Center for Urban Transportation Research
The University of South Florida
Tampa, Florida

National Center for Transit Research (NCTR/UTC)
Southeastern Transportation Center (STC/Southeastern Region 4 UTC)
National Bus Rapid Transit Institute (NBRTI)
Established by the Florida Legislature in 1988
Context

- An outgrowth of FDOT supported research:
  - Investigation of Florida Trends and Conditions
  - Exploration of the land use VMT relationship
  - Analysis of public transit implications of NHTS

- A TRB paper that got out of hand.

- Available online at
Related Work

- Department of Energy (2001) – Age and gender were used to model future VMT.
Key Concepts

- NHTS and Census data help paint a picture of what is going on regarding travel and travel behavior.

- Several socio-demographic and transportation system performance trends are at critical juncture points.

- We are seeing a slowing in the pace of VMT growth that will continue absent new intervening phenomenon.

- Yet congestion may get worse.

- The rate of trip making appears to be the single largest contributor to growing travel demand.

- And there is much we do not yet know.
**Conceptual Model of VMT Growth Drivers**

**Indirect Drivers of Travel Behavior**

- **Socio-Economic Conditions**
  - Household/Person Characteristics
  - Economic Conditions
  - Culture/Values
  - Business Conditions

- **Land Use**
  - Density
  - Mix
  - Urban Form
  - Urban Design
  - Activity Scale
  - Contiguosness

- **Transportation System**
  - Modal Availability
  - Modal Performance
  - Cost
  - Speed/Congestion
  - Safety, Reliability, Convenience, etc.

**Direct Drivers of Travel Behavior**

- **Travel Demand**
  - Population
  - 1. Trip Rates
  - 2. Trip Distribution (length)
  - 3. Mode Selection
  - 4. Route/Path

- **Travel**
Household VMT Growth Outpaces Population Growth

Source: U.S. Census Bureau, NHTS
Incremental Annual Growth in VMT

Miles in Millions

Thru June 2004
Annual Change in VMT and Population

Source: FHWA, Highway Statistics Series, Census population estimates
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Travel
U.S. Population is Concentrated in Peak Travel Age Cohorts

Source: CUTR analysis of NHTS and NPTS and U.S. Census Bureau
Average Household Size is Stabilizing, 1930-2000

Source: U.S. Census Bureau
Economies of Travel Beyond Two Member Households

Source: CUTR analysis of NHTS
Households Size May Have Contributed to VMT Growth, 1940-2000

Source: U.S. Census Bureau
Share of Population 16 Years of Age or Older with a Drivers License, 1970-2000

Source: U.S. Department of Transportation, HSS and U.S. Census Bureau
We have reached Gender Equity in Licensed Drivers, 1963-2001

Source: FHWA, Highway Statistics Series
Older Women Less Likely to Drive

Source: FHWA, Highway Statistics Series, 2000
Vehicle Saturation?  
Vehicle Gluttony?

![Graph showing the ratio of vehicles to persons over 16, drivers, and workers from 1968 to 2001.](image)

- **Ratio of Vehicles to Persons Over 16**
- **Ratio of Vehicles to Drivers**
- **Ratio of Vehicles to Workers**

Source: FHWA, Highway Statistics Series
Declining Zero-Vehicle Households

Source: CUTR analysis of NHTS and NPTS and U.S. Census Bureau
# Percent Teen Auto “Ownership”

<table>
<thead>
<tr>
<th>Age</th>
<th>Teens with Auto Available (percent)</th>
<th>1999</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>New</td>
<td>Used</td>
</tr>
<tr>
<td>16-17</td>
<td></td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>18-19</td>
<td></td>
<td>5</td>
<td>12</td>
</tr>
</tbody>
</table>

Commute Times Are Growing

Source: CTPP 2000 and prior
Travel Time Budgets Have Grown 1.8 Minutes per Day per Person per Year

32.8 more minutes of travel each day since 1983

Source: CUTR analysis of NHTS and NPTS
Change of Time Spent by Major Time Use Category from 1965 (Minutes per Day)

Why?
- Fewer kids
- Technology
- Specialization of labor

Source: Americans’ Use of Time Project cited in Robinson, 1999 and 1998-2001 Time Diary Studies
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Direct Drivers of Travel Behavior

Travel Demand
- Population
  1. Trip Rates
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Travel
How Does Land Use influence Travel?

<table>
<thead>
<tr>
<th>Land Use Traits</th>
<th>Travel Demand</th>
<th>Impact of “Better” Land Use</th>
<th>Impact on VMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>Trip Rates ...........................................</td>
<td>Greater accessibility will tend to encourage trip making</td>
<td>↑</td>
</tr>
<tr>
<td>Mix</td>
<td>Trip Distribution (length) ..........................</td>
<td>Greater accessibility will tend to reduce trip length</td>
<td>↓</td>
</tr>
<tr>
<td>Urban Form</td>
<td>Route/Path .............................................</td>
<td>Greater accessibility will tend to produce shorter trips</td>
<td>↓</td>
</tr>
<tr>
<td>Urban Design</td>
<td>Mode Choice ...........................................</td>
<td>Greater accessibility and density enables competitive</td>
<td>↓</td>
</tr>
<tr>
<td>Activity Scale</td>
<td></td>
<td>alternative modes</td>
<td></td>
</tr>
<tr>
<td>Contiguousness</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conceptual Model of VMT Growth

Indirect Drivers of Travel Behavior

Socio-Economic Conditions
- Household/Person Characteristics
- Economic Conditions
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- Business Conditions

Land Use
- Density
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- Urban Form
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Direct Drivers of Travel Behavior

Travel Demand
- Population
- 1. Trip Rates
- 2. Trip Distribution (length)
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- 4. Route/Path

Travel
Share of Urban VMT by Road Type, 1966-2001

Source: FHWA (Note: Urban Interstate share after 1980 includes Other Urban Freeways and Expressways)
NHTS/NPTS Data Suggest Travel Speeds are Now Slowing

Changes in mode, path, departure time, and moving to the suburbs enabled higher speed travel

Have we run out of ways to travel faster?

Source: CUTR analysis of NHTS and NPTS
VMT per Person Hour Spent in Travel is Declining

Composite effect of mode and speed

Source: CUTR analysis of NHTS and NPTS
Are Income and Travel Cost Driving VMT Growth?

**POV Expenditure per VMT (cents per mile)**

- $0.59
- $0.36
- $0.31
- $0.34

**Income per Person (2001 Dollars)**

- $13,468
- $15,288
- $14,983
- $17,270

Source: CUTR analysis of NHTS, BLS
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Travel Demand
- Population
  1. Trip Rates
  2. Trip Distribution (length)
  3. Mode Selection
  4. Route/Path

Travel
VMT Growth Estimation Equations

1. Population × \( \frac{\text{Person Trips}}{\text{Person}} \) × \( \frac{\text{Person Miles}}{\text{Person Trips}} \) × \( \frac{\text{Vehicle Miles}}{\text{Person Miles}} \) \( \equiv \) Vehicle Miles

2. Population × \( \frac{\text{Person Hour of Travel}}{\text{Person}} \) × \( \frac{\text{Vehicle Miles}}{\text{Person Hour of Travel}} \) \( \equiv \) Vehicle Miles
### Key Indicators, 1977 to 2001

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All Persons (000)</td>
<td>213,141</td>
<td>277,208</td>
<td>+30.1%</td>
</tr>
<tr>
<td>HH VT (000,000)</td>
<td>108,826</td>
<td>234,994</td>
<td>+115.9%</td>
</tr>
<tr>
<td>HH VMT (000,000)</td>
<td>907,603</td>
<td>2,281,863</td>
<td>+151.4%</td>
</tr>
<tr>
<td>Person Trips (000,000)</td>
<td>211,778</td>
<td>410,969</td>
<td>+94.1%</td>
</tr>
<tr>
<td>PMT (000,000)</td>
<td>1,879,215</td>
<td>4,026,158</td>
<td>+114.3%</td>
</tr>
<tr>
<td>PT/P/Year (trip rate)</td>
<td>994</td>
<td>1,483</td>
<td>+49.2%</td>
</tr>
<tr>
<td>PMT/PT (trip length)</td>
<td>8.874</td>
<td>9.797</td>
<td>+10.4%</td>
</tr>
<tr>
<td>VMT/PM (mode)</td>
<td>0.483</td>
<td>0.567</td>
<td>+17.4%</td>
</tr>
</tbody>
</table>

Source: CUTR analysis of NHTS and NPTS
Factors Contributing to US VMT Growth 1977-2001

- Mode Shifts: 16%
- Trip Frequency: 46%
- Trip Length: 10%
- Population: 28%

Source: CUTR analysis of NHTS and NPTS
Person Trips per Person per Year and PMT per Person Trip

Source: CUTR analysis of NHTS and NPTS
Daily Person Trip Rates by Vehicle Availability, 2001

Source: CUTR analysis of NHTS
Daily Mileage by Vehicle Availability and Mode, 2001

Per Capita Daily Mileage by Mode

- No Vehicles (5.1% of pop.)
- Over One Less Vehicles Than Adults (3.9% of pop.)
- One Less Vehicle Than Adults (15.9% of pop.)
- Vehicles Equals Adults, Multi-Adult HH (8.4% of pop.)
- Vehicles Equals Adults, 1 Adult HH (43.5% of pop.)
- More Vehicles Than Adults (23.3% of pop.)

Source: CUTR analysis of NHTS
Declining Walk Shares

Source: CUTR analysis of NHTS and NPTS, U.S. Census Bureau
Ending the Decline in Transit Mode Share – Survey Data

Percent of Trips on Transit

0% 1% 2% 3% 4% 5% 6% 7% 8% 9% 10%


Census Journey to Work
Census Supplemental Survey
NPTS/NHTS (all trips)
NPTS/NHTS (work trips)
AHS (work trips)
Transit Share in Person Miles – Empirical Data

Through June 04, VMT is up approximately 2% and transit use is up approximately 0.5%

Source: CUTR analysis of NHTS, NPTS, FHWA, and APTA data
Census Work Trips
Carpooling Mode Share

Source: U.S. Census Bureau
Stabilizing Vehicle Occupancies – NHTS and NPTS

Source: CUTR analysis of NHTS and NPTS
Slowing Vehicle Miles of Travel Per Person Mile of Travel

Composite effect of mode choices

Source: CUTR analysis of NHTS and NPTS
So What Does this Mean in Terms of VMT?
VMT Growth Estimation Equations

1. Population \times \frac{\text{Person Trips}}{\text{Person}} \times \frac{\text{Person Miles}}{\text{Person Trips}} \times \frac{\text{Vehicle Miles}}{\text{Person Miles}} = \text{Vehicle Miles}

2. Population \times \frac{\text{Person Hours of Travel}}{\text{Person}} \times \frac{\text{Vehicle Miles}}{\text{Person Hours of Travel}} = \text{Vehicle Miles}
VMT Growth Scenario 1

- Population: 30% (1977-2001), 22% (2001-2025)
- Person Trips per Person: 49% (1977-2001), 16% (2001-2025)
- Person Miles of Travel per Person Trip: 10% (1977-2001), 8% (2001-2025)
- Vehicle Miles of Travel per Person Mile: 17% (1977-2001), 5% (2001-2025)
- Total Person VMT: 151% (1977-2001), 60% (2001-2025)
VMT Growth Scenario 2

<table>
<thead>
<tr>
<th></th>
<th>Percent Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>30% - 165%</td>
</tr>
<tr>
<td>Travel Time per Capita</td>
<td>22% - 65%</td>
</tr>
<tr>
<td>Vehicle Miles per Person Hour</td>
<td>17% - -18%</td>
</tr>
<tr>
<td>Total Person VMT</td>
<td>55% - 151%</td>
</tr>
</tbody>
</table>

- Yellow bars represent 1977-2001 data.
- Green bars represent 2001-2025 data.
Future VMT Growth

- Vehicle Miles Traveled 2001 — 2.08% per year (to 2020)
- Scenario One — 1.98% per year (to 2025)
- Scenario Two — 1.90% per year (to 2025)
The moderation of several historic trends may have significant impacts in terms of future VMT demand as well as on other aspects of travel behavior.

Socio-Economic Conditions
- Average Household Size
- Women Labor Force Participation Rates
- Women Share of Licensed Drivers
- Share of Zero Vehicle Households

Transportation System
- Travel Speed

Travel Trends
- Mode Share of Public Transportation
- Vehicle Occupancies
- Mode Share for Walk, Bike
- Perhaps trip rates
Observations (Transportation Supply)

Increases in system capacity (supply) compared to demand growth remains uncertain.

- What will federal, state and local willingness to increase spending be?
- Will there be the public will to tolerate the impacts of transportation system expansion?
- What role will toll facilities play?
- What increase in transit supply and use will occur?
- What capacity benefits will be realized by ITS?
Observations (travel behaviors)

The dynamic response of our system subject to growing demand is not well understood.

How will people adapt?
- Communications substitution
- Temporal shifts in demand
- Location shifts to avoid congestion
- “Fragileness” of our system

Where are we on this HCM curve?
Observations & Speculations

The growth in trip making and travel time budgets poses the greatest risk to moderating travel demand.

- Historic causal variables of income, car ownership and worker status are no longer the dominant drivers of trip making (we no longer know how to forecast trip generation growth?)
- Multi-tasking moderates the reluctance to travel:
  - Eating in car
  - Cell phone use
- Activities are shifting from inside to outside of home:
  - Specialization of labor (eating out, hired services)
  - Socialization (for working Americans the social relationships have moved from the front porch or back yard to the workplace break room)
  - Parenting (more organized youth activities and lessons)
  - Specialization of services (GP Dr. > specialist > lab > scanning center)
- Land use changes will not impact the trip making
Observations

- Uncertainties include:
  - Energy costs and traveler reactions
  - The extend to which development trends change toward smart growth (retrofit versus new town)
  - The extent to which housing affordability encourage housing dispersion
  - Whether activity scale continues to influence travel (mega churches, schools, and stores, create longer trips and different social relationships)
  - What will the VMT trends for truck travel be?
  - What will the VMT trends for long distance travel be?
  - Can/will peak spreading continue?
Socio Demographic Research Questions

- How are older American travel rates likely to change over time?
- Of zero vehicle households what share are by choice, what share have income constraints, what share have mental or physical health or legal constraints?
- Under what conditions do multi-person households result in some economy of travel?
- What happened to the concept of a travel time budget? Are we multitasking in our cars?
Transportation System Performance Research Questions

- Has the increase in congestion occurred so fast as to preclude location decision making from naturally adjusting to intolerable travel times?
- Have we really reached the point where average daily travel speeds are declining?
- To what extent is real income and travel cost, versus time a constraint on additional travel?
Trip Generation, Distribution and Mode Choice Research Questions

- Will trip making levels increase?
- Will trip lengths continue to grow or accelerate?
- Is transit growth inevitable?
- Will walk see a revival as a functional travel mode?
- Will auto occupancies stop declining?
What Will Happen Next?

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