation and Selection of Public Projects, 519 Transit Mode Evaluations, 522	Modes, 587 12.3 High-Performance Transit Modes, 592 12.3.1 Light Rail Rapid Transit (LRRT) Modes, 592 12.3.2 Rail Rapid Transit (Metro), 594 12.3.3 Rubber-Tired Rapid Transit (RTRT), 596
	SEL 11.1	Evaluation and Selection of Public Projects, 519 Transit Mode Evaluations, 522 11.2.1 Classification and Review of Mode-Comparison Studies, 522 11.2.2 The Basic Principles and	Modes, 587 12.3 High-Performance Transit Modes, 592 12.3.1 Light Rail Rapid Transit (LRRT) Modes, 592 12.3.2 Rail Rapid Transit (Metro), 594 12.3.3 Rubber-Tired Rapid Transit (RTRT), 596 12.3.4 Monorails, 597
	SEL 11.1	Evaluation and Selection of Public Projects, 519 Transit Mode Evaluations, 522 11.2.1 Classification and Review of Mode-Comparison Studies, 522 11.2.2 The Basic Principles and Methodology for Transit Mode	Modes, 587 12.3 High-Performance Transit Modes, 592 12.3.1 Light Rail Rapid Transit (LRRT) Modes, 592 12.3.2 Rail Rapid Transit (Metro), 594 12.3.3 Rubber-Tired Rapid Transit (RTRT), 596 12.3.4 Monorails, 597 12.3.5 Review of Guided Modes and Their
	SEL! 11.1 11.2	Evaluation and Selection of Public Projects, 519 Transit Mode Evaluations, 522 11.2.1 Classification and Review of Mode- Comparison Studies, 522 11.2.2 The Basic Principles and Methodology for Transit Mode Evaluation, 527	Modes, 587 12.3 High-Performance Transit Modes, 592 12.3.1 Light Rail Rapid Transit (LRRT) Modes, 592 12.3.2 Rail Rapid Transit (Metro), 594 12.3.3 Rubber-Tired Rapid Transit (RTRT), 596 12.3.4 Monorails, 597 12.3.5 Review of Guided Modes and Their Automation, 599
	SEL! 11.1 11.2	Evaluation and Selection of Public Projects, 519 Transit Mode Evaluations, 522 11.2.1 Classification and Review of Mode- Comparison Studies, 522 11.2.2 The Basic Principles and Methodology for Transit Mode Evaluation, 527 Definition of the Conditions Set, 528	Modes, 587 12.3 High-Performance Transit Modes, 592 12.3.1 Light Rail Rapid Transit (LRRT) Modes, 592 12.3.2 Rail Rapid Transit (Metro), 594 12.3.3 Rubber-Tired Rapid Transit (RTRT), 596 12.3.4 Monorails, 597 12.3.5 Review of Guided Modes and Their Automation, 599 12.3.6 Regional Transit Modes, 599
-	SEL! 11.1 11.2	Evaluation and Selection of Public Projects, 519 Transit Mode Evaluations, 522 11.2.1 Classification and Review of Mode- Comparison Studies, 522 11.2.2 The Basic Principles and Methodology for Transit Mode Evaluation, 527 Definition of the Conditions Set, 528 11.3.1 Passenger Requirements, 529	Modes, 587 12.3 High-Performance Transit Modes, 592 12.3.1 Light Rail Rapid Transit (LRRT) Modes, 592 12.3.2 Rail Rapid Transit (Metro), 594 12.3.3 Rubber-Tired Rapid Transit (RTRT), 596 12.3.4 Monorails, 597 12.3.5 Review of Guided Modes and Their Automation, 599 12.3.6 Regional Transit Modes, 599 12.3.7 Trends in Regional Rail Transit
	SEL! 11.1 11.2	Evaluation and Selection of Public Projects, 519 Transit Mode Evaluations, 522 11.2.1 Classification and Review of Mode- Comparison Studies, 522 11.2.2 The Basic Principles and Methodology for Transit Mode Evaluation, 527 Definition of the Conditions Set, 528 11.3.1 Passenger Requirements, 529 11.3.2 Transit Operator's Requirements, 534	Modes, 587 12.3 High-Performance Transit Modes, 592 12.3.1 Light Rail Rapid Transit (LRRT) Modes, 592 12.3.2 Rail Rapid Transit (Metro), 594 12.3.3 Rubber-Tired Rapid Transit (RTRT), 596 12.3.4 Monorails, 597 12.3.5 Review of Guided Modes and Their Automation, 599 12.3.6 Regional Transit Modes, 599 12.3.7 Trends in Regional Rail Transit Development, 605
	SEL! 11.1 11.2	Evaluation and Selection of Public Projects, 519 Transit Mode Evaluations, 522 11.2.1 Classification and Review of Mode- Comparison Studies, 522 11.2.2 The Basic Principles and Methodology for Transit Mode Evaluation, 527 Definition of the Conditions Set, 528 11.3.1 Passenger Requirements, 529 11.3.2 Transit Operator's Requirements, 534 11.3.3 Community Requirements, 541	Modes, 587 12.3 High-Performance Transit Modes, 592 12.3.1 Light Rail Rapid Transit (LRRT) Modes, 592 12.3.2 Rail Rapid Transit (Metro), 594 12.3.3 Rubber-Tired Rapid Transit (RTRT), 596 12.3.4 Monorails, 597 12.3.5 Review of Guided Modes and Their Automation, 599 12.3.6 Regional Transit Modes, 599 12.3.7 Trends in Regional Rail Transit Development, 605 Appendix I SI and English Units and
	SEL 11.1 11.2 11.3	Evaluation and Selection of Public Projects, 519 Transit Mode Evaluations, 522 11.2.1 Classification and Review of Mode-Comparison Studies, 522 11.2.2 The Basic Principles and Methodology for Transit Mode Evaluation, 527 Definition of the Conditions Set, 528 11.3.1 Passenger Requirements, 529 11.3.2 Transit Operator's Requirements, 534 11.3.3 Community Requirements, 541 11.3.4 Selection of Requirements, 543	Modes, 587 12.3 High-Performance Transit Modes, 592 12.3.1 Light Rail Rapid Transit (LRRT) Modes, 592 12.3.2 Rail Rapid Transit (Metro), 594 12.3.3 Rubber-Tired Rapid Transit (RTRT), 596 12.3.4 Monorails, 597 12.3.5 Review of Guided Modes and Their Automation, 599 12.3.6 Regional Transit Modes, 599 12.3.7 Trends in Regional Rail Transit Development, 605 Appendix I SI and English Units and Conversion Factors, 615
	SEL 11.1 11.2 11.3	Evaluation and Selection of Public Projects, 519 Transit Mode Evaluations, 522 11.2.1 Classification and Review of Mode-Comparison Studies, 522 11.2.2 The Basic Principles and Methodology for Transit Mode Evaluation, 527 Definition of the Conditions Set, 528 11.3.1 Passenger Requirements, 529 11.3.2 Transit Operator's Requirements, 534 11.3.3 Community Requirements, 541 11.3.4 Selection of Requirements, 543 Formulation, Comparison, and Selection of	Modes, 587 12.3 High-Performance Transit Modes, 592 12.3.1 Light Rail Rapid Transit (LRRT) Modes, 592 12.3.2 Rail Rapid Transit (Metro), 594 12.3.3 Rubber-Tired Rapid Transit (RTRT), 596 12.3.4 Monorails, 597 12.3.5 Review of Guided Modes and Their Automation, 599 12.3.6 Regional Transit Modes, 599 12.3.7 Trends in Regional Rail Transit Development, 605 Appendix I SI and English Units and Conversion Factors, 615 Appendix II List of Abbreviations, 621
	SEL 11.1 11.2 11.3	Evaluation and Selection of Public Projects, 519 Transit Mode Evaluations, 522 11.2.1 Classification and Review of Mode- Comparison Studies, 522 11.2.2 The Basic Principles and Methodology for Transit Mode Evaluation, 527 Definition of the Conditions Set, 528 11.3.1 Passenger Requirements, 529 11.3.2 Transit Operator's Requirements, 534 11.3.3 Community Requirements, 541 11.3.4 Selection of Requirements, 543 Formulation, Comparison, and Selection of Candidate Modes, 544	Modes, 587 12.3 High-Performance Transit Modes, 592 12.3.1 Light Rail Rapid Transit (LRRT) Modes, 592 12.3.2 Rail Rapid Transit (Metro), 594 12.3.3 Rubber-Tired Rapid Transit (RTRT), 596 12.3.4 Monorails, 597 12.3.5 Review of Guided Modes and Their Automation, 599 12.3.6 Regional Transit Modes, 599 12.3.7 Trends in Regional Rail Transit Development, 605 Appendix I SI and English Units and Conversion Factors, 615 Appendix II List of Abbreviations, 621 Appendix III Definitions of Transit Systems
	SEL 11.1 11.2 11.3	Evaluation and Selection of Public Projects, 519 Transit Mode Evaluations, 522 11.2.1 Classification and Review of Mode- Comparison Studies, 522 11.2.2 The Basic Principles and Methodology for Transit Mode Evaluation, 527 Definition of the Conditions Set, 528 11.3.1 Passenger Requirements, 529 11.3.2 Transit Operator's Requirements, 534 11.3.3 Community Requirements, 541 11.3.4 Selection of Requirements, 543 Formulation, Comparison, and Selection of Candidate Modes, 544 11.4.1 Formulation of Alternative Modes or	Modes, 587 12.3 High-Performance Transit Modes, 592 12.3.1 Light Rail Rapid Transit (LRRT) Modes, 592 12.3.2 Rail Rapid Transit (Metro), 594 12.3.3 Rubber-Tired Rapid Transit (RTRT), 596 12.3.4 Monorails, 597 12.3.5 Review of Guided Modes and Their Automation, 599 12.3.6 Regional Transit Modes, 599 12.3.7 Trends in Regional Rail Transit Development, 605 Appendix I SI and English Units and Conversion Factors, 615 Appendix II List of Abbreviations, 621 Appendix III Definitions of Transit Systems Terms, 623
	SEL 11.1 11.2 11.3	Evaluation and Selection of Public Projects, 519 Transit Mode Evaluations, 522 11.2.1 Classification and Review of Mode- Comparison Studies, 522 11.2.2 The Basic Principles and Methodology for Transit Mode Evaluation, 527 Definition of the Conditions Set, 528 11.3.1 Passenger Requirements, 529 11.3.2 Transit Operator's Requirements, 534 11.3.3 Community Requirements, 541 11.3.4 Selection of Requirements, 543 Formulation, Comparison, and Selection of Candidate Modes, 544	Modes, 587 12.3 High-Performance Transit Modes, 592 12.3.1 Light Rail Rapid Transit (LRRT) Modes, 592 12.3.2 Rail Rapid Transit (Metro), 594 12.3.3 Rubber-Tired Rapid Transit (RTRT), 596 12.3.4 Monorails, 597 12.3.5 Review of Guided Modes and Their Automation, 599 12.3.6 Regional Transit Modes, 599 12.3.7 Trends in Regional Rail Transit Development, 605 Appendix I SI and English Units and Conversion Factors, 615 Appendix II List of Abbreviations, 621 Appendix III Definitions of Transit Systems

Index

Procedure, 546

641