Course Description

Orf 467
Transportation Systems Analysis and Planning *v1.0*

Fall 2012/13

Professor Alain L Kornhauser	**Class Hours:** Mon. & Wed. 1:30- 2:50 pm Location: 101 Sherrerd Hall (ORFE Building)
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Course Requirements:	% of final grade
bi-weekly assignments	30%
"tenth - week" exams	30%
Term project due at end of Reading Period	30%
Class participation	10%

Course Description

Studied is the transportation sector of the economy from a systems technology and planning perspective. The focus is on fundamental modeling and analytical methodologies that support

- regional and national, long and short-range capital and operations planning initiatives,
- real-time operational decision making by transportation companies, and
- the formulation and analysis of long-range innovation and infrastructure investments focused on the transportation sector of the economy.

The transportation sector of the economy is one in which a continuing "tug-of-war' exists between the private sector and the public sector that seeks a balance between private sector market forces and broad oversight and infrastructure investments by the public sector. Shifting priorities focused on stimulating broad economic recovery and job creation; provide an opportunity for enhancing mobility through synergistic investments in transportation by both the public and private sectors of the economy. The development of successful innovative investments requires a fundamental, thorough and deep understanding of the demand for mobility by both people and goods as well the physical and operational characteristics of the supply-side technologies. Transportation must also address many of society's concerns. The heightened sensitivity of security creates new challenges. Radical concepts such as "value" pricing, private toll roads and for-profit mass transportation are beginning to be seriously considered as elements of a broad transportation policy. Meanwhile, local issues of traffic congestion, road construction, transportation-related environmental issues and the stagnation of transportation funding sources are dominant themes of grass roots planning and policy analysis. Finally, 1/3 of the energy consumed in the US is consumed by the transportation sector. Today, essentially all is carbon based. Will concern about global warming, oil spills, CAFE standards on SUVs, $147 a barrel oil, hybrids, PEVs, the restructuring of the US auto industry, autonomous vehicles and/or PRTs change our addiction to oil as we've changed our views on tobacco (which took forty years)? Investigated will be ways that we can

begin to finally wean ourselves from our addiction to oil. Computerized fleet management, electronic tolling, turn-by-turn navigation, electronic ignition, cruise control, antilock braking, automated people movers are all now common-place with much more automation just over the horizon. A substantial part of the course focuses on the emerging complete automation of the automobile and its implication on public transport systems.

The course focuses on the fundamentals of the demand and supply sides of transportation as well as an understanding of many of the societal issues constraining the provision of mobility to people and goods.

The first part of the course, "policy, planning and decision making", surveys the transportation sector of the economy by studying and evaluating the current change in the balance between Federal, regional and local transportation agencies, private transportation providers, consumers of transportation and those impacted by transportation. Studied are the roles played by each of the participants in the transportation sector of the economy. The historical evolution of transportation policy will provide a perspective for evaluating current activity focused on economic recovery and job creation.

The second part of the course, "analytical models of transportation demand and technology", focuses on the quantitative aspects of the demand for mobility / transportation and the design, planning and analysis of transportation systems. Studied are the methodologies used in the transportation planning process: its objectives, its models and its data requirements. Focus will be on methodologies for quantifying the demand for transportation and analytical processes for the planning and design of infrastructure, facilities and systems that are appropriate for addressing broad national policy issues as well as detailed and specific local circulation and traffic issues. In particular, the classical four-step travel analysis process will be studied involving: Trip Generation, Trip Distribution, Modal Split and Traffic Assignment with Trip Generation and Distribution first studied from a spatially and temporally aggregated perspective and then from an individual traveler perspective. The individual perspective will allow for the synthesis of precise temporal and spatial trip inventories that assemble to reflect the aggregate characteristics of the mobility of the society. These methodologies will be used to synthesize each of the 30+ million individual trips that are made in New Jersey on a typical day.

The third part of the course, "technologies", focuses on emerging technologies that may improve mobility, the economy and address environmental concerns. Studied are the various elements of intelligent transportation systems (ITS) that apply advanced communications, computation, information and control systems to improve the financial viability and reduce the environmental impact of mobility systems as well as advanced traveler information systems and advanced transportation management systems. Of particular interest will be a new "mass" transit concept consisting of autonomous vehicles: autonomousTaxi or aTaxi operating on the existing roadway infrastructure. Armed with the synthesis of each trip made by each person on a typical day in New Jersey generated in the 2nd part of the course, the class will design a state-wide aTaxi system for New Jersey. This will involve the judicious location of aTaxi stands (stations) throughout the State and the operational simulation of the aTaxi system to best serve those trips. Each student will be responsible for the design and analysis of the aTaxi system for at least one county. The class will work together to create a unified synergistic system for the entire state. Work on the system will evolve throughout the semester. Interim results and findings will be presented at two interim workshops. A Final workshop, presenting final recommendations, will take place at the end of Reading Period.

The final part of the course, "current transportation policy issues", investigates several policy issues having significant local, regional and national transportation policy implications:

a) "The Automobile of the Future, Autonomous Plug-in Electric Vehicles, APEVs, or Compressed Natural Gas Vehicles, CNGVs, or ??",
b) "Can Mass Transit Enhance the Arts" (The synergy between the Dinky the new University Arts Center), and
c) How do we address "texting while driving". (How much multi-tasking can we do while driving? How often do we really want to "drive"?),

d) "Privatizing the Cash Cow (aka New Jersey Turnpike) " (Innovative ways to charge for the construction, maintenance and operation of shared assets), and

e) "Taxing gasoline as a sin" (How do we break the "automobile habit").

Course requirements include weekly readings, bi-weekly assignments, one "tenth week" exam, a term project and class participation. Two (2) 80 minute classes plus a 50 minute precept. We'll also visit some transportation facilities in the metropolitan area and have several distinguished practitioners come speak with us. The term project will consider an area-wide mass transit system for the entire state of New Jersey. Instead of PRT, we will investigate an area-wide autonomousTaxi (aTaxi) system. From a modeling point of view, this system is essentially a PRT system operating on the existing street and road system. The focus will be on the precise location of aTaxi stands (equivalent to PRT stations) and the operational analysis focused on optimizing the aTaxi dispatch and empty vehicle management so as to deliver the best service at each station. Central to this analysis will be the synthesis of the precise spatial and temporal demand for transportation by each individual living or working in New Jersey on a typical weekday. Investigated will be the arrival characteristics of these patrons at each aTaxi stand, their assignment to a waiting aTaxi and the occupancy and operational characteristics of the aTaxi vehicles. The synthesis of the travel demand was last year's class project. It developed the methodology for the synthesis of individual travel demand in New Jersey. The synthesis will be recreated. Based on that demand pattern, the aTaxi stations will be assigned precise locations. This will yield temporal demand patterns for each for which an "optimal" operational plan will be devised. This will culminate in a final report: The Design and Performance of an area-wide aTaxi System for New Jersey, that will be similar in structure to previous years' PRT reports for New Jersey: Orf467F10, Orf467F09, Orf 467F08; PRT for New Jersey, Orf 467F07; PRT for Counties in NJ, OrfF05; PRT for NJ, Orf467F04

Syllabus

Enrolled Students

Reference Textbooks:
Cascetta, Ennio *Transportation Systems Analysis, Models & Applications*, 2nd Ed. Springer, 2009, ISNB 978-0-387-75856-5

TRB, *Revised Monograph on Traffic Flow Theory: A State-of-the-Art Report*

Small, K. A. and E. T. Verhoef, *The Economics of Urban Transportation,* Routeledge, 2007, ISBN10: 0-415-28514-3

Ahuja, R. K, T. L. Magnanti & J. T. Orlin ,(Magnanti) *Network Flows, Theory, Algorithms and Applications,* Prentice Hall 1992, ISBN 0-13-617549 (excellent reference text on networks)

Meyer, M. D., & Miller, E. J. (M&M) *Urban Transportation Planning, A Decision-Oriented Approach, 2nd ed*. McGraw-Hill, 2001, ISBN 0-07-242332-3

Ran, B., Boyce, D. *Dynamic Urban Transportation Network Models*, Lecture Notes in Economics & Mathematical Systems, #417, Springer-Verlag

Oppenheim, N. *Urban Travel Demand Modeling*, Wiley, 1995, ISBN 0-471-55723-4

http://www.bts.gov/ US Transportation Statistics http://www.fhwa.dot.gov/tea21/index.htm Current Federal Transportation Legislation http://www.fhwa.dot.gov/trafficinfo/index.htm#TRFF National traffic & road closure