Introduction to Traffic Engineering

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Transportation Engineering

- **Institute of Transportation Engineers (ITE)**

- *Transportation engineering is the application of technology and scientific principles to the planning, functional design, operation, and management of facilities for any mode of transportation in order to provide for the safe, rapid, comfortable, convenient, economical, and environmentally compatible movement of people and goods.*

Traffic Engineering

- **Institute of Transportation Engineers (ITE)**

- Traffic engineering is that phase of transportation engineering which deals with the planning, geometric design and traffic operations of roads, streets, and highways, their networks, terminals, abutting lands, and relationships with other modes of transportation.

Course Syllabus

- Assignments 25%
  - Which should be done by yourself and emailed at the specified time. Assignment solutions would be online after the due.
- Mid-term 25% (Arbitrary)
- Final 50%
- Project 10% (Arbitrary)

- Total 100% + 10% bonus!!
- http://webpages.iust.ac.ir/amiripour

Course Description and Objectives

- Introduction to fundamentals of urban traffic engineering, including data collection, analysis, and design. Traffic engineering studies, traffic control devices, capacity and level of service analysis of freeways and urban streets.
- The objective of this course is to introduce students to traffic engineering fundamentals for highways and freeways. Emphasis is on the safe and efficient operations of roadway intersections.
- By the end of this course, students should be able to evaluate, analyze, and design timing plans for signalized intersections.

References

- *Traffic Engineering*, Roger P. Roess, Elena S. Prassas, William R. McShane, Pearson Education International, 2004.
- *Highway Capacity Manual*, 4th Edition, transportation Research Board, Washington DC, 2000.
- *Traffic Engineering*, Jalil Shahi, “Markaz Nashr Daneshgahi”, (in Farsi)
- Class lecture notes online at
  - www.webpages.iust.ac.ir/amiripour

Transportation Modes

- Road
- Rail
- Air
- Maritime
- Pipeline

Transportation Modes

- Urban People Transportation Systems
  - Automobile
  - Taxi/For-Hire Vehicles
  - Local Bus Transit
  - Express Bus Transit
  - Para-transit
  - Light Rail
  - Heavy Rail
  - Ferry
- Intercity People-Transportation Systems
- Urban and Intercity Freight Transportation

Transportation Modes

- Urban People Transportation Systems
- Intercity People-Transportation Systems
  - Automobile
  - Intercity Bus
  - Railroad
  - Air
  - Water
- Urban and Intercity Freight Transportation

Transportation Modes

- Urban People Transportation Systems
- Intercity People-Transportation Systems
- Urban and Intercity Freight Transportation
  - Long-Haul Trucks
  - Local Trucks
  - Railroad
  - Water
  - Air Freight
  - Pipelines

Traffic Engineering Profession

- Relationship with General Public
  - More than any other engineer.
- Relationship with Elected Official
  - A wide range of officials
- Professional Ethics
  - According to outcomes it produces great responsibility

Safety: The Primary Objective

- The principal goal of the traffic engineer remains the provision of a safe system for highway traffic.

- 26000 fatalities in Iran on 2007.
- 40000 to 43000 in U.S
- Something like a civil war.

- The objective of safe travel is always number one and is never finished for the traffic engineer.

Other Objectives of Traffic Engineer

- Speed
- Comfort
- Convenience
- Economy
- Environmental compatibility

Other Objectives of Traffic Engineer

- While speed of travel is much to be desired, it is limited by transportation technology, human characteristics, and the need to provide safety.
- Comfort and convenience are generic terms and mean different things to different people. Comfort involves the physical characteristics of vehicles and roadways, and is influenced by our perception of safety.
- Convenience relates more to the ease with which trips are made and the ability of transport systems to accommodate all of our travel needs at appropriate times.

Other Objectives of Traffic Engineer

- Economy is also relative. There is little in modern transportation systems that can be termed “cheap.” Highway and other transportation systems involve massive construction, maintenance, and operating expenditures, most of which are provided through general and user taxes and fees. Nevertheless, every engineer, regardless of discipline, is called upon to provide the best possible systems for the money.
- Harmony with the environment is a complex issue that has become more important over time. All transportation systems have some negative impacts on the environment. All produce air and noise pollution in some forms, and all utilize valuable land resources.

Elements of Transportation Systems

- Facilities
- Vehicles
- Control systems

- Users
- Environment

Elements of Traffic Engineering

- Traffic studies and characteristics
- Performance evaluation
- Facility design
- Traffic control
- Traffic operations
- Transportation systems management
- Integration of intelligent transportation system technologies (ITS)

Elements of Traffic Engineering

- *Traffic studies and characteristics*
  - involve measuring and quantifying various aspect of highway traffic. Studies focus on data collection and analysis that is used to characterize traffic, including (but not limited to) traffic volumes and demands, speed and travel time, delay, accidents, origins and destinations, modal use, and other variables.

Elements of Traffic Engineering

- *Performance evaluation*
  - is a means by which traffic engineers can rate the operating characteristics of individual sections of facilities and facilities as a whole in relative terms. Such evaluation relies on measures of performance quality and is often stated in terms of “levels of service.”

Elements of Traffic Engineering

- *Facility design*
  - involves traffic engineers in the functional and geometric design of highways and other traffic facilities. Traffic engineers, per se, are not involved in the structural design of highway facilities but should have some appreciation for structural characteristics of their facilities.

Elements of Traffic Engineering

- *Traffic control*
  - is a central function of traffic engineers and involves the establishment of traffic regulations and their communication to the driver through the use of traffic control devices, such as signs, markings, and signals.

Elements of Traffic Engineering

- *Traffic operations*
  - involves measures that influence overall operation of traffic facilities, such as one-way street systems, transit operations, curb management, and surveillance and network control systems.

Elements of Traffic Engineering

- *Transportation systems management* (TSM)
  - Involves virtually all aspects of traffic engineering in a focus on optimizing system capacity and operations. Specific aspects of TSM include high-occupancy vehicle priority systems, car-pooling programs, pricing strategies to manage demand, and similar functions.

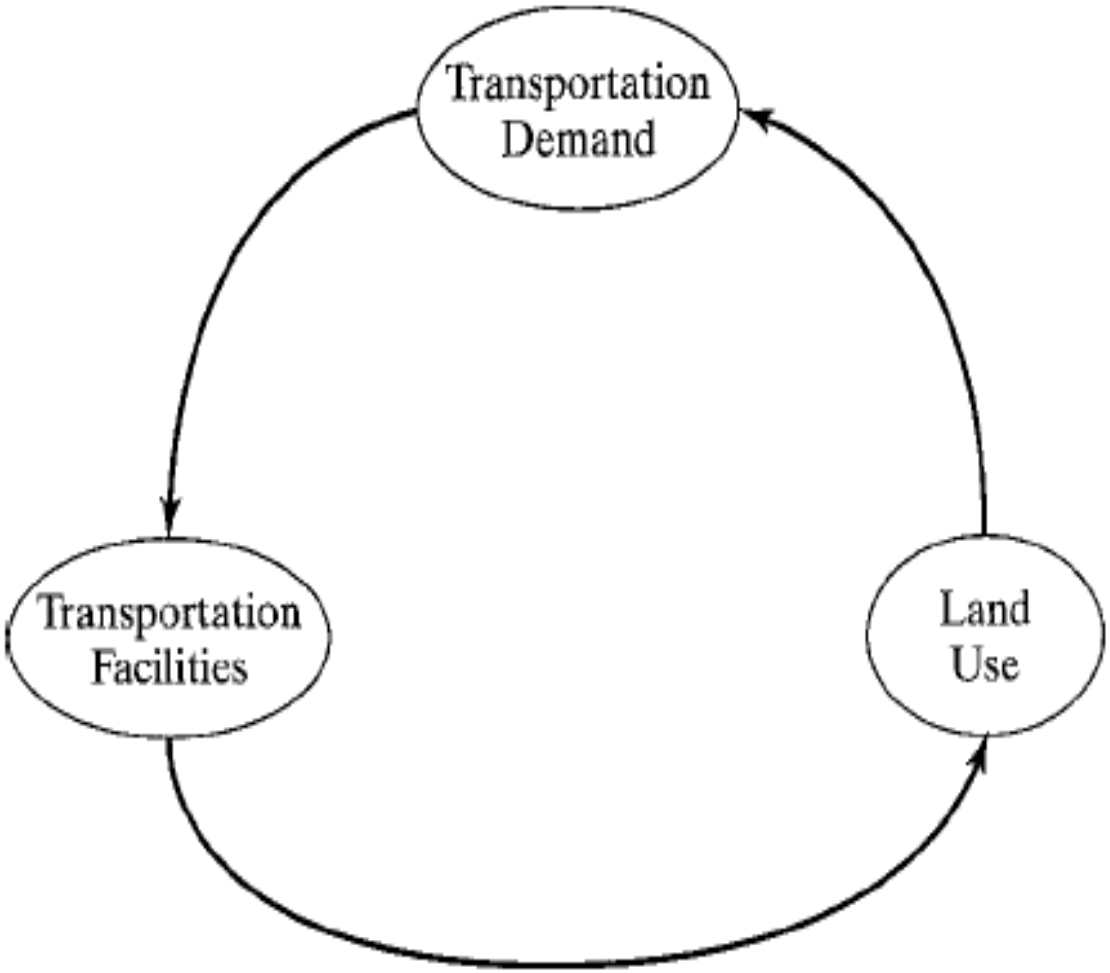
Elements of Traffic Engineering

- *Intelligent transportation systems* (ITS)
  - refers to the application of modern telecommunications technology to the operation and control of transportation systems. Such systems include automated highways, automated toll-collection systems, vehicle-tracking systems, in-vehicle GPS and mapping systems, automated enforcement of traffic lights and speed laws, smart control devices, and others.

Transportation Demand

- Transportation demand is directly related to land-use patterns and to available transportation systems and facilities.
- Transportation planners and traffic engineers attempt to provide capacity for observed or predicted travel demand by building transportation systems. The improvement of transportation systems, however, makes the adjacent and nearby lands more accessible and, therefore, more attractive for development. Thus, building new transportation facilities leads to further increases in lan-duse development, which (in turn) results in even higher transportation demands.

Transportation Demand



Mobility vs. Accessibility

- *Mobility* refers to the ability to travel to many different destinations, while *accessibility* refers to the ability to gain entry to a particular site or area.
  - Mobility gives travelers a wide range of choices as to where to go to satisfy particular needs. Mobility allows shoppers to choose from among many competing shopping centers and stores.
  - Accessibility is a major factor in the value of land. When land can be accessed by many travelers from many potential origins, it is more desirable for development and, therefore, more valuable. Thus, proximity of land to major highways and public transportation facilities is a major factor determining its value.

Mobility vs. Accessibility

- In highway systems, mobility is provided by high-type facilities, such as freeways, expressways, and primary and secondary arterials. Accessibility is generally provided by local street networks. Except for limited-access facilities, which serve only through vehicles (mobility), most other classes of highway serve both functions to some degree. Access
- A good transportation system must provide for both mobility and accessibility and should be designed to separate the functions to the extent possible to ensure both safety and efficiency.

People & Goods OR vehicles?

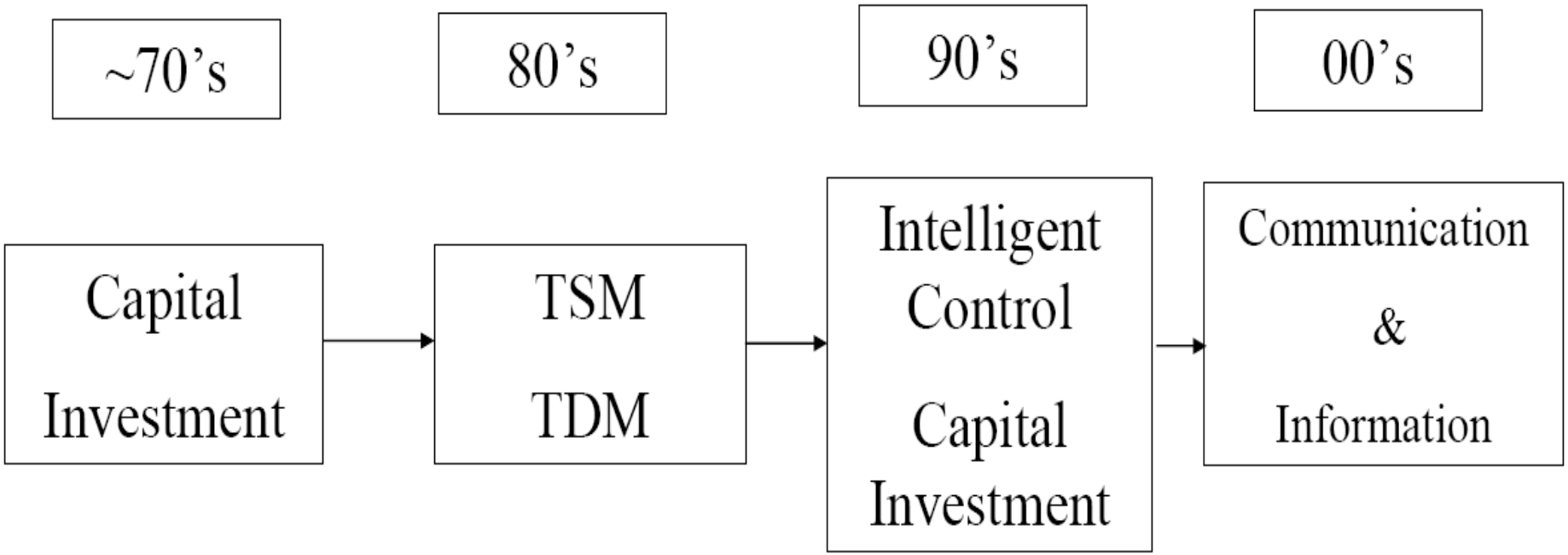
- The most common unit used by the traffic engineer is “vehicles.”
- Highway systems are planned, designed, and operated to move vehicles safely and efficiently from place to place.
- Yet the movement of vehicles is not the objective; the goal is the movement of the people and goods that occupy vehicles.

People & Goods OR vehicles?

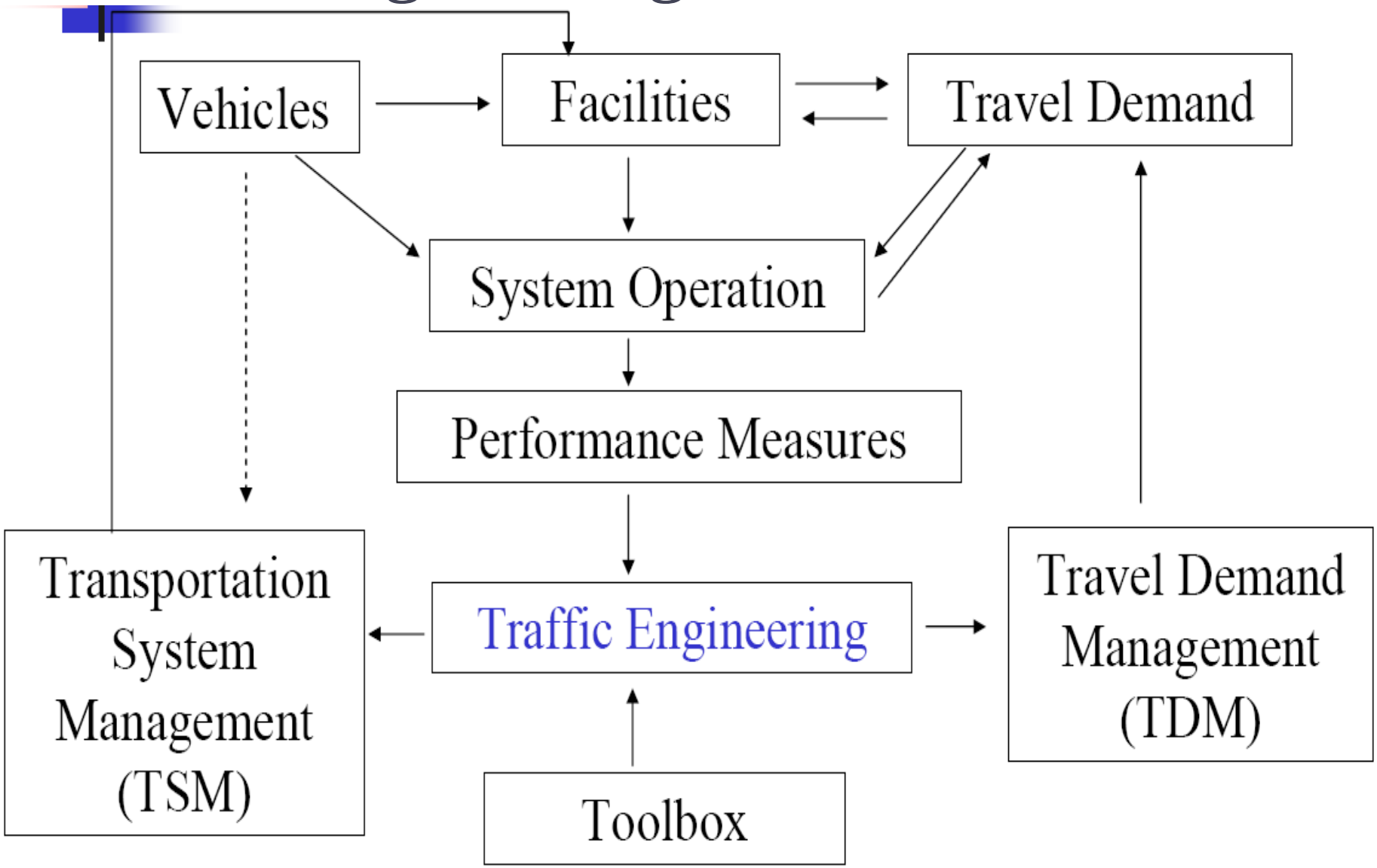
- 1 lane of freeway carries 2200 pcph
- 1 lane of a street arterial carries 800 pcph
- Auto occupancy of 1.1 pass/vehicle
- 3 lane freeway may carry up to7260 pass/hour

- 1 bus lane handles 100 buses/hour
- 3 bus lanes may carry up to 3(50)(100)=15,000pass/hour
- Light rail transit capacity = 20,000pass/hour
- Heavy rail transit headway @ 2 minutes
- HRT capacity can be 30(2,000) = 60,000pass/hour

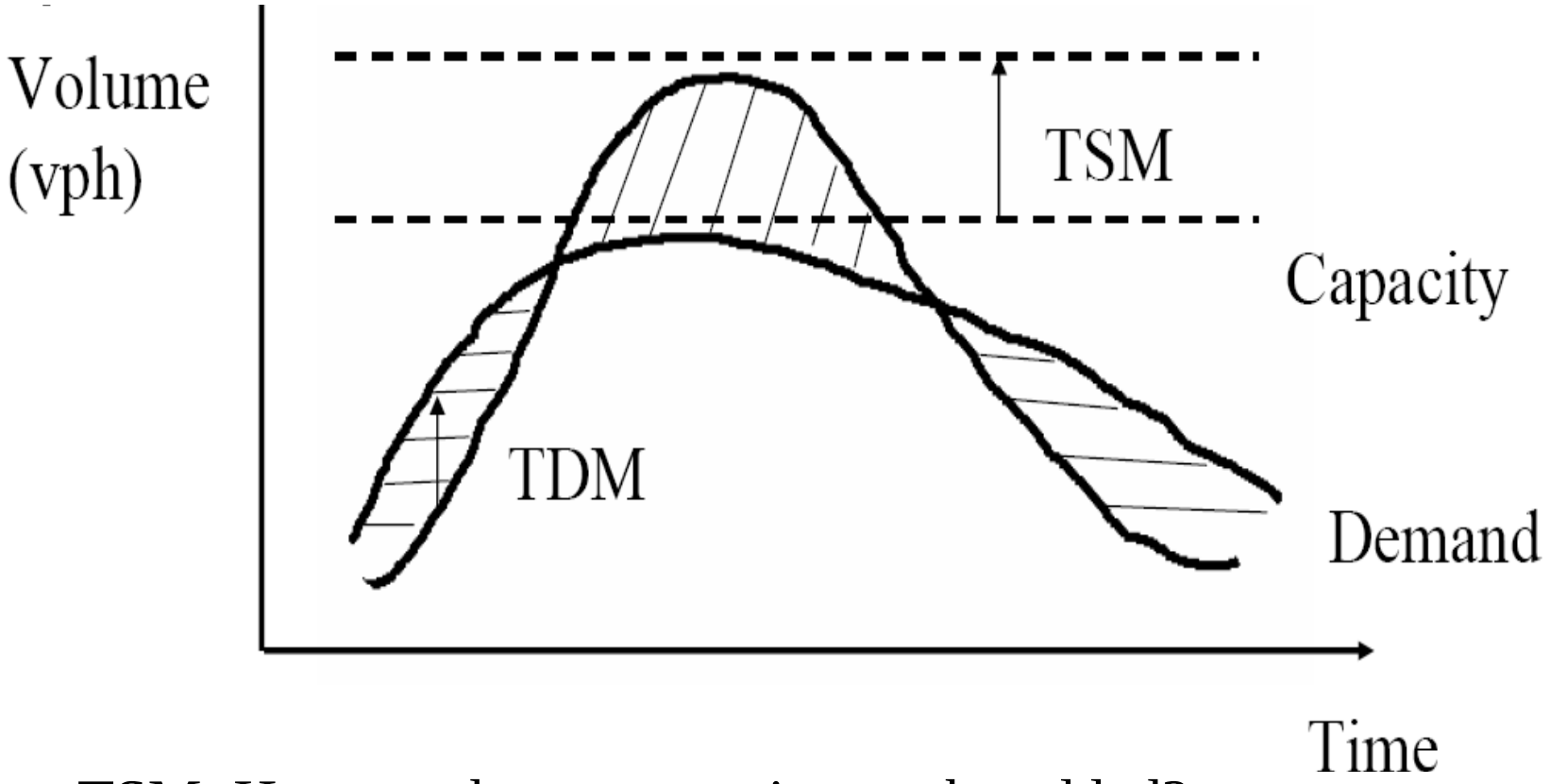
Traffic Engineering History



Traffic Engineering



TSM & TDM



- TSM: How much new capacity can be added?
- TDM: How much capacity can be allowed?

Transportation System Management (TSM)

- **Facility Design**
  - Add Lanes
  - Remove Bottlenecks (Bridges, Tunnel,…)
  - Revise Geometrics to Increase Speed
  - Vehicle Improvement to Reduce Headways

- **Traffic Control**
  - Ramp metering
  - Signal Coordination
  - Signal Phase Sequence
  - Left Turn Treatments
  - Parking Restrictions

Transportation Demand Management (TDM)

- **Reducing Demand**
  - Telecommuting
  - Trip Chaining
  - Shorter Work Week
  - Residential Relocation
  - Alternative Land Use Pattern
- **Shifting Demand**
  - Flexible Working Hours
  - Staggered Working Hours
  - Business Operating Hours
- **Repacking Demand**
  - Car Pooling and Van Pooling
  - Transit

Reading

- *Traffic Engineering*, Roess, Prassas, McShane, [1] pp. 1-16