The Pavement Enterprise- An Educational Partnership with Industry

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ABSTRACT

In the fall semester of 2000 a student program was established at Michigan Technological University in which significant team projects and business elements replace part of the traditional engineering curriculum for a project-based approach to learning. Scholarships are available to students who participate in the Pavement Design, Construction, and Materials (Pavement) Enterprise, which is located within the Civil and Environmental Engineering Department at Michigan Technological University. This is an asphalt paving industry-sponsored Enterprise that addresses the needs of industry in terms of attracting, training, and recruiting skilled individuals who are needed in all areas of the asphalt paving industry. The needs of this industry are for people with traditional construction, engineering, and business skills coupled with enhanced skills in material properties, construction operations, testing procedures, life-cycle cost analysis, advanced specifications, leadership, and teamwork. This is particularly true as this industry moves toward new design criteria, design build contracts, warranty contracts, and just-in-time delivery. Leaders in industry play an important role in helping to define topical issues and in finding summer internships and full-time employment for students in the program through the involvement of an Advisory Board. This paper discusses the creation of the program, the benefits to the students and industry, and the interaction of industry professionals.

Introduction

In a recent report issued by an American Society of Civil Engineers Task Committee, titled Engineering The Future of Civil Engineering[1], it is noted that many entry level engineers are perceived as having a number of inadequacies including "poor communication skills, inability to manage projects profitably, lack of marketing interest and/or skill, getting bogged down in technical matters, failure to meet client expectations, lack of visibility in the community, inability to understand a global context, and having little business sense". Most traditional engineering curricula do not specifically focus on developing the knowledge and skills that would address these perceived inadequacies. A new undergraduate curriculum track at Michigan Technological University (henceforth referred to as Michigan Tech) has the potential to provide a different learning environment suitable for developing better communication skills, project management skills, and a strong business sense in engineering. The Pavement Enterprise is one of eighteen enterprises in this curriculum track. This non-traditional learning environment uses collaborative learning in an entirely team-based course which utilizes the faculty more as mentors than deliverers of information. Students focus on social interaction to foster development of these skills.

Pavement Enterprise and Scholarship

The Pavement Enterprise was created in conjunction with the Thompson Scholars Program within the Civil and Environmental Engineering Department at Michigan Tech and is part of the Enterprise curriculum (http://www.enterprise.mtu.edu/students/minor.html). Bob Thompson established the Thompson Scholars program with a generous gift of $3.6 million to fund undergraduate scholarships, graduate scholarships, laboratory improvements, and support to develop, manage, and operate the Pavement Enterprise[2]. Bob Thompson was the President of Thompson-McCully Company, the largest asphalt paving company in Michigan, until 1999 when he sold the company to The Oldcastle Materials Group. "I'm fortunate to be able to do this," Thompson said. "I'm the lucky one, to be in a position to change the world a little bit." [3] "Bob Thompson's gift to Michigan Tech is not just a scholarship; it's a new way of doing business," then Michigan Governor John Engler said. "This program will result in top-notch graduates with the latest skills and knowledge working on future Michigan road programs." [3]

The Thompson Scholars program provides undergraduate scholarships for up to four years for each student, provided the student meets the requirements of the scholarship which includes maintaining a two-semester "B" average in the program and an approved summer internship in a transportation related position. Thompson Scholars are required to be Michigan residents. The program also provides six graduate scholarships. The graduate scholarships provide full tuition and a monthly stipend. Graduate Scholars provide technical and organizational assistance to the Pavement Enterprise in addition to their other graduate work. The program also included extensive laboratory upgrades including remodeling and equipping an aggregate laboratory, asphalt binder laboratory, and an advanced asphalt mixture laboratory. Improvements to an existing asphalt mixtures laboratory were also made. This has provided Michigan Tech students with facilities that are state-of-the-art in the asphalt pavements/materials area.

The program contains funding for operational support for the Pavement Enterprise which includes staffing. Several other industry and government partners are also financially supporting the program through equipment purchases. More information on the Pavement Enterprise can be seen at http:/ /www .thompsonscholars.mtu.edu/.

Partnerships

The Pavement Enterprise actively partners on a number of levels. The main partnerships are the asphalt paving industry (e.g., contractors, consultants, and governmental agencies),

academia, the local community, and the primary education system. Further discussion addressing each of these areas is provided in the following sections.

Industry Partnership

The Pavement Enterprise partnership with the asphalt paving industry started in 2000 when the program was established. The establishment of the Pavement Enterprise and the Thompson Scholars Program is in part a response to the needs of the asphalt paving industry. There is a recognized need to increase both the numbers of graduating engineers available and their level of education in the specific area of asphalt paving[4]. The need for more technical talent in the asphalt paving industry is in response to the rapid evolution of design considerations, specifications, and construction technologies. Examples of this evolution are the change from the Marshall to Superpave Mix Design system, the movement from method specifications to quality control/quality assurance specifications as well as to warranties, and more automation in construction. Superpave contracts are now common and the laboratory equipment and knowledge required to evaluate performance is presenting a challenge for the asphalt paving industry. Warranty contracts can require the contractor to perform design/build, life-cycle cost analysis, reliability and risk analysis, and other tasks previously not performed in-house. This combination of new technologies and the shifting of responsibilities to the contractor for performance is effectively mobilizing some leaders within the asphalt paving industry to become more active in the process of recruiting talented young people to the industry and influencing the education process.

An important part of developing the Pavement Enterprise was the formation of an Industrial Advisory Board. A board was assembled so that it contained representation from a broad constituency including the Michigan Department of Transportation, the Federal Highway Administration, the Consulting Engineering Council of Michigan, the County Road Association of Michigan, the University, and asphalt paving contractors. The Advisory Board meets two times a year to discuss the program progress, direction, and reviewing activities via student presentations. The Advisory Board meetings serve as an excellent opportunity for interaction between students, associated faculty, and board members. In addition to helping with program guidance, the Advisory Board assists in the development and implementation of projects for the Pavement Enterprise. Board members have also been helpful in identifying opportunities for summer internships. Additionally, the Advisory Board plays an important part in project and program assessment.

Academic Partnership

The Pavement Enterprise has three types for partnering within academia. The academic partnering consists of partnering with the university facilities management, partnering between students who are working together on a project, and between faculty members who are delivering the educational program.

The first type of academic partnering that has taken place deals with working on university projects. One example is the redesign of a parking lot on campus whereby students provided the information and final drawings to university facilities management.

The second type deals with student's educational experience. Every semester, students are assigned to committees in order to complete a specified project. The talent and abilities of the student's on a committee can range a great deal in that each typically is made up of freshmen through seniors with different life experiences and skill sets. The projects are typically one semester in duration. Committees are provided a request for proposal at the start of a semester. A proposal must consist of background information, tasks and timeline for completing the project, individual assignments with associated time/cost commitment for each task with the expected number of total hours by task, and a budget. The budget is expected to include wage costs, fringe benefits, supplies, indirect costs, and profit.

Faculty review the proposals for reasonableness and may require some revisions prior to the committee beginning the project. In this manner the students have established their project goals and expectations of each other. At the end of each semester, students on each committee have the opportunity to evaluate each other as well as perform a self-evaluation that is used to help determine their grade. The students learn the importance of partnering with each other to achieve a common goal as part of their education.

The partnering in academia also extends to more faculty interaction between each other as student projects cover a wide range of topics beyond the expertise of any individual faculty member. The topics include such areas as: transportation; materials; construction; environmental issues; marketing; accounting; webpage design and maintenance; safety; and include faculty facilitating the work in their respective area. The Pavement Enterprise has recently established a faculty committee to more formally recognize the benefit of this interaction for the student's education. This committee allows for faculty to discuss their respective projects amongst each other for other faculty members' perspectives.

Community

The Pavement Enterprise partners with the community in several ways. First, the program has participated for four years in the Michigan Department of Transportation Adopt-a-Highway program by going out twice a year and maintaining the roadway on a section of M-26 in Michigan's western Upper Peninsula.

Another way in which the program has partnered has been by performing project work in the area of civil engineering design and planning for the local community. One recent example is the work done by students that looked at redesigning a section of a local road in order to develop a bypass for the section of highway that passes through Michigan Tech’s campus and the local community. The student's work on this project met with the approval of the Advisory Board members who regularly do this type of work.

Primary Education

The Pavement Enterprise has partnered with the primary education system by coordinating a number of Summer Youth Program scholarships for women and minority students from the metro Detroit area between the ages of 12 and 18. The summer youth program (http://youthprograms.mtu.edu) offers young people the opportunity to familiarize themselves with careers and to develop new skills through laboratory, classroom, and field experiences. The program offers several options called "explorations" that allow different target audiences to come to campus and experience college life. The scholarships offered focus on two explorations in particular: Women in Engineering and Explorations in Engineering. The "Explorations in Engineering" track is for students underrepresented in engineering and science fields (minority or economically disadvantaged students). The "Women in Engineering" track allows women who are academically talented in mathematics and/or science the opportunity to investigate careers in engineering and science. Practicing women engineers from industry and government, along with university faculty, lead informational sessions and discussions.

Summer Internships

While not part of the official curriculum, Thompson Scholars are required to participate in paid summer internships with a company or agency related to some aspect of the broad field of transportation, such as consulting engineering, materials testing, construction, or a public agency. In addition to providing meaningful personal and professional growth opportunities for the individual students, the practical hands-on experiences provided by the summer work benefit the entire Pavement Enterprise team. Students are expected to bring back new technical

and organizational skills from their internships and apply them on their Pavement Enterprise projects. If a student chooses not to participate in an internship they are not eligible for scholarship renewal.

The Pavement Enterprise Director and Manager work with companies to develop summer work experiences that directly complement the academic program. In particular, they look for opportunities that provide a natural progression of increased responsibility for the intern rather than a repetitive set of tasks for the entire term of employment. It is expected that the intern will likely have a better sense of growth if they can accomplish something visible and tangible during their internship. Companies hiring Pavement Enterprise students into internship positions have the opportunity to establish and develop a mutually important industry-university relationship with the Pavement Enterprise. In addition to providing access to highly motivated students interested in working in the transportation field, this relationship can also provide the opportunity for the employer to participate in the educational process of future workers and leaders.

Internships also provide students with important opportunities to develop the critical success skill of networking. By working with and around other professionals in a field of interest, students can establish contacts for reference letters and future opportunities. Students may also identify potential mentors and have the opportunity to model professional behavior.

Self Study

A self study was conducted in 2002 for a peer review team to assess the program. In order to accomplish this, mission and vision statements for the Pavement Enterprise program, the Civil and Environmental Engineering Department, and Michigan Tech, and detailed descriptions of the program were provided in the study.

A group of nationally recognized asphalt professionals were asked to review the program, which included the self study, and visit Michigan Tech to interview students, faculty, and staff as well as to tour the facilities. The people chosen have strong backgrounds in both industry and academia. The peer review team reached the following conclusions with regard to partnering[5]:

- The Pavement Enterprise is an innovative program that makes important contributions to undergraduate education in engineering and places Michigan Tech among the leaders in engineering education reform.
- The single most important contribution of the Pavement Enterprise is the carefully designed series of Enterprise Projects that have provided the students a unique learning

experience, including enhanced communication, management, and business skills in an environment that also promotes teamwork and social interaction.

- The Pavement Enterprise is also unique in the level of training it provides undergraduate students in the hot mix asphalt (HMA) field. The program will make a significant contribution to the HMA industry.
- The Thompson Scholars program has been very important in the recruitment and retention of a number of qualified students. The internship required for Thompson Scholars has also contributed to the unique learning experience for Pavement Enterprise students.
- The Industrial Advisory Board has played an important role in the success and direction of the Pavement Enterprise. The Advisory Board has actively participated in establishing industry contacts for Pavement Enterprise students including placements in summer internships, semester co-ops, and jobs after graduation.
- After careful consideration, we have concluded that while the Pavement Enterprise is highly focused in one technical area, this does not negatively impact the broader technical and general education of the students.

Conclusions

The Department of Civil and Environmental Engineering at Michigan Tech has established an excellent model in higher education for partnering with industry, and governmental agencies, and the local community. The results are graduates more prepared to enter the asphalt paving industry than their conventionally educated peers. The educational experience students receive in the Pavement Enterprise emphasizes partnering between students as they work on timely and relevant projects/issues. The partnership process in the Pavement Enterprise has created a positive experience for students, industry and government leaders, participating faculty, and the university.

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