Intelligent Transportation Systems

Spring 2008, 3 credits, Tuesday 5:45-8:15 PM, ED 232

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COURSE DESCRIPTION

This course covers the basics of intelligent transportation systems. While transportation systems worldwide provide increasing levels of economic and social opportunities, they also create well-known problems of congestion, safety and environmental degradation. This course will examine how Intelligent Transportation Systems (ITS), can be used to enhance mobility, reduce death and injury and protect the environmental resources. ITS are application of information and communication technologies to the transportation system. The issues to be covered in the course will include systems engineering approach applied to ITS, ITS deployment and transportation operations, transportation system management, traveler response to technologies and information, ITS planning, evaluation, and institutional issues. The specific topics covered in the course will include:

- Identification of transportation problems and costs
- Definition and role of Intelligent Transportation Systems
- Policy-makers' perspective on ITS
- Diffusion of innovations through the transportation system
- Applications: Transportation system management
- Applications: Traveler Information Systems (including acquisition and use of technology and info)
- Applications: Public transit, bicycles and pedestrians
- Applications: Commercial vehicle operations
- Application: Automated Highway Systems
- Making plans for intelligent transportation systems
- Evaluation of technologies and large-scale ITS field tests
- Assessing the benefits and costs of ITS
- Learning from ITS deployments in the US
- Challenges and Issues: Technical, institutional, and funding issues
- ITS evaluation software (e.g., IDAS)
- Public and private sector perspectives (institutional and stakeholder issues)

Students: This course is primarily for graduate-level students in Engineering; students from related disciplines interested in transportation may also enroll. Students should be interested in exploring and critically appraising transportation innovations. They will be encouraged to work on transportation innovations of their interest. The course will prepare students to work and conduct research in ITS.

Prerequisites: Graduate standing and at least one introductory transportation course.

Credits and format: This is 3-credit course. Most of the course will consist of lectures. In addition, there will be class discussions, and student presentations, and we may have occasional guest lectures.

SCHEDULE

NO.	DATE	DAY	TOPIC	COMMENT
0	15-Jan	Tue	No Class-TRB	
0	17-Jan	Thu	No Class-TRB	

NO.	DATE	DAY	TOPIC	COMMENT
1	22-Jan	Tue	Introduction to course	Assignment 1 GIVEN
2	24-Jan	Thu	Transportation problems & ITS history/role	Term paper discussion
3	29-Jan	Tue	Policies and innovation diffusion	
4	31-Jan	Thu	IT, communication and cities	
5	5-Feb	Tue	ITS data	
6	7-Feb	Thu	ITS data and ITS architecture	
7	12-Feb	Tue	ITS architecture	
8	14-Feb	Thu	Trans Management Centers	
9	19-Feb	Tue	Trans Management Centers	
10	21-Feb	Thu	High-impact ITS technologies	Assignment 1 DUE (lit review of term project)
11	26-Feb	Tue	ATIS: Traveler behavior	
12	28-Feb	Thu	ATIS: Technologies	
13	9-March	Tue	Traffic assignment	
14	4-March	Thu	Alternative modes: Transit	
15	6-March	Tue	Alternative modes: Pedestrian	Assignment 2 DUE
16	11-March	Thu	Spring break-no class	
17	13-March	Tue	Spring break-no class	
18	18-March	Thu	Automation	
19	20-March	Tue	Safety technologies	
20	25-March	Thu	Evaluation of ITS technologies	Stat analysis DUE
21	27-March	Tue	Benefits and costs	
22	1-April	Thu	Benefits and costs	
23	3-April	Tue	Planning for ITS	
24	8-April	Thu	Institutional issues	
25	10-April	Tue	ITS software	
26	15-April	Thu	ITS software	Conclusions DUE
27	17-April	Tue	Innovative methods	
28	22-April	Thu	Student presentations	Ppt presentation
29	24-April	Tue	Student presentations	Ppt presentation
30	29-April	Thu	Review and wrap-up	
	1-May			Term paper DUE

Requirements: Attendance in all classes is required (unless there is a good reason for your absence). Student assignments will include readings to familiarize them with existing ITS issues and methods. Some of the readings will be from:

Institute of Transportation Engineers. *Intelligent Transportation Primer.* Washington, D. C., 2000.

A major effort will be devoted to doing a class project.

Class Project
For the class project, every student will conduct a three-phased effort aimed at identifying factors that influence the level of transportation problems and innovative solutions/countermeasures, which might address the problem. You can choose a topic that is of interest to you and it can be a project that you are working on or intend to develop into a thesis or dissertation. Final selection of topic should be in consultation with the instructor. Sample topics of interest can include:

- Role of ITS in Hampton Roads Hurricane Evacuation
- Use of ITS technologies for primary and secondary incident management
- Case-Based Reasoning as a tool for better ITS planning
- Economic impacts of freeway traffic incidents on large trucks
- Use of ITS in large truck speed enforcement
- How will ITS diffuse through the system?
- How can primary and secondary incidents be managed?
- How does dynamic information influence traveler behavior?

- Can Automatic Vehicle Location systems improve transit system performance?
- What ITS technologies are available for pedestrians and bicyclists and what are their impacts?
- How can ITS technologies improve transportation safety?

Phase I will involve a review of the literature concerning a specific transportation issue chosen by the student (e.g., evaluating the effect of a freeway service program; understanding traveler response to dynamic information; involving various parties in developing a national plan for intelligent transportation systems). The review will cover what is known about the issue in terms of both problem size and potential ITS solutions/countermeasures. The students will be expected to identify sources of potential studies, conduct Internet search of literature databases, and obtain and review relevant studies. Source material should also be available at University libraries and of course, the Internet provides a good source of ITS resources. Commercially published books are one source of information for the literature review. The relevant books are:

1. Chen, Kan and John C. Miles, ed. ITS Handbook 2000: Recommendations from the World Road Association (PIARC). Artech House: Boston, 1999.
2. ITS America, US DOT FHWA, ITE. Intelligent Transportation Primer. Institute of Transportation Engineers: Washington, DC. 2000.
3. Sadek, Adel and Mashur Chowdhry, Fundamentals of Intelligent Transportation Systems Planning, Artech House ITS Library.
4. Ozbay, Kaan, and Pushkin Kachroo. Incident Management in Intelligent Transportation Systems. Artech House: Boston.
5. Ozbay, Kaan, and Pushkin Kachroo, Feedback Ramp Metering in Intelligent Transportation Systems, Plenum Publishers, 2004.
6. McQueen, Bob, Rick Schuman, and Kan Chen. Advanced Traveler Information Systems. Boston: Artech House, Inc. 2002.
7. McQueen, Bob and Judy. Intelligent Transportation Systems Architectures. Boston: Artech House, Inc., 1999.
8. Barfield, Woodrow and Thomas A. Dingus. Human Factors in Intelligent Transportation Systems. Mahwah: Lawrence Erlbaum Associates, 1998.
9. 2000 IEEE Conference on Intelligent Transportation Systems. Institute of Electrical and Electronics Engineers: Piscataway, 2000.
10. Emmerink, R.H.M. Information and Pricing in Road Transportation. Berlin: Springer-Verlag, 1998.
11. Stough, Roger R. Intelligent Transport Systems. Northampton: Edward Elgar, 2001.

Other ITS documents (sample):
Sussman, Joseph M. "What Have We Learned About Intelligent Transportation Systems (ITS)?" EDL #13316, U. S. Department of Transportation. Washington, D.C. 2000.

ITS/Operations Resources Guide

Electronic databases
PATH Database (Bibliographic Info)
USDOT ITS Electronic Document Library

Websites
ITS America Website
USDOT main ITS website
ITS architecture

(additional websites are available on the course website)

Dr. Khattak will work with the students in planning and conducting this review. The student will present the results of the review *informally* in class. They will also provide a summary of their review not to exceed 5 pages (12 point times roman font, with 1 inch margins).

Phase II will involve critically evaluating one research papers in detail. You will identify a published research paper on the topic of your class project (selected in Phase I). The paper you select for review and critique should be published in a refereed journal. I will provide a detailed checklist on how to crticially evaluate research papers.

Phase III will involve conducting statistical analysis including developing models which predict the impacts of the chosen ITS solution on the transportation problem of interest. Students may want to focus on ITS solutions that have been implemented and relevant evaluation data are available. The data set should include a large number of variables (preferably 5 or more) and the sample sizes should be considerably larger than 30 observations. I will provide datasets. Additional datasets can be found through searches on the Internet (e.g., US government web sites related to ITS, professional society web sites), interaction with professors, other graduate students, and through published work such as journal articles and textbooks. Preliminary statistical analysis of the data will be due as an assignment, before the submission of the final product.

The final product will be a paper of no longer than 7500 words (following guidelines from the Transportation Research Board) and a 15-minute formal presentation to the class, including slides/overheads/visuals.

The criteria for evaluation of the class project (paper and presentation) will include:

- Problem definition: Is it clear to both the reader and writer? Is it logical? Is it complete? Is it manageable? (Weight=1)
- Approach and Analysis: Is there a clear methodology for modeling? Is the methodology logical, feasible, comprehensive and manageable? Are the major issues overlooked? Is the modeling successfully completed? (Weight=4)
- Connection between transportation problems and ITS solutions: Was the review of possible ITS technologies comprehensive? Can the recommended ITS solutions address the transportation problem? (Weight=4)
- Logic of conclusions and recommendations: Do they make sense? Will recommendations work? Are they defensible and defended? (Weight=1)

Readings will be assigned for each class and you are expected to review them before class.

The requirements for this course include:

- Literature review—25% of grade.
- Critical review of selected paper—15% of grade.
- Assigned readings, active participation in class—10% of grade.
- Class project presentation—5%
- Class project—45%

Course Approach:
Intelligent Transportation Systems combine communications and transportation technologies to improve the flow of goods and people, and to save lives, time, and the environment. Their successful strategic planning, deployment and operation requires a fundamental understanding of traveler/user response, transportation network performance, and organizational behavior. The course will assist students in understanding the principles of intelligent transportation systems (ITS), enabling them to effectively plan for and operate ITS programs. The main theme of the course is to help the student think positively, yet critically, about intelligent transportation systems and their role in increasing efficiency and mitigating transportation problems. These problems cost nearly $400 billion annually in the US alone. The instructor will define intelligent systems and then examine transportation trends to make the case that opportunities abound for their application in transportation. However, the challenge is in developing a symbiotic

relationship between intelligent transportation systems and more conventional strategies (such as adding road capacity) to tackle complex transportation problems. The course discusses planning and operations theories and principles of complex transportation systems. These relate to user response and diffusion of transportation innovations, network performance, organizational and stakeholder analysis and evaluation of ITS interventions. The course will cover using information and knowledge to diagnose problems, translate policies and goals into performance measures, examine possible competing and complementary transportation improvement actions, systematically evaluate intelligent transportation systems impacts using models, and support human interactions and deliberations among stakeholders. Through a synthesis of the empirical evidence, the course will identify "high-impact" ITS technologies. The course will discuss various evaluation methodologies and difficulties in measuring and quantifying ITS impacts on the large scale. It also will bridge the gap between high expectations and the implementation of useful strategies that can be applied in daily practice.

In addition to providing a perspective on the literature and activities in ITS, the course will address several gaps. Given that ITS is an important and emerging area with far-reaching social and economic consequences for the transportation system, there remains a need to comprehensively address the issues and complexities involved in understanding transportation problems and the prospects for addressing them with intelligent transportation systems. The course will identify challenges stemming from the complexity of traffic congestion, safety and environmental problems. The increased range and added complexity of the choices available to travelers, transportation planners, and operators further complicates the mission of public agencies. The implementation of ITS technologies, many of which have system-wide implications, will require awareness on the part of practitioners, clear articulation of the impacts, and changes in the institutional arrangements that are currently at work in transportation planning and operations.

Administrative Issues

Class Meeting Schedule and Changes

The dates of classes as planned is shown in this handout. The class is scheduled to meet generally at the regularly scheduled time. If it is necessary to reschedule a class, every effort will be made to accommodate the needs of as many students as possible. If you miss a class, please be sure to check for possible rescheduling of the following class.

Office Hours

The schedule of office hours will be announced in class. Dr. Khattak will usually be on campus the day before the class. However, the easiest way to meet one of us is by fixing an appointment (Tel: Dr. Khattak 757-683-6701).

COURSE CONTENT & READINGS

(TO BE ANNOUNCED—BELOW IS A TENTATIVE LIST; READINGS WILL BE AVAILABLE ON BLACKBOARD OR IN THE LIBRARY)

Week 1.

1. Introduction to course. Overview of course and discussion of ITS.

2. Identification of transportation problems and costs

- BTS, Transportation statistics annual report, Bureau of Transportation Statistics, US Department of Transportation, Washington, D.C. 2006. [Read the Executive Summary.]
- Schrank, D. and T. Lomax, The 2007 urban mobility report, Texas Transportation Institute, The Texas A&M University System, 2007. [Browse through the report.]
- NHTSA, Traffic Safety Facts 2005, National Highway Traffic Safety Administration, US Department of Transportation, 2003. [Read the Chapter on Trends.]
- Small, K. Economics and urban transportation policy in the United States, Regional Science and Urban Economics 27, 1997, 671-691. [Browse through the paper.]
- GAO, Transportation Security. Federal Action Needed to Help Address Security Challenges US General Accounting Office, GAO-03-843, 2003. [Browse.]
- Miller, T. Societal costs of transportation crashes. In The Full Costs and Benefits of Transportation: Contributions to Theory, Method and Measurement. Edited by D. L. Greene, D. W. Jones and M.

A. Delucchi. Springer-Verlag, Berlin-Heidelberg. 1997. [Optional.]

- Murphy and M. DeLucci, A review of the literature on the social cost of motor vehicle use in the United States, Journal of Transportation and Statistics, January 1998. [Optional.]

3. Definition and role of Intelligent Transportation Systems

History of ITS

- Saxton, L. Mobility 2000 and the roots of IVHS, Federal Highway Administration, 150125, US Department of Transportation, undated. [Read the entire report.]
- IVHS America, Strategic Plan for Intelligent Vehicle Highway Systems in the United States, Report No IVHS-AMER-92-3, 1992. [Read the Executive Summary.]
- Sussman, J. What we know now that we wish we knew then about intelligent transportation systems: A retrospective on the 1992 strategic plan, Transportation Research Record 1886, pp. 18-23, 2004.
- French, R.L., et al. A comparison of IVHS progress in the United States, Europe, and Japan, Prepared by R.L. French and Associates for IVHS America, 1994. [Read the Executive Summary.]
- JPO, Implementation of the national Intelligent Transportation Systems program, 1997 report to the Congress, Joint Program Office for Intelligent Transportation Systems, US Department of Transportation, 1997. [Optional.]

Definition

- Chen, Kan and John C. Miles, ed. PIARC Committee on Intelligent Transport. *ITS Handbook 2000: Recommendations from the World Road* Association. Boston: Artech House, 1999. [Read Chapter 1.]
- Albus, J. Outline for a Theory of Intelligence, IEEE Transactions on Systems, Man. and Cybernetics, 21:3, 1991. [Optional.]