

AC 2009-2476: GRADUATE EDUCATION IN CONSTRUCTION MANAGEMENT: SUCCESS ON LINE

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ABSTRACT

This paper will describe the use of videoconferencing software to present synchronous distance learning graduate classes in a construction management department at a Purdue university. Adobe Acrobat Connect Professional allows the faculty to use a hybrid synchronous, interactive delivery model for this department's masters program. Synchronous distance education connects students and professors in real-time. It allows the student to be seen and to be heard, as well as to see and hear what is going on at the host site. This delivery model is a hybrid because there are also students physically attending the class at the host site. Not only can the students attend class at home or at work, but the student can also attend classes while traveling. The paper will outline the technology, curriculum, and development of this online master's program.

Introduction

Distance learning is expanding in all areas of higher education.¹ Computer technology has allowed to expand beyond the early attempts at distance education done via correspondence watching pre-taped lectures or live television courses to real time, online web-based courses. It is now possible for anyone to acquire educational materials from anywhere in the world. Research exists to show minimal differences in the effectiveness of online learning as compared to the brick and mortar / face-to-face traditional learning.^{2,3} Factors that were major in determining the need for online programs have been indentified as convenience, access, and flexibility.^{4,5} In the construction industry, persons currently working can not afford to leave their jobs to become a full time student. Also, there are few companies that give incentives for completing a master's degree in the construction management.

History of the Program

The Department of Building Construction Management (BCM) in the College of Technology (CoT) at Purdue University grew from a craft-oriented, non-degree program that was initiated in 1946 to re-train the returning GI's. The nature of this program slowly shifted from post-war, non-academic teaching of construction craft skills to academic teaching of drafting and surveying skills through the 1950s.⁶ It now is considered one of the leading programs for producing construction managers educated with a Bachelor of Science (BS) degree. It was first accredited by the American Council for Construction Education (ACCE) in 1976 and has passed all accreditation visits since that date. With the undergraduate degree being the basis for the department, graduate course have been introduced since the 1990's to follow the needs of the industry.

Back in the late 1980's, the BCM faculty began planning for a construction management masters degree. At that time only the Industrial Technology (IT) Department had a master's degree program in the CoT. Also, at this time the former BCM department head went on a six month sabbatical and interviewed BCM alumni around the country on the topic of the BCM masters degree. Beginning with the Spring 1990 semester one construction management course was

taught each semester. These courses were taught through the IT department. The courses were taught one evening per week and the students consisted mainly of non-degree part time graduate students who were working full time.

Enrollment in the first courses was between eight and ten students. Soon the enrollments were even lower. Even holding classes in Indianapolis (65 miles from the Purdue campus) did not increase enrollment. The graduate construction courses were then offered on an intermittent basis as a voluntary overload by the faculty. By 2000, the College of Technology had an umbrella master's degree for all CoT departments. During the period from 1990 to 2005, only a few students received a master's degree in CoT with construction management as their primary area. During this period, the master degree enrollment in construction management never rose above eight students. The BCM faculty believed that low enrollments were due to the following factors:

1. Construction management employers do not reward advanced degrees. Starting salaries for masters students were the same as for the undergraduate students.
2. Since 1990 there has been 100% placement for all undergraduate and graduate students, and the industry enjoys full employment.
3. Construction management professional are not willing to give up their full-time jobs to become full-time students.

However, a basic change in the construction industry was in the air. Leaders in the construction industry began conversations on the best way to continually improve their employees. One suggestion was the development of a Master of Science (MS) program in construction management to provide a way for experienced professionals to expand their knowledge. Reacting to the needs of the industry, the Associated General Contractors (AGC) sent a request for proposal (RFP) to develop a MS degree program related to construction management. AGC is a the leading national trade association with a mission statement to: "... serve our nation's construction professionals by promoting the skill, integrity and responsibility of those who build America."⁷ As a service to their members, AGC keeps a pulse on industry and educational needs and provides a conduit to provide services. The Building Construction Management (BCM) department at Purdue University took advantage of this opportunity to develop a program that would fulfill this RFP and align with the needs of the perspective student. The MS program developed would allow students to interact with faculty while maintaining their current residence and job. In return for the development of the program, AGC's support would be shown by strongly promoting the masters degree to all members.

Development of the Program

Research for a MS in Construction Management program was completed by a team of faculty who reviewed existing programs. Through this review it was found that the biggest challenge of online learning is retaining the student. Research has shown that there is a high dropout rate.^{8,9} It was important to the developers to build a program that would align with student success. There are four major categories considered for online courses (a) self-paced, independent study, (b) asynchronous interactive learning, (c) synchronous learning, and (d) a combination of online and

in-person learning .¹⁰ As a department, the need for graduate education was not only to support expanding knowledge in the industry, but also spark interest in practitioners to pursue academic careers. Construction Management programs struggle to fill faculty positions. One goal of the MS in Construction Management program would be to find the select few who would complete the Master's degree and go on to a PhD.

Therefore, a master in construction degree needs to be attractive to young constructors (those who have a minimum of five years experience), but also attract some who might transition to a position in academia. The program needs to provide distance learning options or utilizes other unique delivery systems while limiting residency requirements (cutting cost for out of state tuition). Young constructors are also likely to have less fear of returning to academics. Continuing education is becoming known as providing value to an employee. The ultimate goal would be that a graduate degree is important to their career; it could make them stand out above the others. The program must then provide the ability to be completed with minimal interference of work. They can not quit their jobs and attend school full time as a residential student. Many potential students may have important responsibilities, so it should not be during working hours.

The department's research revealed that technology existed to meet the needs of the young constructors. A team of faculty members met many times to construct the program. The program that was developed included the following:

1. Synchronous, interactive delivery was achieved with a software tool called Macromedia Breeze (now Adobe Acrobat Connect Professional). Synchronous distance education connects students and professors in real-time. The software allowed meeting participants to broadcast and to receive live video and audio using inexpensive webcams and headsets.
2. Classes were scheduled from 7:00 to 9:30 PM Eastern time.
3. Students were required to visit campus during the first week of each semester to connect with faculty and with each other and learn the technology
4. Utilization of Blackboard, the web-based course management tool to post assignments, turn in homework, and record grades.
5. A plan of study would allow the student can finish in five semesters or 21 months.
6. The students have the option to do the directed project or thesis option.

Specific course topics were developed from past graduate courses which had been offered in the department combined with research conducted during the development of the program. Courses were to be relevant and applicable to a wide range of backgrounds. A weekend master's program for general technology management in the College of Technology at Purdue University was used as a guide for program management. The BCM program would utilize more online learning and less campus visits than the existing weekend program.

Emerging Construction Management Technology seminars are given during the first week of the Spring semesters. Distance students visit the campus to complete these one credit seminars. In the fall there are one credit seminars on academic writing, Adobe Connect Training, Blackboard training, use of the Purdue Library via the internet, APA format training, and presentations of student progress. This time allows for the collaboration of students and faculty to discuss

proposals, projects, and progress. Other course topics apply higher level thinking to issues common in the construction industry.

The BCM department also has full time M.S. and PhD students who take classes as residential students, living on the main campus. These students complete individualized plans of study that allows them to attend the classes in the distance program that meet their academic goals. They also take additional classes offered on the Purdue University campus that are related to their specific thesis or directed project topic. The hybrid aspect of the courses allows the residential students to attend the class online while sitting in a classroom together. These students work together with the online students in virtual breakout rooms assigned for interactive class exercises.

A sample plan of study shows a two-year plan for a typical online student. The program consists of five semesters, including one summer semester. Students may begin the program in the Fall semester only. Spring and Fall semesters include 7 credit hours each, while the summer has only 5 credit hours. Additional credit hours of research credit are added if students are not complete at the end of the fifth semester. Residential students have varied plans determined by their research areas.

Semester One (Fall of even years)

BCM 581A Preconstruction Project Management

BCM 581B Construction Quality and Productivity Improvement

BCM 581W Academic Writing 1(on campus)

Semester Two (Spring of odd years)

BCM 581C Construction Operations, Management, and Strategy

BCM 581F Construction Accounting, Finance, and Marketing

BCM 581J Emerging Construction Technologies Seminar (on campus)

Semester Three (summer)

BCM 581H Analysis of Research in Construction

BCM 598 Directed MS Project

Semester Four (Fall of odd years)

BCM 581D Construction Law and Change Management

BCM 581L Construction Management Training and Development

BCM 581V Academic Writing 2 (on campus)

Semester Five (Spring of even years)

BCM 581G Risk Management in Construction Management

BCM 581E Construction Company Leadership

BCM 581J Emerging Construction Technologies Seminar (on campus)

This plan of study is very strict for the online masters students, but can be flexible for resident students who are staying on campus while completing their degrees. These are the graduate students who act as teaching and research assistants in the department. This traditional graduate

student can take the online courses, there are separate section numbers assigned for the residential students because of a different payment schedule. The current distance master's program is being administrated through a distance learning office to allow for a set fee structure that does not have a dramatic increase to the out of state students.

As the program is being developed, new courses numbers are also being approved. Some courses have been taught with multiple instructors along with partnering from industry and other academic departments. The belief of the department is that adding diversity it will also add new knowledge to the industry. The formal process has not yet been completed to approve courses in this program, so the letter designations have been used in with the BCM 581 course and unique course descriptions have been developed for each course. Currently, the program is an area of specialization within the CoT. However, the department is developing a proposal to create a department based construction management program within the university. As a part of the requirements, assessment data is being collected related to the learning outcomes of the program.

Students Enrollment To-date

Fourteen master's students enrolled for the Fall 2006 semester. Twelve were distance masters students and the other two were full time resident MS students. Each student returned for the Spring 2007 semester, and three new students joined them. These first students were recruited through the publication of brochures which were distributed to alumni and corporate partners. The department now has an online presentation that uses the Adobe Connect software as a recorded recruitment tool. This can be viewed at <https://gomeet.itap.purdue.edu/p99173328/>. Figure 1 shows a screen snapshot of that presentation. This recorded session allows the viewer to see and hear the instructor talking through the class. All classes can be recorded to be used in case of absences or for further discussion.

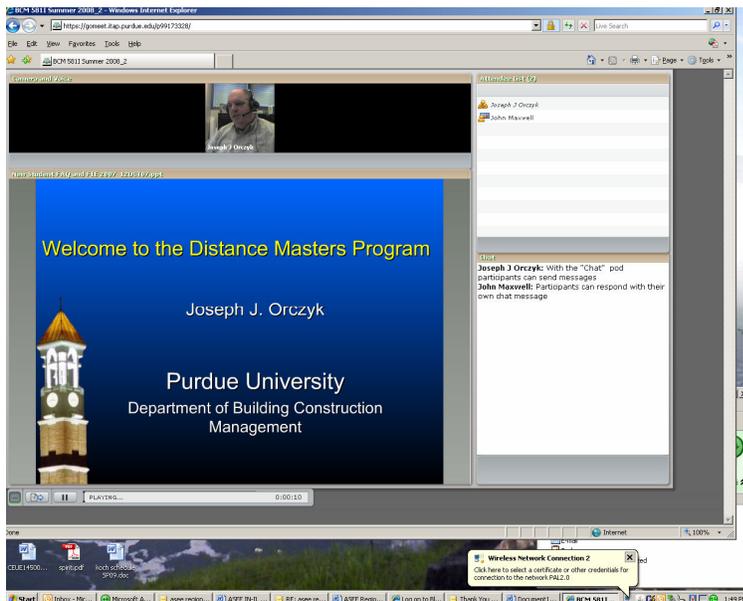


Figure 1: Screen shot online course review

The program continues to grow; Table 1 shows enrollment statistics by region since the program's inception in August 2006. Figure #2 illustrates the division of the regions for the United States used in this analysis. The student admitted from England was an American citizen working for an American contractor. The planned enrollment is 24 for distance students plus a number of resident students commensurate with the number of assistantship available in the department. Once the curriculum was developed and teaching assistantships became available, resident students have also been drawn to the program.

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Table 1:
Distance Masters program enrollment August 2006 – January 2009 by region

Admission Statistics by Region and Date

Region →	Northeast	Southeast	Midwest	Mountain	Southwest	West	England (US Citizen)	Traditional - Resident	Total	Graduates (as of Dec 2009)
Start Date										
August 2006	1	3	4	1	0	2	0	2	13	5
January 2007	0	0	2	0	0	1	0	0	3	3
August 2007	3	0	3	1	0	0	0	4	11	--
August 2008	2	1	2	1	2	1	1	4	14	--
Totals	6	4	11	3	2	4	1	10	41	8

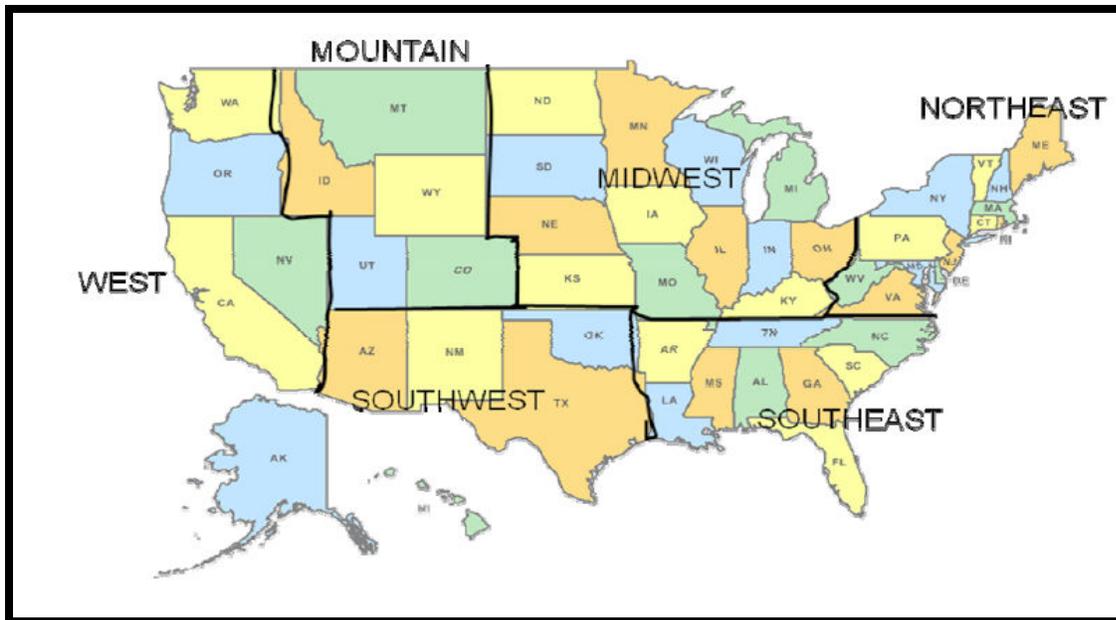


Figure 2: Regional split of United States

Tools for Teaching Online

At the beginning of developing the graduate program, this university had acquired Breeze, a product of Macromedia Inc., as a tool to connect to students via the internet. On December 3, 2005 Adobe Systems acquired Macromedia. Breeze has since been renamed Adobe Acrobat Connect Professional (Connect). Connect is a Web communication system that lets instructors reach an audience anytime with engaging multimedia content. Currently, two of its system components, Connect and Adobe Presenter, are available for use at this university. Because Connect is deployed using Adobe Flash Player, already installed on more than 98 percent of browsers, audiences can join Connect online meetings, courses, and presentations instantly. Connect can be used for distance learning, professional development, and collaboration.

Connect Professional is used for real-time meetings and seminars enriched with interactive presentations and discussion capabilities. It combines existing learning content with real-time interactivity between presenters and students for engaging collaborative teaching and learning experiences. Microsoft PowerPoint slides can be used to give a professional outline in real time, live and recorded video, Flash animations, live screen-sharing, audio, and two-way text chat to deliver more effective presentations. Adobe Presenter (Presenter is a plug-in fully integrated with Microsoft PowerPoint that simplifies the creation and sharing of narrated, media-rich presentations.

Course Management

Blackboard is internet based course management software that all students are automatically a part of as a student at this university. It has been shown to be the most widely used course management software.¹¹ This software allows for posting announcements, distributing assignments, online assessment, submitting student work, grading, email, and other tools

required for a class. At this location, students can log in and acquire information for the class, such as, the internet addresses (URL's) of the site of the class or personal space. Many students are using company emails for communication which sometimes causes problems. For example, some attachments are blocked by company security software firewalls. Utilizing Blackboard allows the student to be notified via company email when documents are available on blackboard. Assignments turned in on Blackboard can be done anytime, this assists with the multiple time zones of students in the class. The telephone is also an appropriate technology for conversations and discussions between the students or between a student and the professor. While students can scan and e-mail written problems, assignments are also accepted via fax machine if necessary.

Videoconferencing Software

Adobe Connect Pro was chosen for use at the university level by a committee of faculty and staff with expertise in distance learning. This videoconferencing software has enough options to permit the use of a wide variety of teaching styles.

Disclaimer - Please note that the descriptions of specific software and hardware in this paper are not endorsements or recommendations for use, and the criticism of unnamed products is not implied.

Figure 3 shows the basic screen format that the faculty has developed for the program. The screen is organized into 'pods'; with each pod performing a specific role. Adobe Connect Pro allows the user to select, move, and adjust the individual pods. Only the pods that are used in the construction management program will be discussed. Note that this section uses the term, participants, to refer the students and instructors in a class.

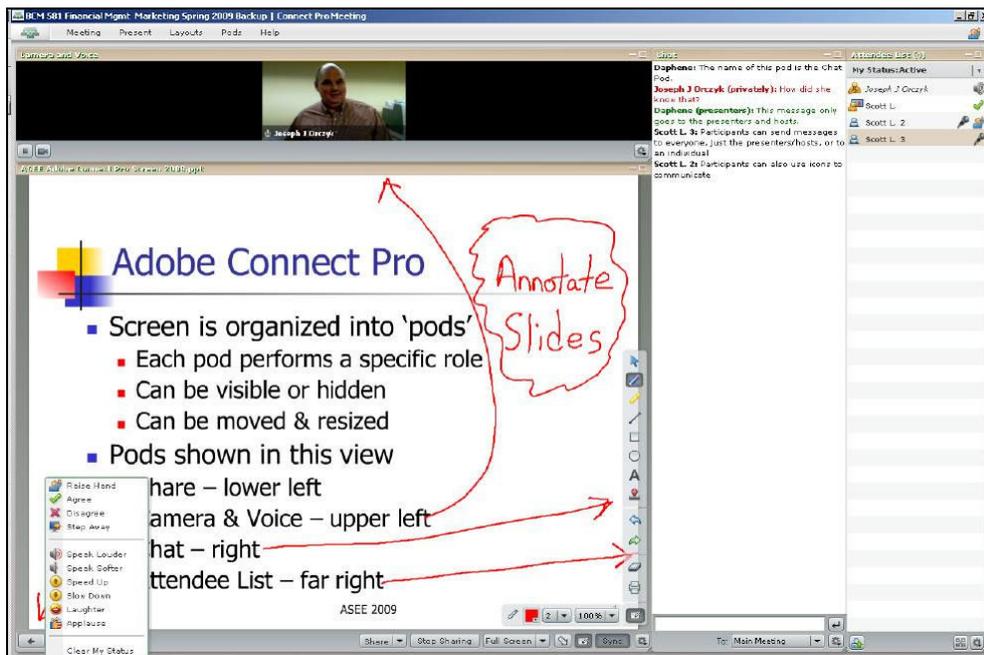


Figure 3: Screen shot demonstrating enhanced pod features.

The large pod in the lower left hand corner of Figure 3 is the Share pod. The contents that can be shared are documents, whiteboards, and computer screen. PowerPoint (PPT) presentations and FlashPaper (SWF) documents work particularly well in Adobe Connect Pro. In this screen you can see that the instructor has written on the slides, “annotated slides,” and drawn arrows. If you viewed the course recording, you would also be able to hear the conversation that took place as the instructor lectured. Students could also be heard asking questions of the instructor or making comments or presentations.

The computer screen of another software application can also be shared. Sharing the computer screen requires a great deal of practice to prevent unwanted applications from obscuring the view of the computer screen. A review of Adobe Connect Pro stated, “Unshared windows can obstruct the view of all participants, making the presentation feature a challenge to manage.”¹² Adobe Connect Pro also contains a virtual whiteboard feature. The whiteboard is the electronic equivalent of color markers on an overhead transparency or a white marker board. The whiteboard feature helps to simulate the traditional classroom online. PC Magazine defines the whiteboard structure as

“a system that allows network participants to simultaneously view one or more users drawing on an on-screen blackboard or running an application. This is not the same as application sharing where two or more users can interactively work in the application. Only one user is actually running the application from his or her computer. In many desktop systems, the application is not viewable interactively. A copy of the current application window is pasted into the whiteboard, which then becomes a static image for interactive annotation.”¹³

In Adobe Connect the whiteboard can be a blank white screen on which the presenter writes or it can be an overlay on another shared screen on which the presenter can annotate the information on the screen. The whiteboard feature helps to simulate the traditional classroom online. The whiteboard menu is shown on the right side of the Share pod in Figure 3 where the arrows are pointing. There are different colors and drawing functions that can be utilized.

For the first 2 ½ years of using Adobe Connect Pro the construction management faculty used a Toshiba tablet PC with a 12.1" Diagonal Wide View Angle XGA Display as the whiteboard input device. This was a good solution. However, faculty desired a larger writing surface. Therefore, in January 2009 the faculty began using a Wacom Cintiq 20WSX pen enabled display with a 20.1" wide format TFT color LCD monitor connected to a desktop PC shown in Figure 4.



Figure 4, Wacom Cintiq 20WSX pen enabled display

This combination is a marked improvement over the smaller screen. The tablet PC, microphone, and headset were taken to the classroom in a laptop case. The 20" monitor, desktop computer, microphone, and headset are housed in a computer cart that is wheeled to the classroom. The cart has a large top that serves as the podium for the class. This is also effective for the residential students who are usually sitting in a classroom learning online while the instructor teaches to the distance and local students.

Camera and Voice Pod

In Figure 1 and Figure 3, the Camera and Voice pod appears at the top of the Share pod. Here participants can view the live video from the web cameras of other participants. This is also the pod where participants turn on their microphones and web cameras. Not only can the participants have a passive role to see and hear, but also the participants can be heard and seen.

Chat Pod

The pod to the immediate right of the Share pod in Figure 3 is the Chat Pod. Participants can send written messages to each other during class. The messages are composed at the bottom of the Chat pod and then sent to the other participants. The message appears in the Chat pod preceded by the sender's name. Messages are sent to all participants unless noted after the sender's name. Messages sent only to the participants with the right to present will be identified with the following note, (presenters). Messages sent only to one of the participants will be identified with the following note, (privately). The instructor is able to turn off the private chat function.

Attendee List Pod

The pod in the top right corner of Figure 1 is the Attendee List pod. The pod does much more than list the current class attendees. Participants can only use two of the pods, the Chat pod and the Attendee List pod, unless given enhanced rights to other pods. The instructor highlights names on the attendee list and assigns permission to use additional pods. Participants can use the Attendee List pod to communicate with the instructor or other participants using the images found on the Status Options menu that appears in the extreme lower left corner of Figure 1. Status Options include: raise hand, agree or disagree to a question from the speaker, stepped away from the computer, laughter, applause, or ask the speaker to slow down.

The Connect meeting room is a series of “pods” which can be moved and resized. Pods include camera and voice, polls, chat, attendee list, whiteboard, notes, discussion notes, share, file share and web links. A single room can actually have multiple screens with multiple pod layouts. Figure 3 shows the Camera and voice pod, presentation pod, attendees pod, and chat pod. The construction management classes use a room with three layouts: presentation, discussion and collaboration. Each screen has its purpose. Most of the class work is done on the presentation screen. The discussion screen is used to facilitate classroom discussions. The collaboration screen includes a large whiteboard which the instructor can use like a chalkboard for drawing illustrations during class.

Managing the Connect classroom requires some multi-tasking by the professor. In addition to presenting a lecture with Microsoft PowerPoint, the instructor must also monitor the chat pod for student questions. While potentially daunting at first, this technique is not unlike monitoring the traditional classroom audience for raised hands. Not only can the students attend class at home or at work, but the student can also attend classes while traveling. One faculty member was able to participate in classes while traveling in China. The local time in China for the class was from 7 a.m. to 9:30 a.m.

Another advantage of Adobe Acrobat Connect Professional for distance learning is that it is desktop-based. This means that using Adobe Flash technology; the desktop (or laptop) computers are connected directly to each other. The software allows students and faculty to broadcast and receive live video and audio using broadband internet access, a computer, an inexpensive webcam, and a hands-free headset/microphone. In addition to the classroom meeting room URL, each student has his or her own room URL in the Connect system. These rooms are used for breakout sessions during class and for student collaboration on projects and meetings outside of class. These rooms are available to the students 24 hours per day, seven days a week.

Conclusions

This is a simple model for implementing an online Master of Science degree. It not only has flexibility for industry, but retains the rigor of academic standards. The Adobe technology has been found to be very easy to learn for instructors and students. Continuous improvements are being made with the introduction of new technology. Faculty members are also becoming more creative as they become more comfortable with the system. Although graduation rates have been

slow in the first cohort, improvements have been put into place to assist in the success of the next groups. It was realized that stricter deadlines are required for the distance masters programs because their academic requirements do not always get first priority over their work requirements. New deadlines for proposal drafts have been given to the students to assist them in their success.

A voluntary online discussion has also been added to collect student responses. This formative evaluation method is being used to continually improve the program. This program should be taken into consideration for other programs needing to extend into the industry at the graduate level. Future studies on this program will be to include the reactions of the instructors and the students. Being a construction management program, the level of experience with the technologies used began very low. One instructor went from using a chalk board to producing an online class, which is a stretch. Understanding the personal issues and how problems were overcome might assist in the continuous improvement of the program.

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