A problem for an individual or a group of individuals is the difference between the desired state for a given situation and the actual state. The difference usually cannot be eliminated completely.
Transportation Service Problems

- **Congestion**
  - Low speeds, long travel times
- **Inadequate Capacity**
  - Demand more than capacity
  - An aspect of congestion
- **High User Cost**
  - Purchase cost, depreciation, repairs, tires, gas, parking, taxes and fees
- **Lack of safety for user**
  - Crashes
- **Transit related**
  - Lack of privacy
  - Discomfort
Traffic Counts Performed May 16, 2000
Between 4PM and 5PM

The roadway is about 30-35% overloaded

Big Beaver Corridor - Travel Time Studies

<table>
<thead>
<tr>
<th>Time</th>
<th>COOLIDGE</th>
<th>CROOKS</th>
<th>LIVERNOS</th>
<th>ROCHESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:30 PM</td>
<td>2 minutes</td>
<td>4 minutes</td>
<td>11 minutes</td>
<td></td>
</tr>
<tr>
<td>4:50 PM</td>
<td>3 minutes</td>
<td>7 minutes</td>
<td>14.5 minutes</td>
<td>Total = 24.5 minutes</td>
</tr>
<tr>
<td>5:20 PM</td>
<td>11 minutes</td>
<td>19 minutes</td>
<td>24 minutes</td>
<td>Total = 54 minutes</td>
</tr>
<tr>
<td>6:00 PM</td>
<td>3 minutes</td>
<td>9 minutes</td>
<td>14 minutes</td>
<td>Total = 26 minutes</td>
</tr>
</tbody>
</table>
3.8 million vehicles

3.3 million drivers

727 miles congested
More of Our Increased Driving Is Encountering Congestion

Congested US Urban Driving, 1982-1999

191,000 traffic crashes
“MOTOR VEHICLE CRASHES ARE THE LEADING KILLER OF AMERICANS OF EVERY AGE BETWEEN 1 AND 29.”

“SAFETY AGENDA FOR THE NATION” NATIONAL SAFETY COUNCIL

HIGHWAY SAFETY IS A PUBLIC HEALTH ISSUE

● 42,000 PEOPLE KILLED IN TRAFFIC CRASHES NATIONALLY EACH YEAR
● 2,830 PEOPLE KILLED IN WORLD TRADE CENTER TERRORIST ATTACK
● 801 PEOPLE KILLED ON WI HIGHWAYS IN 2000
● 63,890 PERSONS INJURED IN WI
● $631 MILLION IN PROPERTY DAMAGE
TRAFFIC FATALITIES and VEHICLE MILES of TRAVEL
1945-2000

YEAR

FATALITIES

VMT (Billions)

0 0 20 40 60 80 100 120

1200

1000

800

600

400

200

0

0 45 50 55 60 65 70 75 80 85 90 95 00

VMT FATALITIES

THREE PRIMARY CASUES OF CRASHES

- ROADWAY CONDITIONS
- VEHICLE DEFECTS
- DRIVER BEHAVIOR
  - SPEED
  - ALCOHOL / DRUGS
  - INATTENTIVENESS
  - LACK OF BELTS – NOT A CAUSE OF THE CRASH BUT CONTRIBUTES TO INJURY AND DEATH
HIGHWAY SAFETY

- ENFORCEMENT
- ENGINEERING
- EDUCATION

Engineering

- Planning, design and construction
- Operation and maintenance
  - Mowing, plowing
  - Pavement repairs
- Rail crossings
- Pavement markings
- Signing and lighting
- Work zones
- Access management
- ITS technologies
### Education

- Classroom visits and instruction
- Presentations to community groups
- Manuals, brochures
- Safety literature
- Statewide campaigns
  - Death Defying Acts
  - Put Brakes on Fatalities
- Media coverage
- Newsletter articles
- Collect, analyze and share crash data

### Enforcement

- Enforce traffic laws
- Enforce criminal laws
- Assist local law enforcement
- Operate statewide programs
  - Training Academy
  - Chemical testing
  - Communications
- Inspections
  - School/commercial buses
  - Ambulances
  - Trucks
  - Human service vehicles
- DMV licensing and registration
- Regulation of motor vehicle dealers
Problems – Affected by Transportation

- Energy Consumption
  - Petroleum dependency
- Air Pollution
- Crime
- Noise
- Poor Appearance
  - The visual aspect
- Excessive ROW acquisition
- Urban Sprawl
- Socio-economic
The Environmental System

- Atmosphere
- Ecosphere
- Hydrosphere
- Lithosphere
- Biosphere
### The Environmental Impacts of Transportation

#### 1. ATMOSPHERE
- Large scale diffusion of pollutants.
- High growth on a short term basis of the concentration of pollutants because of local conditions (e.g. smog).
- Photochemical reactions caused by ultraviolet rays, notably over ozone, sulfur dioxide and nitrogen dioxide.
- Climate changes (global warming).
- Acid rain.
- Synergetic effects when pollutants are combined (e.g. smog).

#### 2. HYDROSPHERE
- Diffusion of pollutants in a dissolved or colloidal state.
- Acidification and loss of neutralizing potential of ground and underground water.
- Drops of pH following snow melting (aquatic organisms are particularly vulnerable).
- Growth in the solubility of several metals because of acidification.
- Additions of organic compounds, aluminum, manganese, iron.
- Acid deposition.
- Liberation of toxic metals (aluminum, cadmium, etc.) through acidification.
- Leaching of nutrients, notably calcium and magnesium.
- Inhibition of the mineralization of nitrogen.
- Modifications in the composition and the depth of decomposition gradient.
- Inhibition of decomposition.
- Loss of the soil flora and fauna.
- Fixation by plants of heavy metals (e.g. lead) and contamination.
- Removal and consumption of land.
- Depletion of raw materials like mineral products and energy.

#### 3. LITHOSPHERE
- Acid deposition.
- Liberation of toxic metallic ions (aluminum, cadmium, etc.) through acidification.
- Loss of nutrients, notably calcium and magnesium.
- Inhibition of the mineralization of nitrogen.
- Modifications in the composition and the depth of decomposition gradient.
- Inhibition of decomposition.
- Loss of the soil flora and fauna.
- Fixation by plants of heavy metals (e.g. lead) and contamination.
- Removal and consumption of land.
- Depletion of raw materials like mineral products and energy.

#### 4. ECOSPHERE

##### 4.1 AQUATIC ECOSPHERE
- Alteration of ecosystems in unforeseeable ways.
- Disappearance of vulnerable species and proliferation of tolerant ones.
- Reduction of bacterial treatment of organic matter by nitrification.
- Reduction of available nutrients to aquatic species.
- Reproductive impediments.

##### 4.2 LAND ECOSPHERE
- Damages over the vegetation modifying:
  - Hydrological cycles.
  - the level of underground water resources.
  - soil erosion.
  - air purification capacity of the ecosphere.
  - food resources (agriculture).
- Reduction of the vital space.
- Reduction of the genetic potential of species.
- Reduction of the food supply and alteration of the food chain.
- Consumption of resources.

##### 4.3 HUMAN ECOSPHERE
- Odors.
- Noise.
- Cardiovascular and respiratory problems.
- Susceptibility to infection.
- Drops in life expectancy.
- Injuries, incapacity, hospitalization, death.
- Damage to structures:
  - loss of useful life (e.g. buildings)
  - loss of property value
  - costs of soil subsidence (fences, walls, etc.)
  - destruction of historical and cultural heritage.

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**Emissions of Major Air Pollutants in the US by Transportation (in million short tons), 1970-1998**

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<tr>
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<tbody>
<tr>
<td>Lead</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen oxides</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Particulates (PM-10)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulphur oxides</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Carbon monoxide</td>
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</tr>
</tbody>
</table>

(in thousand metric tons)
Key Air Quality Impact/Concern

- Public Health Impact - Ambient Air & Concentrated Air Toxics Exposure
- Air and Natural Area Environmental & Aesthetic Degradation
- Chronic effect on Climate Change (global warming) and Stratospheric Ozone Depletion (CFCs)

Average Temperature at the Earth's Surface (Land-based Series, Celsius) and World Carbon Emissions From Fossil Fuel Burning, (in millions of tons) 1866-2000
Noise Generated by a Passenger Car

![Graph showing noise levels vs. speed](graph.png)

Noise Levels (in decibels)

- **Aircraft at takeoff**: 120 dB(A)
- **Pneumatic drill at 1 meter**: 110 dB(A)
- **Truck, motorcycle, underground train**: 100 dB(A)
- **Busy crossroads**: 90 dB(A)
- **Noise level near a motorway**: 80 dB(A)
- **Busy street through open windows**: 70 dB(A)
- **Busy street through closed windows**: 60 dB(A)
- **Quiet room**: 40 dB(A)
- **Broadcasting studio**: 30 dB(A)
- **Desert**: 20 dB(A)
- **Others**: 10 dB(A)
- **Background noise levels**: 0 dB(A)
Problems Affecting Transportation

- Increased population growth and dispersion
- Increased automobile ownership
- Peak hour travel
Transportation Supply, Demand and Travel Time

- Transport supply (A)
- Transport demand (T)

- Morning peak
- Afternoon peak

Travel time: T>A, T<A
So Driving Is Outstripping Road Capacity

Change in US VMT & Lane-Miles, 1980-1997

Result: Congestion’s Going Up

US Congested Travel, 1982-1997
More of Our Increased Driving Is Encountering Congestion

Congested US Urban Driving, 1982-1999

And We’re Paying More For It

And Commuting Times Have Increased

Average Length of US Commute, 1990-2000

While Sprawl Continues
"I Wish My Home Were..."

Survey of 2,000 Families Who Have Purchased Homes Within the Last 5 Years by National Association of Realtors & National Association of Homebuilders January 2002

- "Closer to public transportation" 0%
- "Closer to shopping & restaurants" 12%
- "Closer to work" 10%
- "Closer to the city" 3%
- "Closer to more places by walking" 19%
- "Larger" 44%

Hot Off the Press

Annual Texas Transportation Institute Mobility Study released recently recommends:

- "More capacity" – "More roads & more transit part of the equation"
- "Greater efficiency" – Access management, improved signalization, better transit info, ITS (Intelligent Transportation Systems)
- "Manage the demand" – Time-shifting, tolls & pricing
- "Development patterns" – Reduce auto dependency & increase possibilities to walk, bike or take transit
- "A vision of the future" – Consensus on better land use arrangements “difficult to achieve” but “discussion will help inform” and hopefully “move toward the vision”
- "Realistic expectations"
- Improving reliability is important
World Population (in millions)

Population Pyramid of the United States, 2000
Automobile Production, United States, Japan and Germany, 1950-1999 (in millions)

2025 RTP Fiscal Analysis

$17 billion
unmet needs

$24 billion
investment
Congestion Pricing

Ramp Metering

Advanced Traffic Management

The Automobile

Alternative Energy

Total Automation