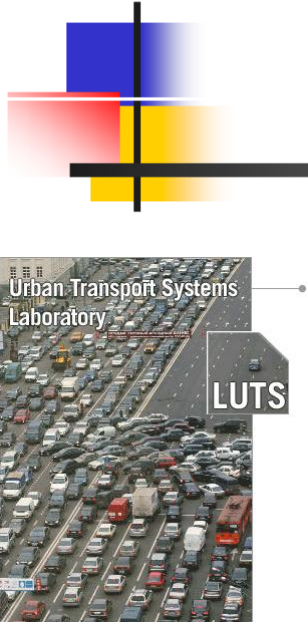


CIVIL-349 -Traffic engineering



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**Urban Transport
Systems Laboratory (LUTS)**



Preliminaries

- **Format:** 2.5 hours of lecture per week + 1.5 hour of exercise-laboratory per week (on average)
- **Class Meets:** *Lectures:* Thursday 2.00 – 6.00 pm, **Meeting room: CM 1 105**
- **Laboratory Room: CM 1103**
- **Instructor in Charge**
- Prof. Nikolas Geroliminis
GC C2 389 , [+41 21 69] 32481 nikolas.geroliminis@epfl.ch
- **The team:** Minru Wang (minru.wang@epfl.ch, GC C2 401)
Marko Maljkovic (marko.maljkovic@epfl.ch, GC C2 385)
Julien Ars (julien.ars@epfl.ch)
Samuel Pancheri (samuel.pancheri@epfl.ch)
- Office Hours for assistants: Wednesday 12:00-13:00 (and by appointment)
- *Office hours is an optional time which give students the opportunity to ask in-depth questions and to explore points of confusion or interest that was not fully addressed in class.



Course Objectives and Description

- Introduce the major elements of transportation systems and create awareness of the broader context
- Develop basic skills in applying the fundamentals of the transportation field
- Understand the key concepts and physics of the transport phenomena
- Connect with real transportation problems
- Be prepared for further study in this field



Course Structure / Grading

Grading

- The final grade will take into account performance in the **final written exam** as well as **team projects (laboratories)**, **midterm exam** and **homeworks**.
- The final written exam will last 165 minutes and will involve questions focusing on the different topics covered during the course and the laboratories.
- The midterm exam will have a similar style and last 75-90min.
- Exercise sessions involve some problem solving with the teaching assistants, they do not require any effort outside classroom and they do not directly contribute to the final grade.

Midterm exam
November 7 (2:15-3:45pm)

Final exam
December 19 (2:15-5:00pm)

Type	Fraction
Homeworks	0%
Midterm	30%
Final Exam	40%
Laboratories	30%
Total	100%



Grading (II)

Lab grades are a function of:

- Correctness of the solution approach
- Quality of the analysis
- Clarity and neatness of written section

Late Assignments: Will only be accepted under extraordinary circumstances

Exam grades are a function of:

- Correctness
- Quality of analysis



Great Expectations

I am expected to....

- Teach
- Be fair and kind with all of you
- Give you feedback on how you are doing in a timely fashion
- Be in my office when we have a meeting or office hours

You are expected to...

- Learn
- Attend lectures and participate
- Do the problem sets
- Not be rude if possible – sleeping, cell phones, using laptops for chatting, texting girlfriend/boyfriend etc.

- [illegible]



TSE EXAMPLES

- NO-RULE TRAFFIC
- TRAFFIC OPERATIONS
- MULTIMODALITY
- MODELING

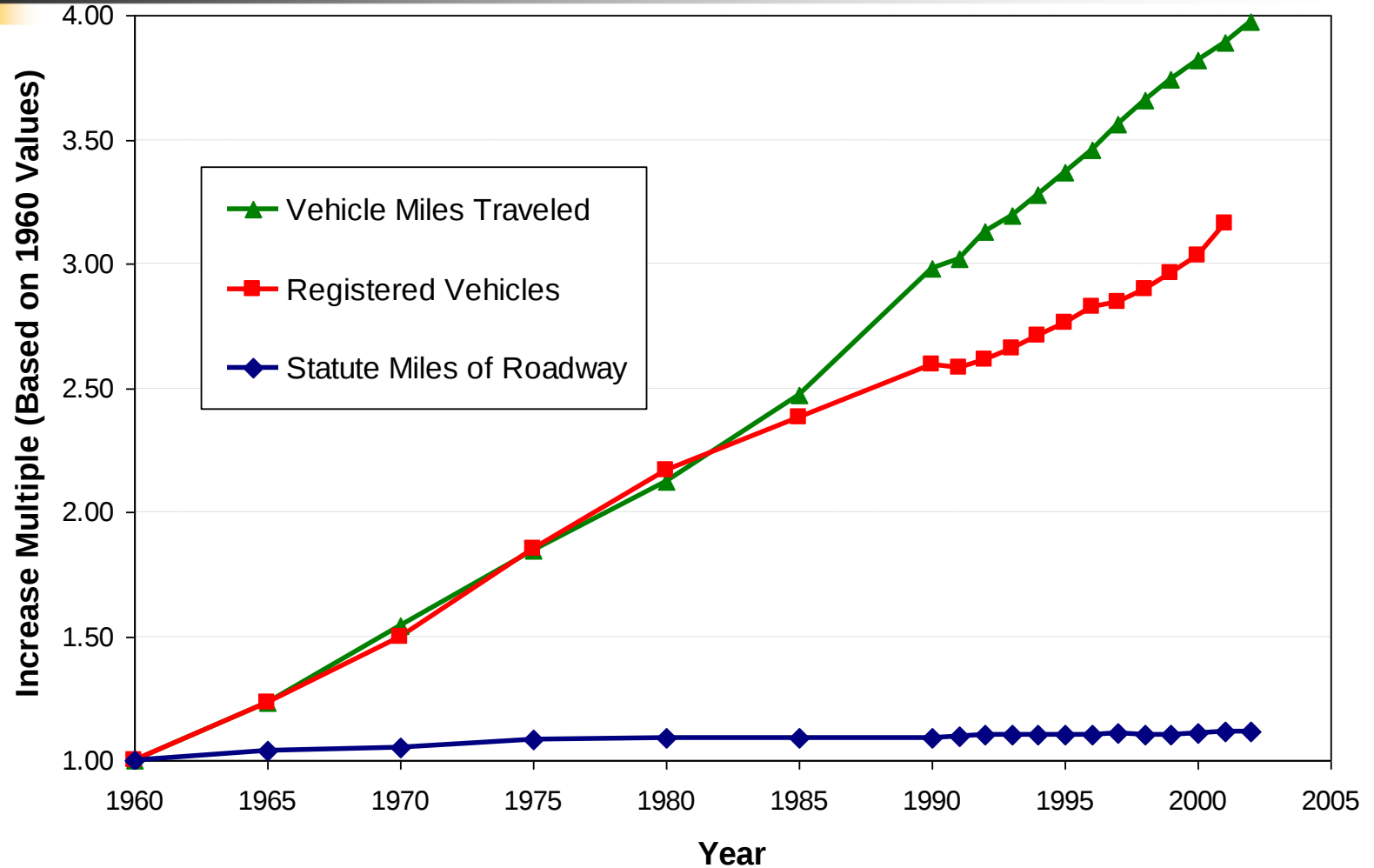
If you build it....



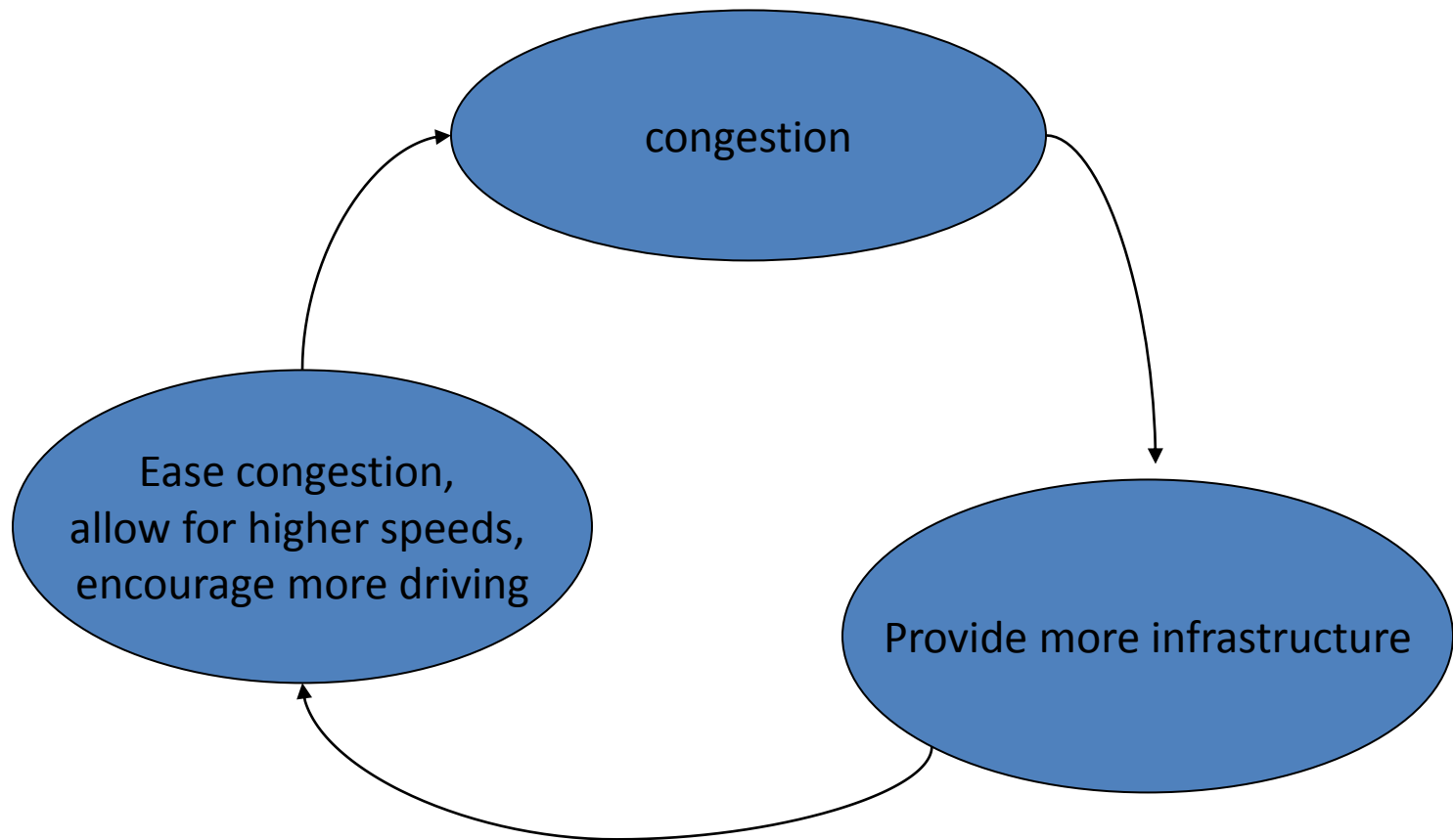
They will come....



Road Use Growth



Infrastructure development is not the only answer





The Transportation Engineering Challenge

- To safely and efficiently move people and goods
- Not just by designing and building the transportation infrastructure, but by managing the infrastructure and demand
- Design a transportation system that is sustainable



Intelligent Transportation Systems

- Our ability to do this has developed dramatically with electronic sensors and communication
 - Quantify congestion and compare congestion costs to rationalize investment
 - Use cost to distribute capacity rather than delay
 - Automatically detect and avoid dangers
 - Improve security
 - Operate more efficiently



CLASS THEMES

- **Transportation Systems and Mobility**

Mobility – Activities - Land Use, Classification-Hierarchy, Multimodality

- **Traffic monitoring**

Observation, Measurement, Sensing Techniques; the collection and interpretation of transportation data

- **Basic Assessment Tools**

Predominantly graphical tools useful for understanding details of transport operations; common properties of traffic streams (flow, density and speed)

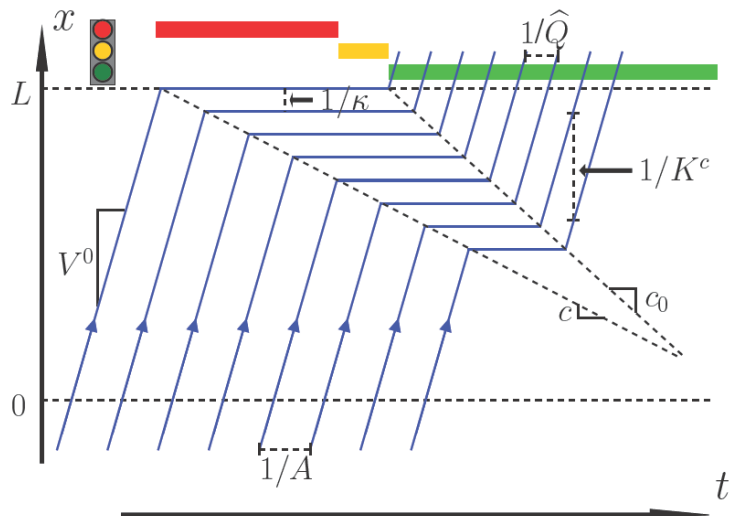
- **Modeling and Operations**

Relations between properties of traffic streams and spatio-temporal models of congestion, Traffic flow modeling, Control and capacity of transport systems, car-following models, shockwave theory

- **Design of multimodal systems**

Urban Policy, Case Studies, Intro to bus operations

CLASS THEMES





Specialties in transportation

- Planning
- Design
- Construction and maintenance
- Traffic Operations

Planning

- Forecast the impact of the project upon the system (e.g., transportation, environment)
- Setting up the specifications of the project
- Determining benefits and costs
- Interact with the decision makers to achieve final decisions



Design

- Involves the specification of all the features of the project so that it can be built.
- geometric design (horizontal and vertical)
- pavement design
- determination of right of way, drainage structures, fencing, etc. (considering the users of the system)
- part of the design process is the production of construction plans



Traffic operations

Its objectives are related to using the facility in the most efficient way. It involves:

- the use of analytical models to determine the most efficient way to operate the facility
- the use of monitoring devices to determine actual conditions and level of service
- the use of devices to implement control strategies



Components of the transport system

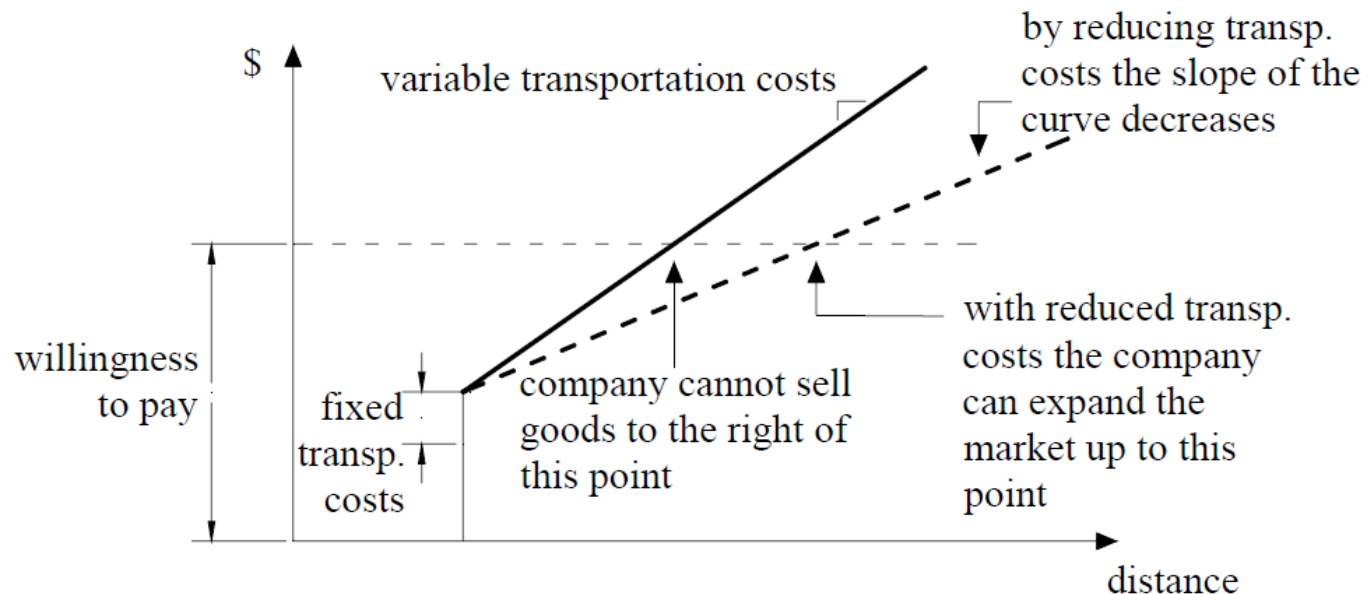
- Physical facilities: streets, highways, ports, railroads.
- Fleets of vehicles: trucks, passenger cars, vessels....
- Operating bases and facilities: maintenance facilities,
- Organizations
 - Facility oriented: involved in planning, design, construction, maintaining and operating fixed facilities
 - Operating organizations (carriers): railroads, airlines, shipping companies, private individuals
- Operating strategies: routing, scheduling, traffic control



What Transportation Systems do? (Advantages)

Transportation might affect time/place utility of goods.

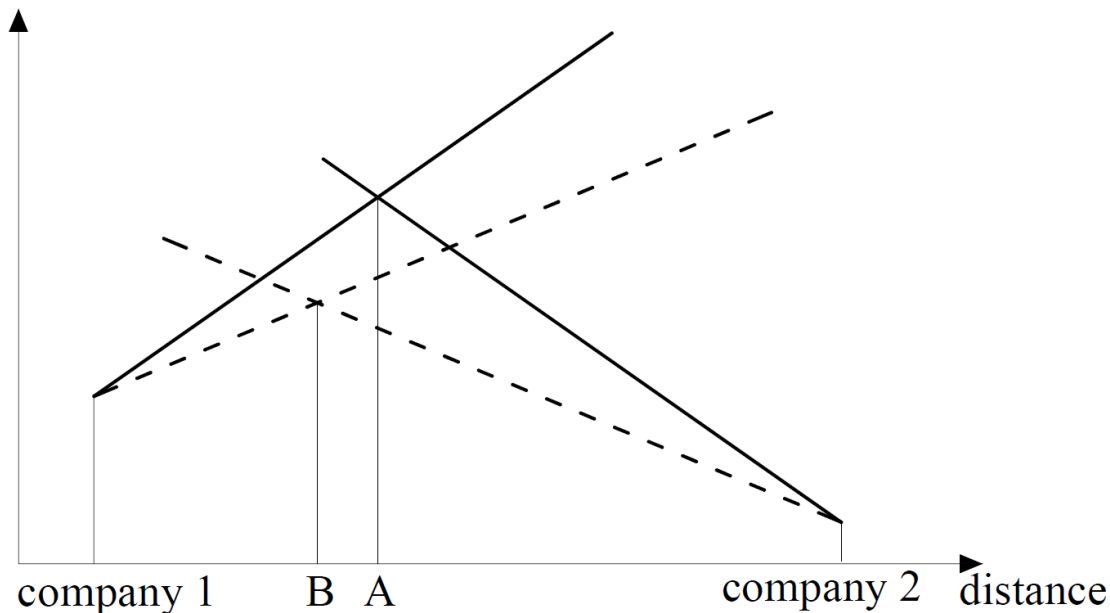
- If we can increase the value of a good by reducing its transportation time then we obtain “time utility” (i.e. fast delivery of newspaper)
- We might expand the market of some goods by reducing their transportation cost (place utility)



What Transportation Systems do? (Advantages)

If we reduce fixed transportation costs:

- Overall cost reductions
- Expanded market
- OR induce competition



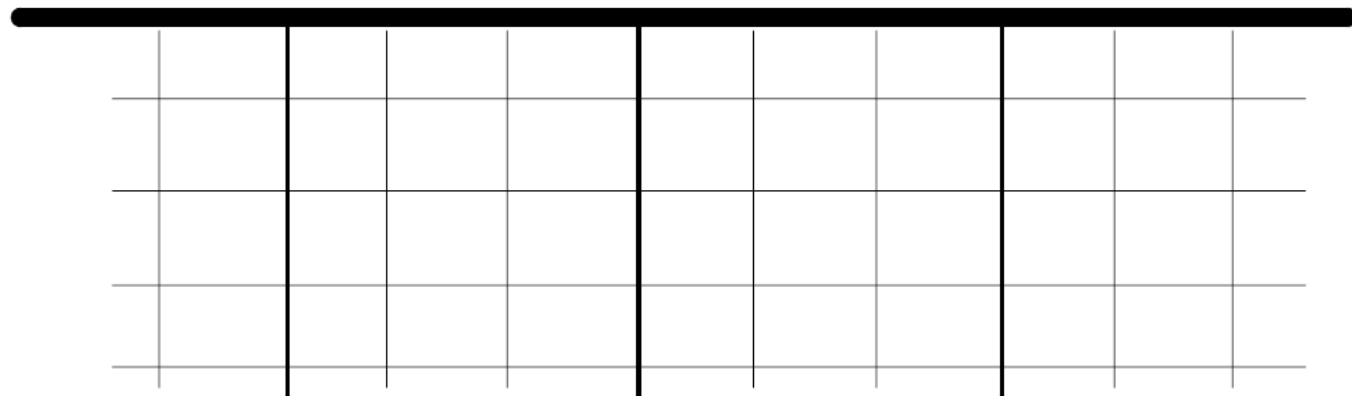


What Transportation Systems do? (Disadvantages)

Resource Consumption	Alterations of the environment
• Energy consumption (fossil fuels) • Land consumption • Consumption of raw materials • Safety	• Air pollution • Water pollution • Noise • Aesthetics • Disruption of animal habitats • Disruption of human habitats

How Transportation Systems work?

Hierarchy: we try to focus trips on the high-cost facilities to save lifecycle costs. However, there is the penalty of circuitry: if we only build one facility there would be huge detours.



-  freeway
-  arterial street
-  local street



Hierarchy in Transportation Systems

- In scheduled transportation:
 - One might take the taxi to the airport
 - Then a regional jet to a bigger airport (airline hub)
 - Finally a bigger plane for the transatlantic flight
- In unscheduled transportation:
 - Freeways handle a lot of traffic in an efficient way (they are very expensive)
 - Arterial streets connect local streets to freeways
 - Local streets are very accessible, although not very efficient (they have a low unit cost)



The role of hubs in TS

A hub can reduce the number of city pairs from N^2 to $2N$.

