Distance Learning - The Solution for Graduate Programs in Engineering Management - A Case Study

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Abstract *- The paper will discuss how a distance education program has been established to serve professionals pursuing their Master's degree in engineering management. Using tools such as Internet courses, videotapes, and satellite teaching, these professionals have been able to obtain their master's degree in engineering management without having to attend on-campus classes. The paper will evaluate the tools that have been used in the case study, and what the lessons were learned from this experience.*
Key Words *- Education, continuing education in construction, distance education, video courses.*

Introduction

Distance Education Customers

One of the major problems in continuing education for professionals in general, and practicing construction professionals, is the question of how to keep up-to-date with their professional knowledge. In most cases, the solutions used in the past were to develop seminars, courses or to use printed material. However, many professionals who only have a Bachelor's degree (Civil Engineering, Building Construction, or Architecture) would like to pursue a Master's degree. If those professionals do not have any graduate program available in their nearest location, the only alternative they have is to stop working for one to two years and to become full time students. This solution is expensive, time-consuming, and often do not fit the construction professional needs. Using the newest tools of distance education, the University of Florida has developed a master's degree program for a major construction firm.

Distance Education

The term "Distance Education" (DE) is often interchanged with "Distance Learning". However, this is not accurate since the educational delivery is controlled by institutions and/or instructors, while the students are responsible for learning. Therefore, distance learning is actually the result of distance education [1].

The different definitions of distance education are evolving with the technology the system utilizes. The term has existed for more that twenty-five years, and since it is an international term it carries various connotations. Various education specialists have defined the term as follows:

- *The educational technologist:* "Distance education is media-based instruction. The terms emphasizes media's freedom from classroom limitations in location and time, as well as its ability to provide needed interaction and correction."
- *The director of independent study:* "Distance education is education. The central difference between DE and conventional education is the absence of immediate contact with teachers and classmates."
- *The educational corporation president:* "Distance education is an industrial response to the need to transfer knowledge. Remove the cottage industry aspects of preparing and presenting courses, and you have DE." [2]

Nevertheless, most experts agree that the term "distance education" refers to a method of instruction with the following characteristics:

(1) student and teacher are geographically or spatially separated,

(2) either formal or informal learning takes place under the auspices of an educational institution,

(3) technical media (audio, video, computer) replaces somehow written text, and

(4) involves student-instructor two-way communication.

Delivery Systems and Programs

There are two main categories of distance education delivery systems: synchronous and asynchronous. Synchronous system requires the simultaneous participation of all students and instructors. The main advantage of this system is that the interaction among the key players of the system (teachers and students) is done in "real time". Asynchronous instruction does not require the simultaneous participation of students and instructors. Rather, students may choose their own instructional time frame according to their schedules. The principal advantage of asynchronous delivery system is obviously the student choice of location and time and the interaction opportunities for all students, in the case of telecommunications (e-mail, for example). [1]

As for distance education programs, most of them share similar characteristics: they provided credit for prior learning, they offer open entry/exit, they offer various administrative options, they usually offer open/liberal time for course completion. Educators have been asking if distant students learn as much as students in the traditional face-to-face instruction. Several researches comparing both distance and traditional education systems have indicated that teaching and learning at a distance can be as effective as traditional instruction system when the method and technologies used are appropriated for the instructional tasks, when there is interaction among students, and when there is feedback from teacher to students in a timely manner [3]. Table 1 outlines the main differences between traditional and distance education delivery systems.

Table 1: Differences between traditional and distance education delivery systems [4]

ITEM	TRADITIONAL CLASSROOMS	DISTANCE EDUCATION
Time to learn	Set by the academic calendar or teacher availability	Flexible. Compressed or expanded to fit individual needs and deadlines
Location and Pacing	Regular meetings at a fixed location. Equipment when needed. Library for research. Structure and classroom atmosphere meet student expectations.	Variable times and locations, often at work or home. Fits into irregular schedules. Few limits on class size. Often self-paced. Some programs offer library support.
Cost	Extensive administrative and other fixed costs, requiring state and federal support. Out-of-pocket costs include travel, time away from home and work.	Often wholly or mostly self-supporting; strong pressures to hold down costs. Competitive costs a concern. Low "opportunity costs" with fewer job conflicts.
Learning Outcomes	Real advantage when individual tutoring is needed; necessary when course objectives required interaction, discussion, or extensive fixed resources (as library, laboratory facilities). Identification with teacher.	Achieves cognitive goals, but not necessarily affective or motor skill goals, as well or better than the classroom. All courses are carefully planned. Self motivation is a factor.

History of Distance Education

The term distance education was officially adopted in 1982 when the International Council for Education met and changed their name to the International Council for Distance Education. A German educator, Otto Peters says,

> "Distance education-with its primary focus on production of educational materials, its specialized roles and organizational structures... is neither a substitute for nor a supplement to conventional education; it is an identifiable area within the field of education, and not simply a mode of instruction". [2]

What Peters means is that instructors and students should approach distance education with an open mind, and not necessarily compare it to conventional education. Everything is different, from the pace of instruction and the communication means, to the societal mix comprising the student body.

Instructional Tools

There are a wide range of technological options available for the instructors, and in general, they can be categorized as follows:

Printed Materials

Printed material has been the foundation of distance education. The first distance education courses were offered by correspondence, with printed materials sent and returned by mail, and it is still widely used. Advantages of printed materials:

- Spontaneity - materials can be used anywhere without the need for sophisticated equipment.
- Non-threatening - students can focus on the content of the material, without being frustrated by technology
- Cost-effectiveness - it is the least expensive media

As for the disadvantages, these issues are usually solved by more advanced means of communication:

- Timeliness - with emerging technologies associated with engineering disciplines, material may be outdated by the time it goes to print (Internet, e-mail transmission of files, etc.).
- Feedback - lack of timely feedback from the instructor (also solved somehow by communications such as electronic mail)

Audiographics

Audiographic teleconferencing uses standard personal computer and audiographics software along with a high-quality audio-conferencing system to share information and visual images simultaneously among many sites. The instructor can transmit, for example, pictures, text, data or graphics to accompany his instructional narrative. At any time during the session, students can participate in discussions and ask questions through their microphones. It is also possible to use electronic pen and tablets to create or annotate visual materials on the computer screen. This system operates on Plain Old Telephone Systems (POTS) and it is relatively easy to set up. The transmitted still-frame graphics do not look as good as a full-motion video, but the low costs of the system and its easy use are its main advantages. The University of Wisconsin has used autiographics for many years.

Videoconference

This instructional tool has been defined as "the capability to broadcast audio and full-motion, slow scan, and freeze-frame images over a closed-circuit to one or more locations". One of the advantages of videoconferencing is the visual connection established among the participants. Since an instructor can see and hear remote students in real time, he/she can use conversation and body language to enhance communication. Some of the advantages of videoconferencing include that frequent interaction increases understanding, and the method involves convenient access to remote experts, and the preparation and training for this media is minimal. Obviously, this method also offers document sharing for collaboration.

Transmission Options

There exists several options available today for transmission purposes: plain old telephone system (POTS), fiberoptic, Fractional T1, Integrated Services Digital Network (ISDN) telephone lines, and satellite links via terminals (VSAT). The associated transmission costs for these means are summarized in Table 2, and Table 3 outlines the four primary categories of videoconferencing: room-based systems. Mid-range or rollabout systems, desktop systems, and videophones.

Table 2: Digital Transmission Lines and Associated Costs [4]

LEVEL	NAME	CAPABILITY	TYPE LINE	COST(*)
Base Version	Switch 56 Switch 64 ISDN	56 kbytes/sec 64 kbytes/sec 128 kbytes/sec	telephone telephone ISDN	$ 0.24 0.38/min $ 0.24 0.38/min $ 0.64/min
High End	T-1 Line	comparable to 24 telephone lines	T-1	$ 0.50/min
(*) costs vary by distance, time of day, and telephone company.				

Table 3: Videoconference Systems [4]

SYSTEM TYPE	PRICE RANGE	DESCRIPTION	MAIN ADVANTAGE
Room-based	$150,000 and up	Large screen in dedicated meeting rooms. Includes screens, cameras, microphones that are permanently installed	High quality video and synchronized audio. Cost effective if videoconferencing is frequently needed.
Midrange	$20,000 to $50,000	One screen, 2 cameras, 3 microphones. Better picture quality than desktop systems, good collaborative computing tools available, such as: far-end camera control, document cameras, WAN interfaces, on-line graphics, whiteboard capabilities.	Portability, cost

Desktop	$ 5,000 to $ 15,000	PC with small camera and microphone, can be used for video mail over LANs, conferencing over WANs. Compatible with Ethernet networks, TCP/IP networks, do not need ISDN lines	Simplicity and convenience
Videophones	$ 1,000 to $ 10,000	Includes a small screen, built-in camera, video coder, audio system. Video quality in low-end models is generally poor, but as good as desktop system in high-end models.	Cost. Good for one-on-one communication, impulse conferencing.

The falling cost of equipment is also contributing to the increased use of videoconferencing. A $50,000 mid-range rollabout video-conferencing system costs about $10,000 per year when depreciated over five years.

FEEDS (Florida Engineering Education Delivery System)

This delivery system was specially developed in response to the needs of engineering graduates working in industry for access to quality programs and extended studies in different fields of engineering. The system involves the use of several tools such as television (live and recorded), telephone line-based teleconferencing and computer-aided communication and hence is able to bring students and professors together regardless their physical locations.

FEEDS is a product of a joint effort of the State University System of Florida and the public/private sector industries located within the state. The system provides graduate engineering courses to support degree programs (Master of Engineering or Master of Science) or non-degree programs (Professional development).

Internet and Distance Education

Internet is the largest and most powerful computer network in the world. It is used by more than 30 million people in more than fifty countries, and current estimates suggest that over four million computers are part of the Internet [5].

Universities, schools, companies, and private citizens can have access to the Internet either through affiliations with regional not-for-profit networks or by subscribing to information services provided by for-profit companies. This new media has opened a large variety of possibilities for distance educators to overcome time and distance to reach students. By accessing the Internet, distance educators can make use of:

• *Electronic mail (e-mail)* - Like postal mail, e-mail is used to exchange messages or other information with people. As a comparison, regular mail is delivered by the postal service to a postal address; e-mail is delivered by Internet software through a computer network to a computer address.

•*Bulletin boards* - There are several bulletin boards accessible through the Internet. Two common public bulletin boards on the Internet are USENET and LISTSERV. USENET is a collection of thousands of topically organized newsgroups, covering about every topic. LISTSERV also provides discussion forums on a variety of topics broken out by topic or area of special interest.

•*World-Wide Web (WWW)* - WWW provides Internet users with an uniform means of accessing the vast resources of the network (pictures, text, data, sound, video). Popular software interfaces, such as Microsoft Internet Explorer and Netscape, facilitate navigation and use of the WWW, and they are now referred to as " Web browsers". Web browsers permit users to connect to the Internet and facilitate accessing information located on another remote computer. Documents created to be viewed by a browser are formatted using Hypertext Markup Language (HTML). The central organizing feature of the WWW is the "home page". Every organization and even every individual user of the WWW can create a home page that contains whatever information they want to present. The hypertext capabilities of the WWW facilitate linking of information among the different home pages.

Instructional Possibilities of the Internet

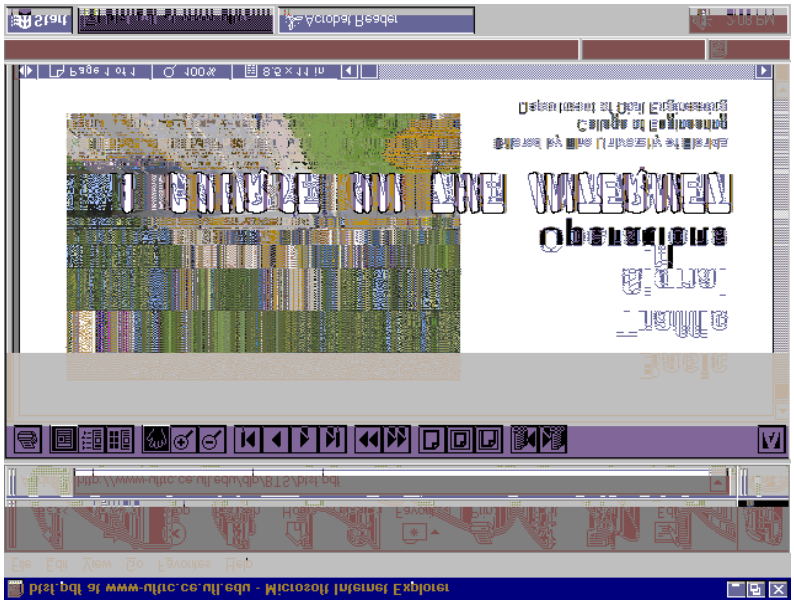
Some instructional possibilities of the Internet include:

•Using e-mail for informal one-to-one correspondence. Feedback from the instructor can be received very quickly, and the students can read messages at their convenience and easily store them for later reference.

• Establishing a classroom bulletin board. Distant students often work in isolation without the assistance and support of fellow students. Setting up a class bulletin board can encourage student-to-student interaction. With a class bulletin board individual students can post their comments or questions to the class, and every other individual is free to respond. This option can also be used to post modifications to

the class schedule or curriculum, assignments/tests, and answers to assignments/tests. Developing a classroom home page. The WWW and Web browsers have made the Internet a more user-friendly environment. For educators, the WWW provides an exciting new opportunity for distance teaching and learning. The WWW can be used by the distance educator to build a classroom home page. The class home page can include the following elements: Course & Instructor Information (course topics to be covered, textbook information, course objectives, and grading policies); Class Communication (instructor's e-mail, link to discussion groups); Assignments and Tests (distribute assignments and tests, provide for online completion or submission, give solutions, hints, or samples); Material covered in the classroom (lecture notes and handouts available either as web pages or as downloadable files); demonstrations, animation, video, audio; reference material (list materials in print and electronic form that supplement the textbook). In addition, the class home page can provide links to other pages which cover information on the topic, similar courses that may also be available on WWW, university library, and discussion lists or 'listserv' that had been set up for student communication. [6]

Following, is an example of a recently developed University of Florida Course "Basic Traffic Operations" using Internet WWW.



The Case Study

General Description

The University of Florida was approached by a major engineering organization , the Army Corps of Engineers, about the possibility of offering a master's degree in construction/engineering management. This organization has in its Jacksonville District around 150 engineers, architects, and related professionals that would like to pursue their graduate degree. The Army Corps of Engineers made it clear that they would support the program but because of budget and manpower limitations their employees would not be able to travel to Gainesville (Univ. of Florida location). The Army estimates the cost of sending an employee for 18 months to the University in order to get a Master's degree is close to $120,000. Because of those high

expenses, the Army could send only one employee per year for full time studies. A preliminary survey showed that 30-40 Army engineers would like to participate in the graduate program. Trying to respond to the industry's needs, the University of Florida decided to offer a Master's degree program in Jacksonville using distance education tools.

The Program

The Master's degree that was offered was a regular Civil Engineering Master's degree which included 32 credit hours of which 12 credits have to be in the major area of engineering management. The rest of the credits can be from various areas of civil engineering and related management areas. All the students will have to submit a Master's report before the completion of their studies. As of the end of 1997, twenty students participated in the program. The majority of them finished 50-70% of their required credits. Two students were able to complete their degree by coming to the University as full time students for a short period of time.

The second cycle of the Army engineers pursuing their master's degree started in 1998 and 10-15 new students joined the program. The author estimates that it will take 2 more years for the majority of the students (from the first cycle) to complete their studies. This experiment has gained a very positive reputation around Florida, and other organizations such as the Department of Transportation, public works organizations (Sarasota County) are trying to participate in similar programs.

Distance Education Methods That Have Been Used in the Master's Program

The following five methods were used in the case study. Their advantages and disadvantages will be discussed in the following pages.

Distance Traveling

A few of the professors were ready to travel to Jacksonville in order to teach in-house graduate courses. The distance between Gainesville and Jacksonville (75 miles) created some administrative problems, but with the use of e-mail, phone, and fax, most problems have been solved. This method was the best one regarding interaction between the professor and students. However, this method is very expensive and time consuming. The following figures will demonstrate the cost dilemma.

Total cost of teaching 2-3 credit hours was $15,000 this included lecturer's fee, travel, per diem and administrative cost. When the course was a required one, 25-30 students participated in the course and the cost per student was around $500/student per course, compared to regular fees of $400/student. This difference of $100/student was acceptable for the Army.

However, when classes were elective, only 10-15 students participated and the cost per student was very high. The second problem was that most of the professors consider this method to be very exhausting (it is a full day of work) and only a few were willing to continue doing it in the future.

Video Courses (FEEDS)

For many years, the University of Florida has offered courses that were taped in studios in Gainesville and the videos were sent by express mail to various locations. Each student could watch the tape at home/work and participate in the class, homeworks were sent to the lecturer by mail, tests were done in-house with some security system.

This system, economically, is very efficient. The cost for the students was comparable to regular course tuition. Because of the extra efforts of the lecturer there has been university discussion to increase such course tuition by 25% and to give to the lecturer some monetary incentive. The major disadvantage of this method is not having any direct interaction between the professor and the students and both parties admit that this way of teaching is less beneficial than regular teaching.

Videoconferences

In this method the lecturer was teaching his regular courses for the full time students at Gainesville, however he was giving his lectures in the distance education studio. Using telephone connections his lecture was transferred to the Army studio in Jacksonville.

The Army studio included a few video monitors and video cameras. When any participant in Jacksonville had a question or a remark he/she called the studio in Gainesville establishing an audio-visual communication. There were some delays in communication time but after some early technical problems, the system was working very well. The major advantage with this method is the interaction between the professor and the students. In the future, this method will become the major tool for our distance education program. Economically, it is not expensive when using telephone lines. The cost of establishing the two studios is substantial but is can be distributed over many courses and over many years. The major disadvantage of this tool is that the professors have to get used to the new media and they would need training and more time for preparation.

One of the major conclusions from using this method was to video tape the lecture at the source (university) and to send the tape (by fast mail) to the students in Jacksonville (they got it the next day). The tapes from the source were of a much better quality than the recording in the Jacksonville studio.

Internet Courses

A few professors are developing courses on Internet. This is in an experimental stage and the idea is that all the course material will be offered on the Internet. Many universities are working on this concept. In the case of the Army Corps of Engineers, two courses are going to be offered next year. This method has many advantages if the right type of course is chosen. It will fit to those courses that are very defined and have less type of discussions and opinions. The author's opinion is that courses like Cost Estimating, scheduling, legal, and similar courses are suited to this Internet media. The major disadvantage of Internet courses is that to develop a good course of 2-3 credits takes substantial resources (time, money). From the author's experience it will take at least a year of hard work to develop a course using Internet.

Summary and Conclusions

From the three years of directing the program, the following major conclusions can be drawn:

•Distance education is a different media than conventional education (classroom) and it requires special training and specialization.

• The transfer from classroom teaching to distance education is, at least for the first time, time-consuming and can be expensive. The cost benefit will come in later stages. For example, preparing a course on the Internet is very expensive and time-consuming but when offered on a regular basis it will be cost effective.

•The best solution for distance education is not to use one media but a combination of tools. The decision of what tool to use depends on the course, the teacher and the students.

• It is essential to have some mechanism so that the students and the professors will meet face to face. This can be done by some periodical meeting, during tests, or any other arrangements. However it is essential that those meetings are arranged.

•There are many practical issues that have to be addressed when using distance education. Those issues are different from one university system to another university system. Some of these issues that have to be addressed, for example, from the University of Florida experience are:

1. How will professors who teach distance education be compensated (if at all) for their efforts?
2. Can every university offer courses anyplace in the state?
3. Will the industry look on distance education degrees as equal to conventional ones?
4. Security problem of tests, homework, and so on.
5. How to evaluate the quality of distance education as compared to regular teaching?.

Final Conclusion:

Distance education will be a major part of graduate programs in construction management in the future. The main reason for the increasing use of distance education is the need of the engineering profession for advanced degrees and the cost benefit of this method.

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