Multicampus Multidisciplinary Curriculum Development in Transportation Engineering

Norbert Delatte,[1] Michael Anderson,[2] Kathleen Leonard,[3] and John McFadden[4]

Abstract

A University Transportation Center for Alabama was recently established, incorporating the three campuses of the University of Alabama system – the University of Alabama (UA), the University of Alabama at Birmingham (UAB), and the University of Alabama in Huntsville (UAH). Education is one of the 6 goals of all federally supported University Transportation Centers. Thus, the UTCA Executive Committee designated this project as a high priority topic to enhance management and safety of transportation systems. This project focused on the design of an ideal curriculum of multidisciplinary transportation course work for the three UA system campuses. The major objective of this project was to develop a unique multidisciplinary multicampus transportation curriculum for all three UA System campuses. A thorough investigation of transportation engineering graduate programs throughout the U.S. was performed to provide a benchmark and identify educational opportunities. An undergraduate Transportation Certificate program was developed. Graduate programs were developed to attract students who do not have an undergraduate civil engineering background to careers in transportation engineering, as well as students with undergraduate civil engineering degrees. The investigators evaluated existing curricula and courses on all three campuses, identified desired new courses, and prepared sample transportation curricula. The project team also identified barriers and incentives for adoption of the program. New courses will need to be developed, new faculty must be recruited, and resources must be allocated to make the program fully successful. The University Transportation Center for Alabama will require a well-developed undergraduate and graduate curriculum to attract students, increase the impact of the center, and support research and outreach efforts. This coordinated curriculum will improve transportation engineering education in the University of Alabama System.

Introduction

Transportation is an industry that, as a whole, is estimated to comprise 16.3 % of the gross domestic product and affects the lives of every citizen (Garber and Hoel, 1999). Professional opportunities for those with the

---

[1] Assistant Professor, Department of Civil and Environmental Engineering, 1075 13th Street South, Suite 120, The University of Alabama at Birmingham, Birmingham, Alabama 35294-4440.

[2] Assistant Professor, Department of Civil and Environmental Engineering, The University of Alabama in Huntsville, Huntsville, Alabama, 35899.

[3] Associate Professor, Department of Civil and Environmental Engineering, The University of Alabama in Huntsville, Huntsville, Alabama, 35899.

[4] Assistant Professor, Department of Civil and Environmental Engineering, The University of Alabama, Tuscaloosa, Alabama, 35487-0205.

skills to plan, develop, and implement transportation operations have never been greater, and are expanding rapidly. To respond to this challenge, a number of students at University of Alabama (UA) System universities are enrolling in Civil Engineering programs to become transportation professionals. A University Transportation Center for Alabama (UTCA) was recently established, incorporating the three campuses of the University of Alabama system – the University of Alabama (UA), the University of Alabama at Birmingham (UAB), and the University of Alabama in Huntsville (UAH). Education is one of the 6 goals of all federally supported University Transportation Centers.

However, transportation is more than just engineering, and students in other university programs could benefit from a basic understanding of transportation, and the importance of transportation in everyday life. Because transportation is inherently interdisciplinary, solving complex transportation problems facing the next generation of professionals will also need a multidisciplinary approach. The diversity of students participating in the Transportation Certificate Program will enrich the academic experience and allow the student to see the strength of interdisciplinary approaches to planning, operating, managing and maintaining the next generation of transportation systems.

Problem to be Addressed

The University Transportation Center for Alabama will require a well-developed undergraduate and graduate curriculum to attract students, increase the impact of the center, and support research and outreach efforts. The new curriculum will enhance recruiting and retention and improve transportation engineering education in the University of Alabama System.

Project Objective

The major objective of this project was to develop a unique multidisciplinary multicampus transportation curriculum for all three UA System campuses. Existing programs were developed for specializations within civil engineering. For example, Master of Science in Civil Engineering (MSCE) programs usually require an undergraduate civil engineering (CE) degree. However, it is important to make transportation accessible to students that do not have a CE background, and broaden the perspective of the students who do by including courses in other disciplines. Thus, the unique aspects of this curriculum development project were pooling the efforts and resources of three campuses, as well as the incorporation of other disciplines.

Research Approach

A team approach encompassing all three campuses was used. An undergraduate area of emphasis certificate (4 courses) and MSCE program were investigated.

The project team:

- Investigated existing curricula and courses on all three campuses, identified desired new courses, and prepared sample transportation curricula.
- Designed an ideal curriculum of multidisciplinary transportation course work.
- Identified barriers and incentives for adoption of the programs.

Background

In this section, current UA system course offerings and degree programs are discussed, as well as competing programs in the Southeast and the rest of the country and opportunities in transportation education.

Current UA, UAB, UAH programs

The project team reviewed the courses and programs in transportation and related fields offered by the three campuses. A discussion of these programs and a listing of the transportation related courses offered at the three campuses are provided as Appendix B of the project final report (Delatte et al., 2000). Information on the programs and courses may also be found at the three campus Civil and Environmental Engineering (CEE) web sites, listed in the references.

Presently all three UA system campuses offer Bachelor of Science in Civil Engineering (BSCE) degrees that include a transportation emphasis and at least one required transportation engineering course. In addition, UAB offers a Civil Engineering minor. All three campuses also offer Master of Science (MS) degrees in Civil and Environmental Engineering. UA and UAB offer Master of Science in Civil Engineering (MSCE) degrees, and UAH offers a Master of Science in Engineering (MSE) degree. At both UA and UAB, students may specialize in environmental engineering or structural engineering/structural mechanics. UA has a well-established Ph.D. program in Civil and Environmental Engineering, and UAB has recently established a Ph.D. program in Environmental Health Engineering. Both programs can accommodate students in transportation.

Related programs include the Master's of Business Administration (MBA) and Master's in Public Administration (MPA) at UA and UAB, and MSE in Engineering Management and MS in Materials Science at UAH. Overall, UA and UAB programs are similar, but UAH programs have significant differences from the other two.

Competing programs – Southeast and U.S

The research team reviewed programs offering graduate level transportation courses throughout the U.S., with special emphasis on the Southeast. A thorough review of programs in the Southeast, including course listings by category, is provided in the project final report (Delatte et al., 2000). Data were compiled through a review of 16 universities in the Southeast with graduate level transportation offerings. A similar study was made nationwide, and is documented in the project final report . Programs and course listings were examined by the research team to determine the most common areas addressed, as well as neglected areas that offered opportunities for innovative scholarship.

Opportunities

The review of competing programs revealed that most MS programs in Transportation are general, pavement oriented, and traffic engineering oriented. This suggests that opportunities for specialization exist in planning and highway design. No specializations in management or safety of transportation systems were found in the Southeast. Since this is the designate focus area for UTCA, this offers an obvious opportunity for developing new courses and programs.

Based on the review of graduate course offerings, opportunities exist in several categories where five or fewer courses are offered throughout the Southeast:

- Seaport Planning & Design

- GIS & Transportation
- Environmental Impacts
- Mass Transit
- Intelligent Transportation Systems

With the exception of Seaport Planning & Design, these categories deserve serious consideration for further development. New courses and programs can be developed using UA system faculty in these areas.

Proposed UTCA Certificate Program

The research team proposed a Certificate in Transportation to be offered by UTCA and endorsed by the UA System. The certificate program is intended to become an additional option for students in non-engineering majors to gain knowledge regarding transportation problems in both the public and private sector.

Students in the Transportation Certificate Program are expected to come from various backgrounds. Students may be pursuing bachelor degrees in programs such as Business Administration, Economic, Geography, Sociology, or Urban Planning, and should be within two years of obtaining their degree. It is also open to BSCE students.

Completion of the Transportation Certificate Program is expected to support careers in:

- Transportation Policy Analysis
- Urban and State-wide Transportation Planning
- Transportation and Development Economic Analysis
- Federal and State Transportation Strategic Planning
- Transportation Planning and Engineering Consulting
- Transportation Systems Management

At present, it is proposed that the Transportation Certificate Program be comprised of 12 credit hours of course work. The coursework must be from an approved course list. Currently, the list comprises primarily Civil Engineering courses. However, as the program progresses, other transportation related courses from other disciplines may be added.

The UTCA Transportation Certificate Program would serve several purposes:

- It would provide a way for non-BSCE majors to take courses in Transportation and have that work recognized.
- It would define the required preliminary course work for non-BSCE graduates to enter the MS programs discussed below.
- It would provide a specialization credential available to BSCE students.

It is also possible that the Transportation Certificate could be used as a basis for the development of a minor on one or more UA system campuses in the future.

Proposed MS Programs

The proposed MS programs would be parallel in configuration but housed on the three respective home campuses. The programs would meet home campus requirements, as well as the common UTCA requirements. The common UTCA requirements include 12 hours in CE transportation courses, as well as 6 hours in non-CE courses to provide breadth and depth. A common list of courses and course descriptions in these two categories has been developed and is provided in the project final report (Delatte et al., 2000). Students will be encouraged to take at least one course on another UTCA campus, and may be required to do so by their supervising committees. This requirement may be met through residence or distance learning. The interdisciplinary aspect of the transportation specialization is developed through the inclusion of multidisciplinary courses for breadth and depth in the potential course offerings.

To make more courses available on all three campuses and enhance the multi-campus nature of the program, transportation courses should be offered over the Intercampus Interactive Telecommunications System (IITS). This system uses wired classrooms at the three campuses that can be used for interactive lectures, with students at distant campuses able to ask questions and fax documents in real time.

Students who do not have a BSCE prior to acceptance to this MS program will complete a transportation certificate or civil engineering minor as the required preliminary course work. Courses may be counted for the Transportation Certificate or an MS program, but not both.

Since UA and UAB already have in place MSCE programs with specialization in Structural Engineering or Environmental Engineering, these programs were used as models to add a third specialization in Transportation Engineering. For these two campuses the addition of the additional specialization will require little additional effort.

Implementation of the transportation MS at UAH will require more coordination. The UAH Master's Degree is currently an MSE with two majors, one of which must be mathematics. Students will meet the MSE requirements as well as those outlined in the UTCA requirements.

Implementation Recommendations

Full implementation of the research team's recommendations will require new courses, new faculty, increased use of the IITS system, and other additional resources. Although much use is made of existing facilities and offerings, delivery of a truly innovative multidisciplinary program will require a higher level of institutional commitment.

Recommended New Courses

The research team recommended the development of a number of new courses, shown below. These courses should be offered at the undergraduate level (400) as well as the graduate level (500 or higher).

One new recommended course is CE 495 Transportation Planning Laboratory – based on a Transportation Management and Development Laboratory taught by Mike Anderson at UAH. This is a team based, problem-solving course conducted in partnership with a city.

Other proposed course topics include:

- Urban Mass Transit and Mobility
- Construction Project Management
- GIS in Transportation
- Highway Capacity
- Pavement Management Systems
- Transportation Economics
- Evaluation and Repair of Civil Infrastructure
- Contemporary Issues in Transportation Engineering

The research team further recommended that UTCA fund small course development grants for faculty to prepare innovative courses. Grants of approximately $ 15,000 would provide a powerful incentive for CEE faculty as well as faculty in other departments to develop new multidisciplinary graduate courses.

New Faculty Recruiting

New faculty recruiting for the three UA system campuses should address both educational and research needs and opportunities. New faculty should be recruited in the following specialties:

- Traffic operations and safety
- Mass transit

Engineering practitioners can make competent part-time instructors in their area of expertise until full-time faculty can be hired. However, long-term support of a new educational initiative requires dedicated, full-time faculty experienced in that field.

Intercampus Interactive Telecommunications System (IITS) Program

The IITS system provides an excellent mechanism for sharing transportation course offerings among the three UA system campuses. It is recommended that at least one course be offered each semester, with rotation among all three campuses to spread the teaching load. The incentive to the faculty to take responsibility for the course should lie with the home institution, but a team teaching model that gives all three campuses credit for their own students and the professor credit for the class load would be an inducement to make this system work.

Additional Resources Needed

The research team identified the following additional resources that are needed to fully implement these curriculum proposals:

- A dedicated IITS facility for UTCA, per campus. Current facilities are heavily used across the university. This would require installing the IITS equipment in an existing engineering classroom.

- Release time or similar incentives to develop courses for IITS

- Funded graduate teaching assistants for each IITS course at each campus, to provide administrative support for IITS students.

- An education infrastructure funded by UTCA, similar to the administration infrastructure at each campus

Summary and Conclusions

University curricula often change slowly and incrementally, and do not necessarily keep pace with industry needs and technological developments. The inauguration of UTCA offers a rare and historic opportunity to implement an innovative educational program across an entire state university system.

In this project, a three-campus research team worked together to develop a new transportation curriculum reaching across traditional campus and departmental boundaries. The research team examined the current state of transportation engineering education across the country, with the intent of identifying areas of opportunity for innovative scholarship. The team also investigated industry requirements and employment opportunities in this area.

Next, the research team investigated their current campus offerings to determine available resources within Civil and Environmental Engineering departments as well as other disciplines. Finally, new curriculum programs reaching across traditional campus and departmental boundaries were developed. Although the new programs can be started with little commitment of additional resources, long-term development and expansion of these programs will require additional institutional commitment.

Acknowledgements

This research was supported by the University Transportation Center for Alabama under project number 99249, as well as by the UA, UAB, and UAH Departments of Civil and Environmental Engineering.

References

Delatte, Norbert, Michael Anderson, Kathleen Leonard, and John McFadden (2000) *Development of a Multicampus Multidisciplinary Transportation Curriculum for UTCA*, Final Report 99249, The University Transportation Center for Alabama, Tuscaloosa, Alabama. To be published on the UTCA web site, see below.

Garber, Nicholas J., and Hoel, Lester A. (1999), *Traffic and Highway Engineering*, PWS Publishing, Pacific Grove, CA.

University of Alabama (UA) Department of Civil and Environmental Engineering web site (2000), http://civil.eng.ua.edu/

University of Alabama at Birmingham (UAB) Department of Civil and Environmental Engineering web site (2000), http://www.eng.uab.edu/cee/default.asp

University of Alabama in Huntsville (UAH) Department of Civil and Environmental Engineering web site (2000), http://coeweb.eb.uah.edu/cee/

University Transportation Center for Alabama (UTCA) web site (2000), http://bama.ua.edu/~utca/

Norbert Delatte

Dr. Delatte joined the UAB faculty as an Assistant Professor in fall 1997. He received his B.S. in Civil Engineering from The Citadel in 1984, a Master's Degree in Civil Engineering from The Massachusetts Institute of Technology in 1986, and a Ph.D. in Civil Engineering from The University of Texas at Austin in 1996. He served for eleven years in the United States Army as an officer in the Corps of Engineers, including two years of service in the Republic of Korea, wartime service in the Arabian Peninsula during Operation Desert Storm, and command of an engineer company during Hurricane Andrew relief operations in southern Florida. He taught as an Assistant Professor at the United States Military Academy at West Point, New York during the 1996-1997 academic year. He specializes in structural engineering, transportation engineering, and construction materials. He is a member of the American Society of Civil Engineers, the American Concrete Institute, the International Concrete Repair Institute, the Structural Engineer's Association of Alabama, and the American Society for Engineering Education. Dr. Delatte is a registered professional engineer in the State of Alabama and in the Commonwealth of Virginia.

Michael Anderson

Dr. Anderson is an Assistant professor of Civil Engineering at the University of Alabama in Huntsville focusing on Transportation Engineering and Geographic Information Systems. He received his degrees in Civil Engineering from Iowa State University (BSCE '94, MSCE '96, PhD '98). Dr. Anderson teaches courses in Geographic information Systems, Transportation Engineering, Urban Transportation planning, and Traffic Engineering. His research interests include travel demand modeling, rural public transportation, magnetically levitated vehicle transportation, and geographic information systems.

Kathleen Leonard

Dr. Leonard is an Associate Professor of Civil and Environmental Engineering at the University of Alabama in Huntsville. Dr. Leonard received her BSCE and MSCE from the University of Wisconsin in 1983 and 1985, respectively. In 1990 she was awarded a Ph.D. in environmental Engineering from University of Alabama in Huntsville. She performs funded research in the areas of fiber optic chemical sensing for environmental systems, optimization of wastewater treatment systems, and novel methods for groundwater/hazardous waste remediation. In addition to her academic and research duties, Dr. Leonard is very active in professional societies, including ASCE, SAME, WEF, and SWE. She serves as the chair of the ASCE Environmental and Water Resources Institute's Student and New Professional Activities Council and is a corresponding member of the ASCE Committee on Public Service and history and heritage committee. Dr. Leonard is a registered professional engineer in the state of Alabama and performs environmental consulting through her own firm, Optechnology.

John McFadden

Dr. McFadden currently serves as an Assistant Professor in Civil and Environmental Engineering at the University of Alabama and specializes in the interaction of geometric design of highways, traffic operations and safety. Dr. McFadden received his Ph.D. in Civil Engineering with a Minor in Statistics from The Pennsylvania State University. Dr. McFadden received a Bachelors and Masters degree in Civil Engineering from Villanova University in 1991 and 1994 respectively. Dr. McFadden is a registered Professional Engineer in New Jersey, Virginia and Maryland. He is also certified as a Professional Traffic Operations Engineer.