PUBLIC TRANSPORT MODAL CHARACTERISTICS AND ROLES

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Part III

Outline

1. Modal Characteristics
2. Public Transport Planning
3. Organizational Options

ROLES FOR EACH MODE

Low density flows | High density flows

Spread O-D pairs | Concentrated O-D pairs

Auto → Car pools → Van pools | Automated guideway

Subscription bus

taxi→ shared ride taxi → publicos → fixed route bus → light rail → heavy rail

SPECTRUM OF SERVICES

Increasing vehicle capacity →

Increasing flows →

Operating Arrangements \ Vehicle type	Car	Van	Minibus	Bus	Light Rail	Heavy Rail
Drivers	Free	Low cost	High cost (conventional transit)			Low cost (automated)
Right-of-way		Shared		Dual Mode		Dedicated
Routing and Scheduling	Flexible	Hybrid		Fixed		

Traditional Transit Services

- Bus on shared right-of-way
- Streetcar on shared right-of-way
- Light rail on exclusive right-of-way
- Heavy rail on exclusive right-of-way

Increasing Diversity

- Driver arrangements
- Routing and scheduling
- Vehicle types
- Control options
- Dual mode operations

Section 15: 1994 Performance for Top 30 Agencies

	Bus	Heavy Rail	Light Rail	Comm. Rail
Annual Pass-miles ($x10^9$)	10.6	10.5	0.6	7.5
Op. Cost/Rev Veh Hr ($)	84.29	151.31	198.85	356.53
Op. Cost/Rev Veh Mile ($)	6.97	7.34	14.50	10.59
Op. Cost Unlinked Pass Trip ($)	1.91	1.74	1.46	6.47
Op. Cost/Pass. Mile ($)	0.55	0.36	0.54	0.28
Unl. Pass Trips/Rev Veh Hr	44.1	87.1	136.1	55.1
Pass Miles/Rev Veh Hr	153	426	379	1,297
Mean Trip Length (miles)	3.5	4.9	2.7	23.3
Mean Pass Load	12.7	20.7	27.0	38.2
Mean Operating Speed (mph)	12.0	20.6	14.0	33.9

MODAL COMPARISON: BUS vs RAIL

Rail Advantages

- High capacity
- Lower operating costs
- Better service quality
- Stronger land use influence
- Fewer negative externalities

Bus Advantages

- Low capital costs
- Wide network coverage
- Single vehicle trips
- Flexibility
- "Dual mode" nature

Simple Capacity Analysis

Question: Given a pie-shaped sector corridor serving a CBD served by a single transit line, what will be the peak passenger flow at the CBD?

Given:

P_c = population density at CBD
dP = rate of decrease of population density with distance from CBD
θ = angle served by corridor
r = distance out from CBD
L = corridor length
t = number of one-way trips per person per day
c = share of trips inbound to CBD
m = transit market share for CBD bound trips
p = share of CBD bound transit trips in peak hour

Then:

Population in corridor
$$= \int_0^L r\theta\,(P_c - dPr)\,dr$$

$$= L^2\theta\left(\frac{P_c}{2} - \frac{dPL}{3}\right)$$

Peak Passenger Flow
$$= L^2\theta\left(\frac{P_c}{2} - \frac{dPL}{3}\right)tcmp$$

Maximum access distance to transit line = $L\theta/2$

Examples:

P_c	dP	θ	L	t	c	m	p	*Req. Capacity*	*Max Access*
10,000	800	$\frac{2\pi}{9}$	10	2.5	0.2	0.5	0.25	10,000	3.5
20,000	1,600	$\frac{2\pi}{9}$	10	1.5	0.3	0.8	0.25	30,000	3.5

ACTUAL CAPACITIES

Rail:	10 car trains, 200 pass/car, 2 minute headway	≡ 60,000 pass/hr
Bus:	70 pass/bus, 30 second headways	≡ 8,400 pass/hr
Light rail:	150 pass/car, 2 car trains, 1 minute headways	≡ 18,000 pass/hr

WORLDWIDE URBAN RAIL SYSTEMS

A. Full Metro Standards

Start Date	N. America	Europe	Rest of World	Total Starts	Cumulative Starts
Pre 1901	2	5	--	7	7
1901-1920	2	4	1	7	14
1921-1940	--	4	2	6	20
1941-1960	2	5	1	8	28
1961-1980	4	17	12	33	61
1981-1989	2	4	12	18	79
In Construction	1	7	5	13	92
TOTALS	13	47	32		

B. Light Rail Systems

	N. America	Europe	Rest of World	Total
Total Systems	18	42	12	72

SOME IMPORTANT QUESTIONS

- Need for quality in public transport
- Need to look critically at organizational options
- How to build new infrastructure
- How to finance public transport operations

PUBLIC TRANSPORT QUALITY

- Higher speed and reliability
- Greater responsiveness
- Better information
- Greater service diversity

PUBLIC TRANSPORT PLANNING

A. Long Range (> 3 Years)

Major Capital Investment: Infrastructure

Major Institutional Changes

Major New Services

B. Medium Range (1-3 Years)

Bus Network Structure

Network Size

Fleet Size

Fare Policy

C. Short Range (< 1 Year)

Route Structure

Service Frequency

Organizational Models

- Unregulated/Deregulated
- Regulated Competition
- Threatened Competition
- Private Monopoly
- Public Monopoly
- Contracting Out

Figure 1 - Six Organizational Models

	Unregulated	Regulated Competition	Threatened Competition	Private Monopoly	Public Monopoly	Contracting Out
Regulation	Minimum	Yes	Yes*	Yes	Yes	Yes*
Financing	PR	PR	PR	PR	PU	PR
Planning	PR	PU & PR	PU & PR	PR & PU	PU	PU
Ownership	PR	PR	PR	PR	PU	PR (or PU)
Operation	PR	PR	PR	PR	PU	PR
Maintenance	PR	PR	PR	PR	PU	PR

* The model is regulated in the form of contracts.

PU: Public Sector
PR: Private Sector

Purchased Transit Service in US Transit Industry (1994)

Mode	Operating Expense ($ million)			% Purchased
	Directly Operated	Purchased	Total	
Bus	8,050	810	8,860	9.1
Metro	3,786	---	3,786	---
Commuter Rail	1,934	294	2,228	13.2
Light Rail	412	---	412	---
Demand Responsive	194	440	634	69.4
Other	353	48	401	12.0
Total	14,729	1,592	16,321	9.8

Buses Operated in Maximum Service (1994)

	Directly Operated	Purchased	Total	% Purchased
MARTA	559	---	559	---
MTA	636	75	711	10.5
Boston	750	72	822	8.8
Chicago	1,729	---	1,729	---
Cleveland	636	---	636	---
Dallas	519	216	735	29.4
Denver	504	181	685	26.4
Honolulu	408	31	439	7.6
Houston	915	76	991	7.7
OCTA	365	48	413	11.6
LACMTA	1,912	36	1,948	1.8
MDTA	496	21	517	4.1
MCTO	849	11	860	1.3
NYCDOT	---	922	922	100
NYCTA	3,153	---	3,153	---
NJ Transit	1,596	1,073	2,669	40.2
SEPTA	1,120	---	1,120	---
PAT	733	---	733	---
TriMet	490	9	499	1.8
AC Transit	583	5	588	0.9
Muni	386	---	383	---
Santa Clara	380	13	393	3.3
Seattle	818	26	844	3.1
WMATA	1,294	---	1,294	---
TOTAL	19,102	2,815	21,917	12.8

Obstacles to greater private sector provision:

Key ingredients for private sector participation:

- service is new and different
- external intervention
- incomplete assimilation of private operators

Public monopoly model is highly stable in North America:

- small leverage for central government
- at state/local levels of government organized labor is a powerful force likely to resist change
- confrontational/ideological nature of the debate

Strategies for Progress:

- development of non-confrontational, incremental change proposals
- contingency plans
- replacement of marginally performing routes by contracted van or minibus service
- develop a database on results of initiatives by credible agency
- split policy board from operating functions
- corporatization and privatization of bus depots in large metropolitan areas