Today’s Outline

- Introduction
- Technologies in Transportation
  - Infrastructure of Technologies
  - Vehicle Technologies
  - Traffic Control Technologies
- Human Behavior
  - Dominance of Single-Occupant Vehicles
  - Demographic Trends
Introduction

- All modern economies are directly or indirectly linked to transportation.
- Transportation has an impact on:
  - Freight
  - Buses, trains, transit
  - Residential, Commercial and Industrial zones
  - Highways
- Highway domination of transportation systems have been studied for decades from cultural, economic and social scopes.
Introduction

- The demand for bigger and better transportation systems started during the 20’s.
- Since that time large infrastructure projects were created in the U.S. such as the Eisenhower Interstate Highway System which remains to this day the largest infrastructure project in human history.

Map of Interstate Highways

people.hofstra.edu
Introduction

- The creation of this road system brought more mobility to the population as well as new economic and industrial opportunities.

- But with new roads, more maintenance has to be done involving high investments reflected on taxes as well as other issues like pollution, congestion, etc.

I-75 and I-94 in Michigan

Photo by Wayne E. Smith The Detroit News 10/06/2005
Introduction

- Externalities involved in highway and road construction:
  - Pollution
  - Congestion
  - Accidents
  - Property damage
  - Reduction in work productivity

- Accidents have create terrible tolls in terms of life loss and injuries. Because of this and the high costs that accidents involve, new highway design guidelines and countermeasures have been implemented, aimed at reducing frequency and severity of accidents.
Introduction

- Highway Design Manual
  - Provides information and tools to provide decision making that has a better impact on highway safety.
  - It focuses on “objective and quantitative measures of safety with a primary emphasis on crash frequency and severity” (TRB).
  - More information about manual at [www.highwaysafetymanual.org](http://www.highwaysafetymanual.org)
- This manual as well as the use of state-of-the-art technologies in vehicles and infrastructure has helped reduce accidents by 10% from 1970 to 1990.
Introduction

- During the last 2 decades this rate began to increase. Possible factors:
  - Increase in aggressive driving
  - Increase in disrespect for traffic control devices
  - In-vehicle driving distractions
  - Poor driving skills of younger and older population
  - Increase in use of SUV and vehicles with low ranking of safety.
Technologies in Transportation

- **Infrastructure Technologies**
  - Eisenhower Interstate Highway System brought many challenges including the creation of maintenance programs that would prolong the service life of this roads. If inappropriate maintenance is given to roads then users will suffer loss in mobility and safety.
  - Engineers now deal with developing new technologies to extend the life of these roads and. Technologies include:
    - Structural health monitoring
    - Material Nanotechnology
    - ITS
Technologies in Transportation (ITS)

- Technologies that include information processing, communications and control systems are collectively known as Intelligent Transportation Systems (ITS). (i.e. they do NOT simply involve building new roads)

- ITS dates back to the late 1980’s and the technologies used for ITS were pioneered by freight transportation companies. (e.g. FedEx, UPS)
Technologies in Transportation (ITS)
Examples of ITS

- Weight in Motion devices: record truck weights as they pass over a sensor without stopping
- Global Positioning System (GPS): uses multiple satellites to pinpoint position on Earth
- Electronic Fare Payment: uses credit card technology and allows transit user to pay fares with their credit cards
- Video Image Processing: uses image processing software which can aid in traffic enforcement, traffic counting, or license plate identification
- Electronic Toll Collection: debits the account of registered vehicles at toll plazas without coming to a complete stop.
- Intelligent Signal Controls: use sensors to optimize signal timings and operations
Technologies in Transportation (ITS)

- The issues of congestion, safety, access, environment, funding and security present unique and pressing challenges to transportation engineers.

- Intelligent Transportation Systems are present in vehicles, public transit, freight operations and enable us to make Intelligent transportation decisions.

- ITS is still in development and the future of ITS will allow for the integration and consolidation of technology and information.
Technologies in Transportation

- **Vehicle Technologies**
  - During the 1970’s a new wave of technological advances surged mainly because of:
    - Government regulations in air quality, fuel efficiency and vehicle safety.
    - Energy shortage and fuel price increase
    - Intense competition from foreign vehicle manufacturers.
  - Some of the standards for this technologies have not change since the 70’s.
Technologies in Transportation

- **Vehicle Technologies**
  - Demand from user for new technologies has been so high that companies relocated resources and restructure manufactory and inventory processes.
  - New technologies include:
    - Antilock brake systems
    - Traction control systems
    - GPS
    - AVP
  - Creation of new technologies affect the design and rehabilitation processes for highways.
Technologies in Transportation

- Vehicle Technologies

http://www1.eere.energy.gov/vehiclesandfuels/
Technologies in Transportation

- Traffic Control Technologies
  - The most famous for this group is the intersection traffic signals.
  - Procedures for developing traffic signal control plans improved dramatically in the past years, providing quicker responses and avoiding congestion.
  - In some cases the traffic control is for an entire network of signals.
  - These control technologies used in conjunction with ITS have reduced traffic congestion and improved safety on roads.
Human Behavior

- Over the years people’s travel-related choices have resulted in an increase in congestion on urban areas and millions of accidents and injuries as well as economic effects related to job productivity.
- Even though the demand-supply effect is expected to be a limiting factor in urban traffic congestion, traffic growth continues upward.
- The main reason for this is people’s willingness of using private vehicles - **single occupancy**. How can we encourage travelers towards high occupancy vehicles?
Human Behavior

- This continuous growth is a serious obstacle for mobility.
- Technological advances have the potential to offer relief to this problem. Traffic demand typically exceeds supply. Can we have technologies that are up to date with user demand and behavior?
Human Behavior

- Dominance of Single-Occupant Vehicles
  - In the last 40 years there has been an increase from 69% to 90% on the use of private vehicles versus 10% use of other transportation modes.
  - On this same period the average vehicle occupancy for private vehicles dropped from 1.9 to 1.22 users/veh.
  - The single-occupant private vehicle has such high demand that users are willing to confront congestion, struggle with parking just to have extra flexibility and privacy.
Human Behavior

- Demographic Trends
  - Traveler’s commuting patterns are linked to socio-economic characteristics as:
    - Age
    - Income
    - Household size
    - Education
    - Job type
    - Distribution of land
Human Behavior

Demographic Trends

- The increasing use of private vehicle and development of highway projects has created Urban Sprawl or migration of people from the core of cities to the suburbs.

- Logic suggests that as congestion grows, commuters would go back to utilizing public transport or residing in the city.

- Trends suggest the opposite; employment centers have developed in the suburbs and people keep searching for high quality of life by using their private vehicles.
Future of Transportation

http://www.youtube.com/watch?v=2mSqBXCXDSg&feature=user