Traffic Engineering Lecture 1: Outline-Traffic System Components

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Course Information

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Course Information

- Grading
  - 50 Final Exam
  - 25 Mid-term/Assignments/Attendance

Course Information

- Acknowledgment
  - Prof. Hozayen A. Hozayen, Cairo University.
  - Prof. Baher Abdulhai, University of Toronto.
  - Prof. Essam Radwan, University of Central Florida.
- References
  - Roess, R., Prassas, E., and McShane, W. (2011). Traffic Engineering. Pearson.
  - Garber, n., & Hoel, L. (1988). Traffic and Highway Engineering. West Publishing Company.
  - Adolf, M. (1990) “Traffic Flow Fundamentals”. Prentice Hall.

Transportation Profession

- "Application of science, math, and technologies to the basic functions of planning, design, operation, and management of any mode to provide safe, efficient, rapid, economical, comfortable, and environmentally acceptable movement of people and goods". (Institute of Transportation Engineers)

Basic Concepts

- Demand Vs. Capacity
  - Demand: refers to number of vehicles that desire to travel a specific highway stretch during a specific time period.
  - Capacity: refers to the maximum number of vehicles that could travel a specific highway stretch during a specific time period.
- What happens when the Demand exceeds the Capacity??
  - → Delays
  - → Traffic System Failure

Basic Concepts

- Mobility Vs. Accessibility
  - Mobility: refers to the ability to travel to many different destinations
  - Accessibility: refers to the ability to gain entry to a particular site or area
  - Examples…

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Basic Concepts

- Vehicles Vs. Persons Movement
  - 1 Lane of Freeway could carry 2200 passenger car per hour (pcph)

    2200*1.2 passenger/hr

    (for an average occupancy of 1.2 person per car)
  - 1 bus lane that handle 100 buses/hr

    100*50 passenger/hr
  - Light Rail Transit Capacity → around 20,000 pass/hr
  - Heavy Rail Transit Headway of 2000 passenger @ 2 minutes → around 60,000 pass/hour

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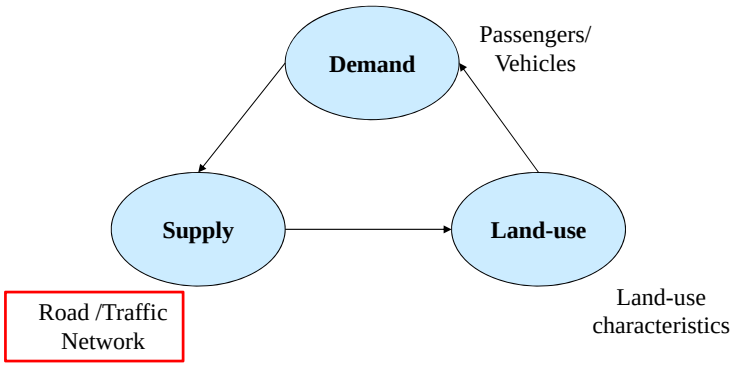
Basic Concepts

- Supply/Demand/Land-use Interactions



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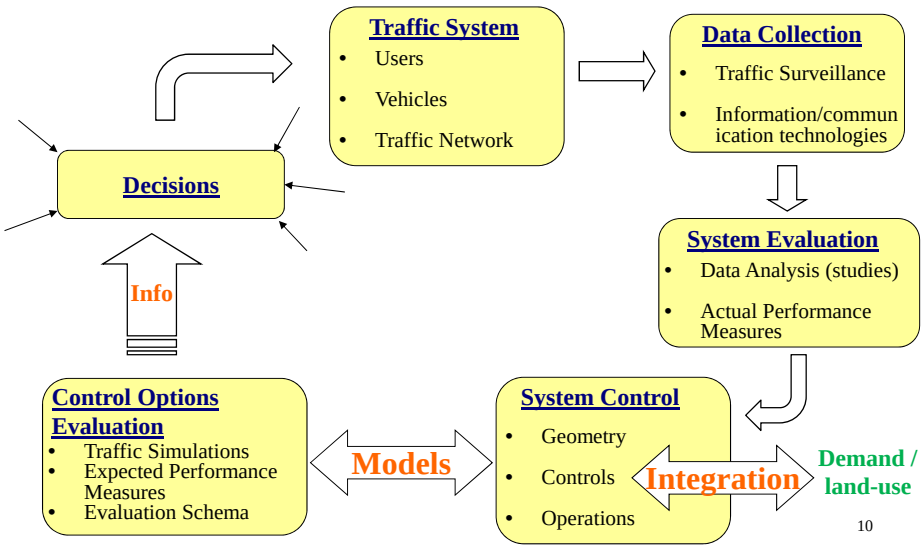
Supply Management

Time Frame???



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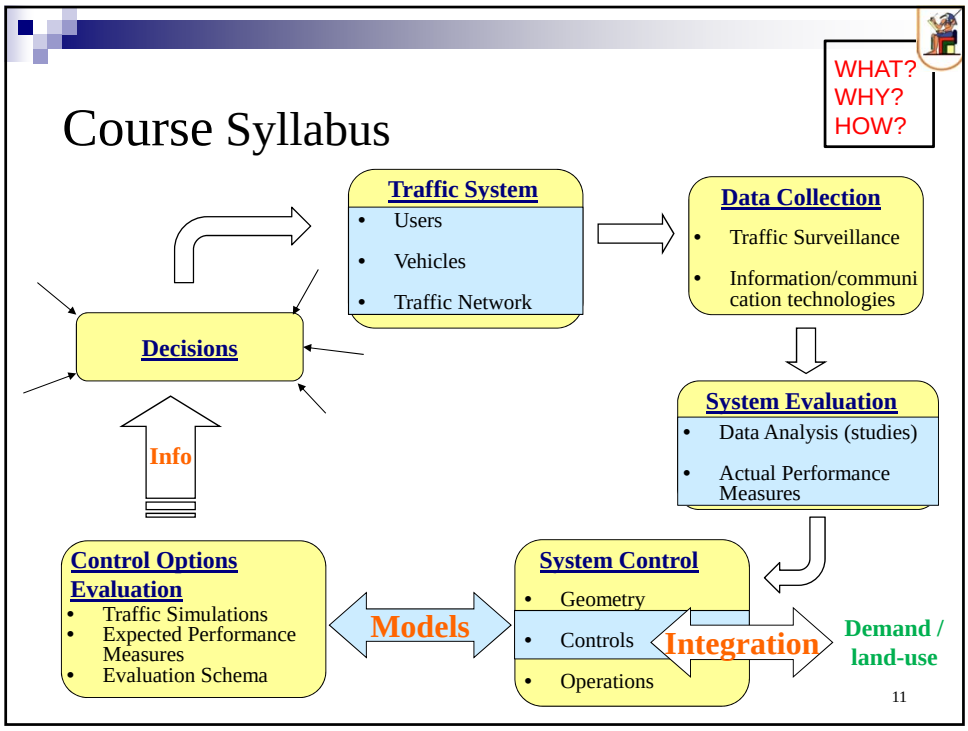
Course Syllabus
WHAT?
WHY?
HOW?
Traffic System
Users
Vehicles
Traffic Network
Data Collection
Traffic Surveillance
Information/communication technologies
Decisions
Info
System Evaluation
Data Analysis (studies)
Actual Performance Measures
Control Options Evaluation
Traffic Simulations
Expected Performance Measures
Evaluation Schema
Models
System Control
Geometry
Controls
Operations
Integration
Demand / land-use
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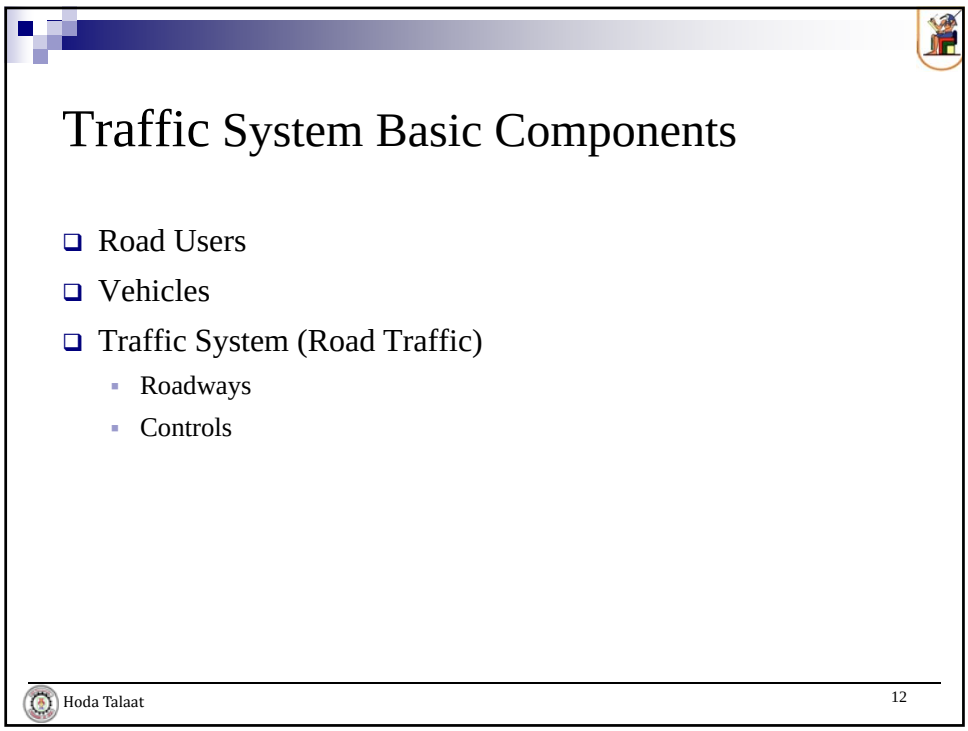
Traffic System Basic Components
Road Users
Vehicles
Traffic System (Road Traffic)
Roadways
Controls
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Road Users

- What?

The main users of a traffic system are:

- Drivers
- Pedestrians
- Bicyclists
- …

- Why?

Users directly impact traffic system operations through:

- Perception and Reaction process
- Decision making process (route choice, departure time choice, driving behavior compliance to recommendations…)

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Road Users

- How?

Users Perception and Reaction Process incorporates:

- Detection
- Identification
- Decision
- Response

} Perception and Reaction Time (PRT)

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Road Users

- How?

Recommendations:

- Drivers PRT
  - 2.5 sec for stopping sight distance
  - 1 sec for signal stopping
- Pedestrians PRT
  - 7 sec
- Pedestrians Walking Speed
  - 4 – 5 feet per second

Vehicles

- What?

Vehicles are the most dominantly used mode of travel.

- Why?

Vehicles characteristics and dynamics directly impact traffic system operations.

Characteristics

- Dimensions: clearances, sight distances, geometric design…etc.
- Weight: structural design, grades…etc.

Vehicles

- Why?

  Dynamics
  - Air Resistance
  - Grade Resistance
  - Rolling Resistance
  - Curve Resistance

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Vehicles

- How? Design Vehicles Specs.
  - Passenger car
  - Single Unit Truck
  - Pickup .
  - Single unit Bus .
  - Semi-Trailer .
  - Full-Trailer .
  - Others: Fire Fighting , Ambulance…etc

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Vehicles

- How? Study vehicle dynamics

Stopping Sight Distance (SSD)=

Distance traveled during PRT + Braking Distance

$$\mathbf{1.47\ Ut_{PRT} + (U^2 - V^2) / 30(f+g)}$$

U: Starting Speed (mph)

V: final speed (mph)

g: grade

f: coefficient of skidding friction (0.28 – 0.4)

t_{PRT}: Perception and reaction time (sec)

Vehicles

- Example applications
  - Example 1:

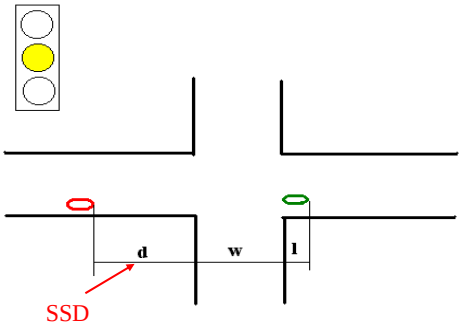
Estimating the speed of a vehicle involved in an accident

➔ **Thoughts?**

Vehicles

- Example applications:
  - Example 2: Dilemma Zone (vehicle cannot stop before the intersection or clear the intersection within the available yellow interval).

➔ **Thoughts?**



clearence Interval at Signalized Intersections

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Roadways

- What?

Roadways are carriers of vehicular movements

- Why?

Roadways characteristics directly impacts traffic system operations, through;

- Physical characteristics (such as lane width, radius of curvatures, slopes…etc).
- Operational characteristics (such as speed limit).

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Roadways

- How?

Functional Classification of Roads

- Urban
  - Freeway
  - Arterial
  - Collector
  - Local

Roadways

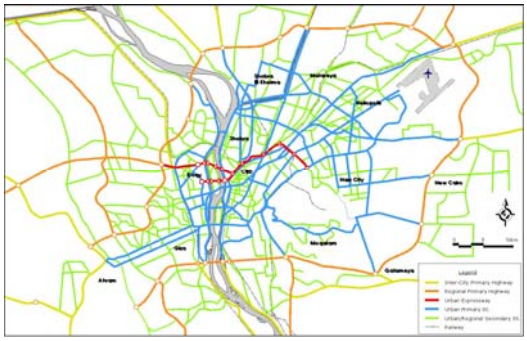
- How?

Functional Classification of Roads

- Rural
  - Interstate
  - Primary
  - Secondary
  - Tertiary

Greater Cairo Region Road classification (JICA, 2002)

- Inter-Urban Primary Arterial Highway
- Regional Primary Arterial Highway
- Urban Expressway
- Urban Primary Arterial Street
- Urban Secondary Arterial
- Collector/Distributor Street
- Local Street



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Controls

- What?

Interference to control vehicles' movements, such as:

- Marking
- Signs
- Signals
  - Pre-timed: Fixed signal plan (red, green and yellow time intervals).
  - Actuated: Signal plan is subject to limited changes based on inputs from traffic sensors.
  - Adaptive: Signal plan is continuously changing based on a self-learning optimization algorithm.

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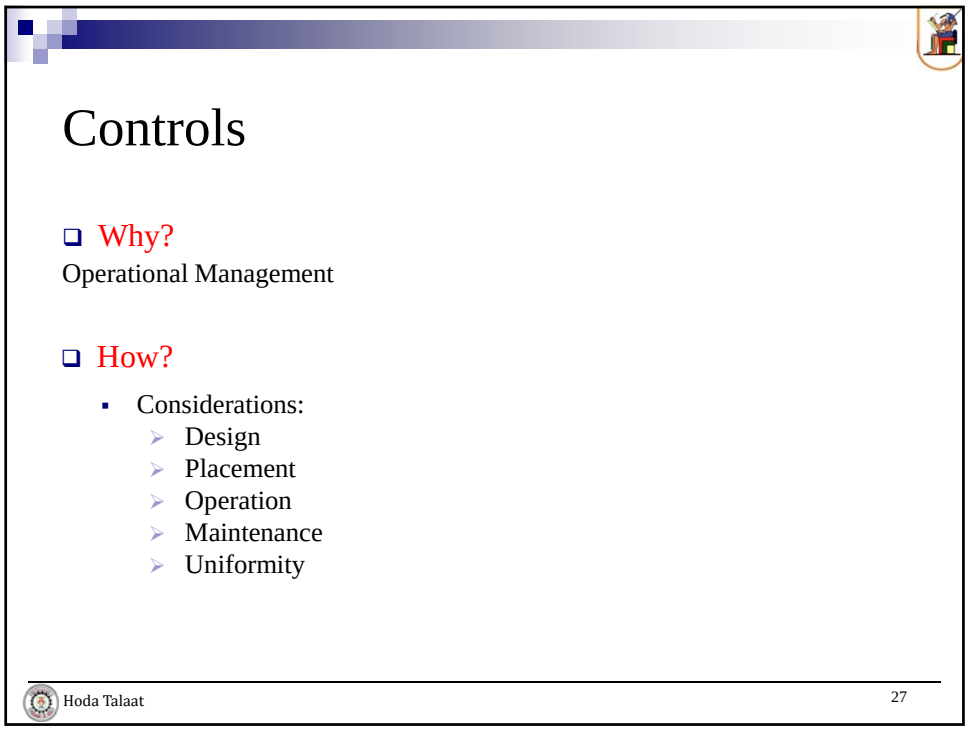
Controls
Why?
Operational Management
How?
Considerations:
Design
Placement
Operation
Maintenance
Uniformity
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