

AC 2007-2603: LEARNING THROUGH WORK STUDY OPPORTUNITIES IN CIVIL ENGINEERING

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Abstract

Pavement management systems are used by many agencies as a tool for making informed decisions about pavements in the area of construction, design and maintenance. Since funds are limited, it is only possible, in many instances, to rehabilitate a limited number of pavement projects. Hence, the need for priority allocation of funds to projects and the appropriate timing of such allocations becomes a challenge that has to be dealt with. In this country, preserving and managing existing pavements is a task that needs to be undertaken to preserve a vital component of the nation's infrastructure.

The Pavement Management Center for Counties, Cities and Villages (PMC-CCV) at Ohio Northern University (ONU) is a program which was established to promote the use of pavement management systems to make better decisions of pavement rehabilitation. This program is currently focusing on the area of mid and northwest Ohio. PMC-CCV is currently being operated as a joint venture between the University of Toledo and Ohio Northern University. It serves as a local technology transfer entity by providing the forum for pavement professionals to come and share their expertise with its members. Typically, members of PMC-CCV are personnel charged with making decisions regarding pavement maintenance. They represent municipalities, townships, cities and villages of the surrounding area.

PMC-CCV depends on students for its operation, events and activities. Students can assist in organizing events, contacting professional speakers from the pavement industry and sending out bulk mail notices of upcoming events. Moreover, students are also responsible for the operation of a pavement management system for the township which is home for the university. The township has contracted the center to assess the condition of the pavements within its corporation limits and to prepare priority listing of pavement sections in need of maintenance. The center is currently using the software Micro PAVER which has been used to prepare reports about pavement condition and priority listing of pavement sections that need immediate attention.

This paper explores this model experience and assesses its impact on student learning. PMC-CCV has provided over the years useful hands on experiences for many students and allowed them opportunities to interact with professionals in the pavement industry. It has also been viewed by many participants as an opportunity for professional development. This paper will attempt to discuss these issues in an informative manner.

Introduction

An emerging trend in engineering education is that engineering schools are using curriculums that provide students with more "hands on" experiences. These experiences include opportunities for students to work in teams and to communicate with professionals. These experiences allow students to be more practical and creative¹. Some institutions used commercial ventures that included recruitment, organization and business activities in their curriculum to expose students to real-world engineering applications².

Other institutions used experimental project-based courses^{3,4} where students were taught many skills that would allow them to succeed in an actual engineering environment. These courses in most cases simulated the operation of a small engineering firm where a real client was involved. Earlier attempts included the collaborative work of faculty and students to serve an industrial client⁵. Several institutions have provided educational experiences for their students which involved some aspects of community service^{6,7}. Many of these attempts were done as a part of a course within the curriculum; however this paper reports on a method to introduce “hands-on” engineering experience as independent activity outside of the classroom. The Pavement Management Center for Cities Counties and Villages (PMC-CCV) as described in this paper is introduced as an independent activity. Participation in this program is completely voluntary and all students can be involved. Over the years, students from freshmen year to senior year have been involved in this experience. Students working under the PMC program are involved in work that is directly beneficial to the local community.

At a predominantly undergraduate institution such as ONU, the number of students that can be involved in research and hands-on learning experiences through funding from external research grants is limited. In these cases, use of the Federal Work-Study Program can be beneficial. The Federal Work-Study Program provides jobs for undergraduate and graduate students with financial need, allowing them to earn money to help pay education expenses. The program encourages community service work and work related to each student’s course of study. Also the Federal Work-Study program prevents students from being overworked since the amount earned cannot exceed the total Federal Work-Study award. When assigning work hours, the employer or financial aid administrator takes into consideration the student’s class schedule and academic progress.

The activities described in this paper involve little to no equipment and students can be easily trained. Also, the topic of pavement management is one which is relevant to almost every community. As such, the educational tool could serve as a model which could easily be implemented in other schools.

History of PMC-CCV

The PMC-CCV was established in 1992 as a technology transfer organization. It was intended as a joint activity between the University of Toledo and Ohio Northern University. Initially, PMC-CCV would organize monthly technical breakfasts from September to June of every academic year. Speakers from industry and academia would be solicited to speak monthly once on the campus of ONU and the next month at the University of Toledo. One-day workshops related to pavement maintenance were also organized. The membership pool for PMC-CCV includes counties, cities, villages, contractors and industry companies and organizations. All members are required to pay annual membership dues ranging from \$50 to \$150. As a part of the local activities in the township in which ONU is located, the students from the Civil Engineering Department will annually inspect and evaluate the pavement conditions in the town. Data is normally collected and recorded. Then the data is input into the Micro PAVER software. Reports on condition of pavements and their ratings can be obtained to aid the town in making the right maintenance decisions.

In recent years, students have worked through PMC-CCV on research projects. For example, two undergraduate students worked on a project to establish correlations between temperature and skid resistance of asphalt pavements⁸. Another two students were involved in a research project aimed at developing a composite index for pavement management that incorporates not only the surface distress (Pavement Condition Rating) but also the ride quality (indicated by the International Roughness Index)⁹.

The costs associated with maintaining the Pavement Management Center include hosting ten monthly catered breakfast meetings, providing lodging for speakers who travel long distances, mailing meeting announcements and membership renewals to more than 300 individual and organizational members, and paying students for their work. Income to the PMC is primarily through annual dues. In addition, a slight profit is made by charging more than the cost per head for professionals at the breakfast meetings; while allowing the students to attend for free.

Pavement Management Software: Micro PAVER

Micro PAVER, the Pavement Maintenance Management System software¹⁰, was originally developed to assist the Department of Defense in analyzing the condition of pavement on air fields, streets, and parking lots. This program is most useful for smaller cities and other limited-size projects to plan for future road maintenance and repair. Here at Ohio Northern, the team of students uses the program to rate the local village roads.

The process begins by going into the field and compiling a worksheet of all pavement distresses, with their severities and extents for a given section ranging in size from 0.10 to 0.25 miles. This data is then input into the Micro PAVER software so that various reports can be generated. It organizes the reports by county, city, street, and section so they can easily be found. These reports denote the pavement condition rating (PCR) for each section, the date of inspection, section-dimensions, and material composition. This helps to determine the condition of the section with respect to others in the area, as well as listing the deformation so that one could determine how the section should best be repaired. In future years, plans are being made to incorporate the PCR information together with digital images of pavement sections into a GIS based map. This will make a visual analysis of entire networks of pavements readily available.

The Student Team:

Every year, two interested students are recruited to lead and organize the student team and these students normally become the student supervisors. Early in the academic year, interested students sign up to become involved in the activities as work study students. The interest stems from the fact that the students are earning money while performing a professional activity related to their field. Many of them will note this experience on their resumes and some students have indicated that this experience has been valuable to them in their job search. The students can help in a number of ways through inspection of pavements, data entry and mail assistance for the monthly program announcements.

Benefits from the Program:

An assessment rubric has been developed for participating students and is shown below in Table 1. This instrument of assessment will be administered starting in the 2006-07 academic year.

Table 1. Assessment rubric for learning outcomes associated with PMC

Outcome	Strongly Agree 4	Agree 3	Disagree 2	Strongly Disagree 1
I would rather work for PMC because it is related to my profession than a higher paying non-related job				
The technical sessions were informative and beneficial				
The PMC experience has enhanced my sense of professionalism				
The PMC experience allowed me to perform a useful function for my community				
The PMC experience introduced me to real world engineering problems				

Based on input from the students the benefits can be summarized as follows:

1. The program allows the students to gain experience related to their field of study. The activities are easy to perform without hindering their ability to keep up with their course work.
2. The program seems to foster a great team spirit and dynamics. All activities can be done in teams and require delegation of tasks and scheduling.
3. The program provides the students opportunities of learning through their attendance at the technical breakfast programs. These programs are normally attended by practicing engineers from the industry. This also allows the students chances of establishing industrial contacts and enhances their professional network diversity.
4. The program allows students to lead and take part in a professional engineering service project where the students themselves are able to lead and perform the work with minimal faculty supervision.
5. Interaction with professionals enhances the students' communication skills and provides them with more confidence in a professional setting.
6. The program allowed students to stay current with new innovations in construction and maintenance of roadway pavements. On occasions, senior design groups were able to pursue ideas and alternate solutions to senior design projects in the area of bridges and culverts.

Testimonials from two current seniors follow: "PMC-CCV has given us the opportunity to attend various presentations and meet outside professionals. These presenters provided an insight to real-world applications of transportation engineering. Being part of PMC-CCV has offered a sense of belonging to an organization that has state wide connections. It has also given us an opportunity to interact with our faculty while being compensated for our work. It has been a great experience and has provided us with skills for our future professions."

The PMC-CCV model is one that can easily be adopted by other schools. Pavement management is a topic that is relevant to almost every community. Suggestions for implementation would be

to first contact the local authorities responsible for pavement management, for example, the City Engineer's Office to see how your students could assist them with their data collection. If the Office does not have a pavement rating form already established, this can usually be obtained from the State Department of Transportation website. The Dean of Engineering's Office or the Office of Alumni Affairs in the university can often assist with generating contacts of practicing engineers in the area who would be interested in attending and delivering talks in pavement management or other infrastructure related areas. Finally, the Financial Aid Office at the university can generate a list of students who are Work-Study eligible.

Conclusions

It is widely agreed by engineering educators that hands-on opportunities provide a valuable learning experience for students. Most schools focus on implementing these activities into the classroom. In this paper a model for independent learning activity is presented. Furthermore, in a predominantly undergraduate institution where external research funding is limited, the Federal Work-Study Program can be used to engage students in meaningful learning experiences. The activities described in this paper involve little to no equipment and students can be easily trained. Also, the topic of pavement management is one which is relevant to almost every community. As such, the educational tool could serve as a model which could easily be implemented in other schools. Students who have participated in the program have indicated that it was very beneficial in increasing their engineering professionalism.

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