OC Transport - Chapter 2

What does the National Transportation Database Say?

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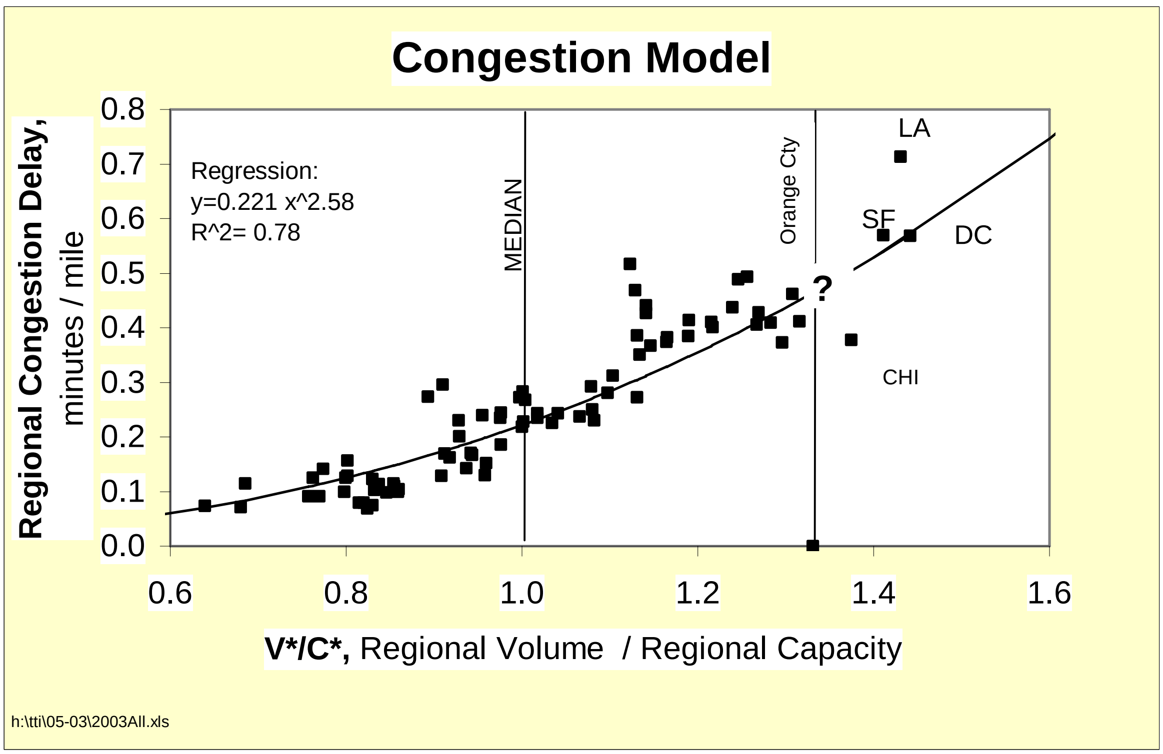
Figure 1 here addresses the question "How can we fairly measure and compare the mobility benefit[1] of diverse transportation improvements on a mode neutral, balanced scale. It plots urban regional average congestion delay, minute/mile (i.e. ***im***mobility) as dependent on the Regional Volume / Regional Capacity ratio, V*/C*.



V* is the regional *volume* of travel generated in regional travel. C* is the regional *capacity*, defined as the volume the regional system *could* support *at nominal (national median) congestion levels*. V* and C* are both expressed in "person-

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[1] "Mobility", the ability to get where we want to go in minimum time, is the generally accepted primary goal of our transportation system. The US DOT, SCAG, and the Texas Transportation Institute (TTI) (the de-facto national experts on urban mobility) all agree that the best single *measure* of Mobility is freedom from congestion, as defined and measured by regional average travel-delay, minutes per mile.

miles/day" (ps-mi/dy), summed over *all* components of the local transportation system, freeways, highways, roads, bus, rail, skyways, subways whatever. [2]

Each of the 83 dots in the chart correspond to one of the major US cities treated in the TTI Urban Mobility Study[3] and the congestion delay is that calculated by TTI. Furthest to the right, with worst congestion and worst V*/C* is the Los Angeles Urbanized area, of which Orange County is a part. Orange County itself lies somewhere on the labeled vertical line, presumably near the ? symbol.

What this tells us is this: Regional congestion can be estimated reasonably accurately by the regression curve, dependent only on V* and C*. For any given region, like Orange County, V* is to pretty good approximation, fixed or invariant with respect to moderate capacity increases. Therefore, the only way to reduce congestion significantly is to increase C*, adding capacity and sliding down the curve to the left and reduced congestion delay. That means we can get a rough but usefully accurate measure of the congestion or mobility benefit of a transportation project by how much added regional capacity, person-miles/day, it provides, irrespective of whether derived from freeway, streets, light rail, bus, street or whatever mode. In other words,

C is a mode neutral measure of mobility benefit*.

Our Orange County congestion immobility problem right now may be stated as a shortfall of about 31% or 33 million person-miles/day capacity, C*. In principle we could fill that need with roads, freeways rail, bus, skyways, subways whatever. Doing so would predictably cut our regional average congestion delay and $2 billion cost of congestion in half. However, there are vast differences in how much that might cost in dollars and right-of-way required under the various modal alternatives. For this we can turn to national precedents as documented in the NTD.

The National Transportation Database (NTD)

Since about 1970, the Department of Transportation has been compiling superb extensive annual databases of cost and performance of all highways, roads and transit programs of each of the about 650 US transportation agencies. Primary among these are

- "National Transit Database", (NTD) FTA , Annual. Primary source for Finance, capital and operations Expenditures, Performance, Usage, and Properties by transit mode for each of about 650 agencies http://www.ntdprogram.com/NTD/
- "Highway Performance Monitoring System", (HPMS) FHWA , sporadic, every 3-5 yrs or so. Primary Source for physical extent, condition and usage by 1-5 mile homogeneous segment, by agency for all US Urban and Rural, Interstate, freeway, primary and secondary arterial, collector and local streets, roads and highways. http://www.fhwa.dot.gov/policy/ohpi/hpms/index.htm

[2] Further technical details are in an accompanying paper, "A Multimodal Regional Congestion Model"

[3] "Urban Mobility", Texas Transportation Institute", 2005 (2003) http://mobility.tamu.edu/

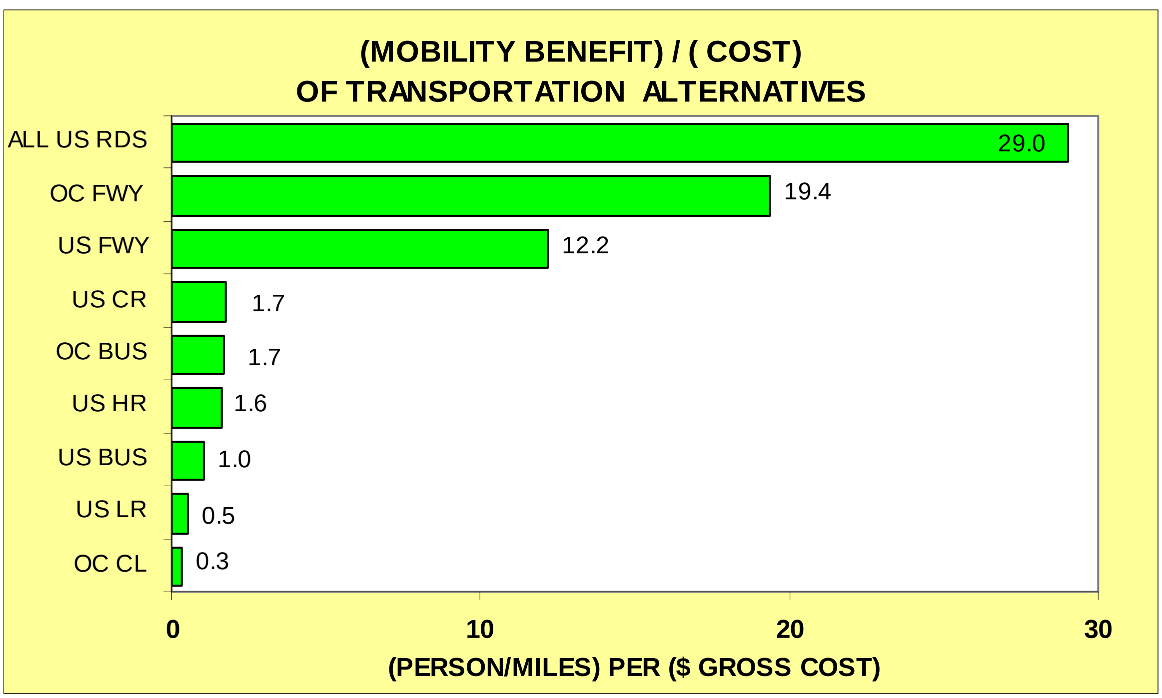
- “Highway Statistics” , (HS), FHWA, Annual. Primary source for federal, state and local roads and highway finance and expenditures. http://www.fhwa.dot.gov/policy/ohpi/hss/index.htm
- “National Household Travel Survey”, (NHTS), US DOT, BTS. Extensive survey census of travel characteristics, carpooling, AVO, trip lengths etc.by place and time of day. http://www.fhwa.dot.gov/policy/ohpi/nhts/index.htm

These primary US databases provide all the data needed to compute cost effectiveness ratio: C* / $, and, ROW effectiveness, C* / (ROW area), Arguably, these quantities, summed or averaged over 650 some national transportation agencies, can give us the best possible representative estimates of these effectiveness criteria for alternative modes.

The appended Spreadsheet, Table 1 carries out these calculations using primary data from national and Orange County experience.

Cost Effectiveness Results

Figure 2 charts the Cost Effectiveness, C*/$, (ps-mi/) / ($ gross cost) results.



Far the most cost effective mode is all US roads. This includes all categories from Urban interstates down through Rural collectors. However, most of these categories are not candidates for, nor relevant to solving urban congestion. Next in order is Orange County freeways followed closely by US freeways. The best of the transit modes, Commuter rail, bus, and heavy rail are only about 1/10 as cost effective as freeways and primary arterial roads. On the whole, if we are limited in funding, as we surely are, we can buy only about 1/10 the capacity and mobility benefit with the best of transit as with road. Orange County bus is significantly more cost effective than the US average bus system. The down side that goes with that is that it may imply a lower grade of service in the form of heavier average vehicle loading and headway.

US and OC CenterLine Light rail come in at the very bottom of the heap, dollar for dollar, about 1/40 the congestion relief of roads. The CenterLIne light rail numbers, at the bottom-bottom of the heap differ from all the other categories in that they are not derived from actual, but from consultant *predicted* costs and ridership. Historically, predicted light rail costs and ridership projections nationally and internationally have more often than not turned out to over optimistic.

CenterLine in particular comes in at 0.31 ps-mi/$ or, $3.22 /ps-mi. The following exercise may help to appreciate the significance of this: Suppose we decided to fill a significant fraction, say **37%** of our present 34 million person-mile/day capacity shortfall with Center Line light rail extensions at the same effectiveness. Using a 40 year life and 7% interest assumptions, the present value cost of doing so would be $208,000,000,000, two-hundred eight billion dollars. That happens to be *the assessed valuation of all Orange County* [4]. 'Nuff said.

Right-Of-Way Effectiveness

Some people these days, see availability of right-of-way as a more serious constraint than funding. In such case, *ROW effectiveness*, the transportation benefit per unit ROW area should be equally or more important than cost effectiveness. "ROW-effectiveness" may be expressed as (Mobility Benefit or C*) per (unit ROW area). For convenience we can choose to express ROW area in units of directional track-mile, essentially equivalent to roadway directional lane-mile, and about 1.57 acres.

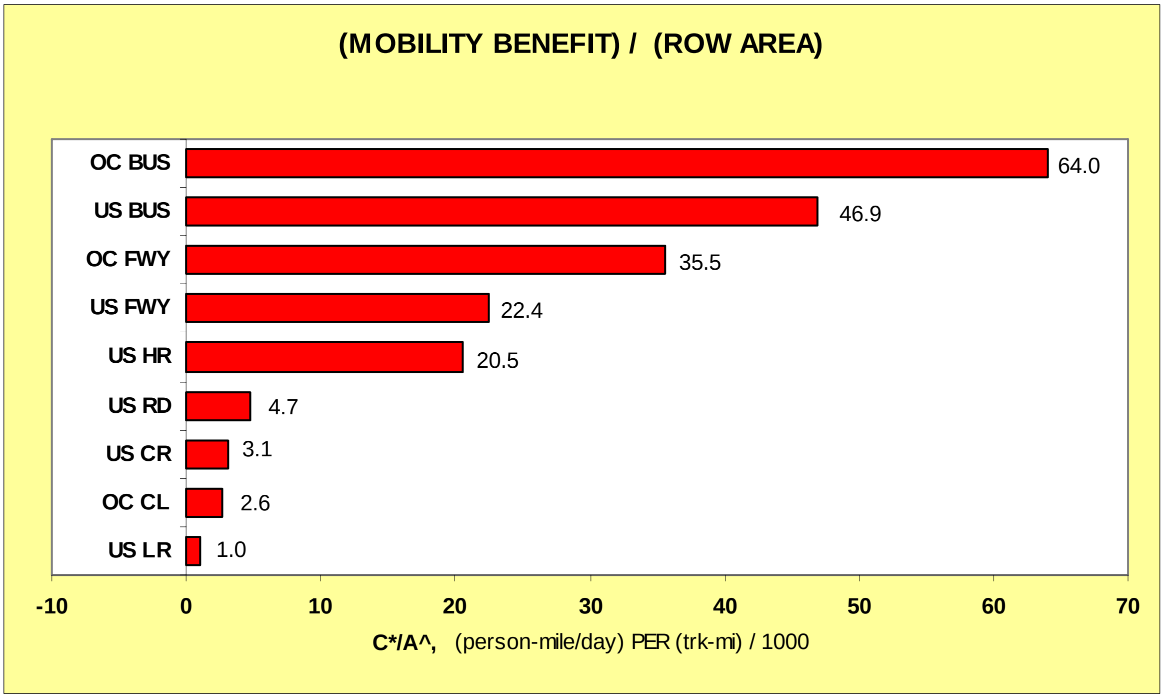
For most systems the amount of right of way is clear from NTD or HPMS track-miles or lane-miles data. Ordinary street bus, however, differs in utilizing only a small fraction of the capacity of the arterial (generally principal + minor arterial) street lanes it travels. We approximate that fraction as equal to the bus-to-total DVMT fraction adjusted for the 1.6x passenger car equivalency factor for bus[5], so that:

$$(\text{ln-mi-used})_{bus} = \text{ln-mi}_{art} \times (\text{DVMT}_{bus} / \text{DVMT}_{art}) \times 1.6$$

[4] "Orange County Progress Report", Cal State Fullerton Center for Demographic Research, 11/16/2000.

[5] Highway Capacity Manual, TRB Special Report 209, sec. 8.8

Figure 2 below shows the ROW effectiveness comparisons.



Here the horizontal axis is mobility benefit, C* per (unit ROW area). For convenience we measure area in units of track-mile, or lane-mile, taken as essentially equivalent, at about 1.6 acre.

Light rail is far the least ROW effective mode, about 40 times worse than Orange County bus and 10 – 20 times worse than freeways. This leads us to an important conclusion that, judged by the same standards: :

> *If there is "no more room to build freeways",*
> *there sure as heck isn't room to build light rail.*

Moreover, these terrible results for light rail cost and ROW effectiveness are probably still far too optimistic, in that they do not include any accounting for the loss of overall street system capacity due to the adverse impacts of the usual[6] exclusive guideway. These results will be discussed later in OC#4.

Common street bus is far the most ROW effective, both nationally and in Orange County. This conclusion finds further support in the massive effective organized bus transportation systems to be found in crowded areas like Curitiba, Brazil and Buenos Aries, Argentina. It is to be emphasized, however, that this result pertains only to *non-exclusive*, shared street access bus operation. *Guideway* bus which seems to finding increasing favor with transportation planners, is an entirely different story. Unfortunately, available data does not support a comparable analysis for guideway or busway systems. However, based on results to be discussed in Essay # 4, there is reason to expect that in this respect, when all adverse traffic impacts of the *exclusive*

[6] The original San Diego trolley, a true streetcar is one of the few exceptions.

guideway are taken into account, guideway bus will be a factor of at least 2 *worse* than light rail, and may show up as a negative cost and ROW effectiveness.

SUMMMARY- Major Findings

In summary, the national transportation Database yields several strong conclusions about where to concentrate our efforts if the goal is mobility, and reduced congestion.

1. Under funding limitations, freeways afford 10 to 20 times more benefit than "good" transit (bus and commuter rail); good transit 5 to 10 times more than light rail.
2. Under Right-Of-Way limitation, bus affords almost twice as much benefit as freeways, freeways 10 to 20 times more than light rail. However, lest one think of bus as a practical way to solve our 31% capacity shortfall, consider that bus presently attracts only about 1% of our travel – what is the likelihood of getting that other 30% into bus?
3. If there is "no more room for freeways" there sure is no more room for light rail nor any form of transit other than bus.

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The Master Spreadsheet showing the source data, and how these results were derived follows.

Table 1. Master Spreadsheet

	A	B	C	D	E	F	G	H	I	J	K	L
1	**COST AND PERFORMANCE COMPARISON OF URBAN TRANSPORTATION ALTERNATVES**									© A. J. Mallinckrodt		
2	H:\COSTS\CostComp3.xls		**US**	**US**	**US**	**US**	**ALL US**	**OC**	**OC**	**All US**	**US Fwys**	**OC FWY**
3	4/17/06 13:25	**UNITS**	**BUS**	**HVY RAIL**	**COMM. RAIL**	**LT RAIL**	**TRANSIT**	**CntrLine (Projctd)**	**Bus**	**RDS**		
4	Expense, Operating Total	million$/yr	$ 15,240	$ 4,446	$ 3,179	$ 815	$ 23,680	$ 11	$ 150.2	$ 62,141	$ 9,403	$ 113
5	Expense or Annualized Capital	million$/yr	$ 3,242	$ 4,437	$ 2,479	$ 2,325	$ 12,483	$ 65	$ 7.5	$ 53,870	$ 63,536	$ 765
6	Expense, Total Gross O&C	million$/yr	$ 18,482	$ 8,883	$ 5,658	$ 3,140	$ 36,163	$ 77	$ 157.7	$ 116,011	$ 72,939	$ 878
7	User Fees	million$/yr	$ 4,270	$ 2,654	$ 1,552	$ 229	$ 8,705	$ 3	$ 38.7	$ 119,100	$ 74,881	$ 901
8	Net Cost (Subsidy)	million$/yr	$ 14,212	$ 6,229	$ 4,106	$ 2,911	$ 27,458	$ 73	$ 119.1	$ (3,089)	$ (1,942)	$ (23)
9	Person-miles/yr	million ps-mi/yr	18,921	14,354	9,715	1,576	44,567	22.8	268.8	3,367,764	892,833	16,996
10	Dir Trk-Mi or Ln-mi	tk-mile or ln-mi	87,835	2,237	10,011	4,986	105,069	17	334.4	2,300,000	127,072	1,529
11	Veh-Mi/yr	million mi/yr	1,884.5	91.668	45.861	41.447	2,064	NA	$ 23.3	2,066,113	547,750	10,427
12	DVMT	million v-mi/day	6.02	0.29	0.15	0.13	6.593	NA	0.074	6,601	1,750	33
13	DPMT	million ps-mi/day	60.45	45.86	31.04	5.04	142	0.05	0.86	10,760	2,853	54
14	DVMT/trk-mi or ln-mi	veh/day/ln	69	131	15	27	63	NA	223	2,870	13,772	21,788
15	DPMT/trk-mi or ln-mi	ps/day/tk	688	20,501	3,101	1,010	1,355	2,647	2,569	4,678	22,448	35,515
16	ROW Utilized	ln-mi or trk-mi	0.040	1.00	1.00	1.00	NA	1.00	0.04	1.00	1.00	1.00
17	Op cost/unit $/ps-mi	$/ps-mi	0.81	0.31	0.33	0.52	0.53	0.48	0.56	0.018	0.011	0.007
18	Cap Cost/Unit $/ps-mi	$/ps-mi	0.17	0.31	0.26	1.48	0.28	2.86	0.03	0.016	0.071	0.045
19	Total Gross Cos/unit, $/ps-mi	$/ps-mi	0.98	0.62	0.58	1.99	0.81	3.35	0.59	0.034	0.082	0.052
20	User Fees /unit, $/ps-mi	$/ps-mi	0.23	0.18	0.16	0.15	0.20	0.14	0.14	0.035	0.084	0.053
21	Total Net Cost, Subsidy/unit	$/ps-mi	0.75	0.43	0.42	1.85	0.62	3.21	0.44	(0.001)	(0.002)	(0.001)
22	% Subsidy	%	77%	70%	73%	93%	76%	96%	75%	-2.7%	-2.7%	-2.7%
23	Avg Speed , mph	mph	12.7	20.6	31.7	15.7	19.5	NA	13.0			
24	AVO (NHTS 2001)	ps/veh	10.0	156.6	211.8	38.0	NA	NA	11.2	1.63	1.63	1.63
25	Avg Trip Length , mi	mile	3.7	5.1	23.3	4.4	8.4	4.8	3.9			
26	ADTv	veh/day/ln	68.5	130.9	14.6	26.6	NA		229	2,870	14,575	21,785
27	ADTp	ps/day/ln	688	20501	3101	1010	1355	4,292	2,569	4,678	23,757	35,515
28	**Gross Cost Efficiency ps-mi/$**	(ps-mi) / $	**1.02**	**1.62**	**1.72**	**0.50**	**1.23**	**0.30**	**1.70**	**29.0**	**12.2**	**19.4**
29	**Net Cost Efficiency**	(ps-mi) / $	**1.33**	**2.30**	**2.37**	**0.54**	**1.62**	**0.31**	**2.26**	**>100**	**>100**	**>100**
30	**ROW Efficiency**	thous ps-mi/day/ trk-mi	**46.90**	**20.50**	**3.10**	**1.01**	**NA**	**2.65**	**63.97**	**4.68**	**22.45**	**35.51**
31	SOURCES:			Shaded cells denote primary data from listed sources. Non-shaded derived therefrom.								
32	Transit: National Transit Database, FTA, 2003			Highway user fees allocated to road categories in proportion to total gross cost								
33	Highways: "Highway Statistics" FHWA 2004			For Rail components Vehicle is taken as Train								
34	"Highway Performance Monitoring System",FHWA, 2003			"trk" = "ln" = 13 ft width								
35	Auto AVO: "National Household Travel Survey", NHTS, DOT, 2001			"trk-mi"="ln-mi"=1.57 acre								
36	CenterLine: "5309 New Starts Report", FY2006, OCTA, 2005			>100 denotes indeterminate because of non-positive denominator								