

## **DEVELOPING AN “IN-HOUSE” GRADUATE PROGRAM IN ENGINEERING MANAGEMENT – A CASE STUDY**

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### **Introduction**

The engineering management profession these days is facing a major problem. In most cases, engineers leave universities after completing their Bachelor’s degree, and a few years later, after accumulating practical experience, they express the desire to continue their education towards an advance degree (mainly a Master’s degree) in their area of specialization. These engineers, who are typically employed full time, are only able to continue their education if a suitable graduate program is available locally during evenings or weekends. This scenario is very rare and more often the only other option these engineers have is to become full time students at a university for a period of 1 - 2 years. This option is very expensive and in most cases unfeasible for financial and logistical support people.

One of the solutions to this problem is to offer an “in – house” graduate degree. An organization that can provide financial and logistical support to such a program can offer the degree “in – house”. This solution will enable engineers to work full time and at the same time get their degree without having to give up their job. As for the organizations offering convenient access to advanced education, can help them to recruit top people, as well as motivate existing employees.

The paper will describe such a program developed at University of Florida and is offered in the Army Corps of Engineers in the Jacksonville district. This program which started in 1995, has 35 students (army professionals) and is very successful. The program was using three different lecturing tools:

- Professors traveling to organization’s location to teach graduate classes there;
- Graduate courses offered on videotape (FEEDS);
- On – line courses (Internet).

The paper will analyze the conclusions drawn from seven years of conducting this program and will discuss some problems that had to be overcome. The authors believe that such a program

can be developed for almost any midsize to large organization. Steering the experience in outsourcing from this program will enable other universities to develop similar programs in their area.

Finally the paper will discuss the administrative and financial aspects of such a program, from both the university and organization's point of view.

## **Distance Education (DE)**

Distance education covers a wide range of knowledge acquiring approaches and techniques. The one basic characteristic that these techniques have in common is the distance between learner and teacher. From a systemic point of view distance education can be defined as being both a system and a process, which connects learners to distributed sources of knowledge.

There are many different definitions of distance education continuously evolving with the technology the system utilizes. The term has existed for more than twenty-five years, and since it is an international term it carries various connotations. Some of the definitions given by various education specialists are shown below [2]:

- *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."

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. Written text is replaced by technical media (audio, video, computer), and
4. Involves student-instructor two-way communication.

## **Delivery Systems**

The two main categories of distance education delivery systems are: 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 (i.e. e-mail) [3].

Most of the distance education programs share similar characteristics:

- Provide credit for prior learning,
- Offer open entry/exit,
- Offer various administrative options,
- 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. Research 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 [4].

## **The Case Study**

### **The Program**

The Army Corps of Engineers approached the University of Florida 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 agreed to that support the program with the amendment that their employees would not be able to travel to Gainesville (Univ. of Florida location) because of budget and manpower limitations. The army estimated 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 program. Trying to respond to the industry's needs, the University of Florida has decided to offer a Master's degree program in Jacksonville using distance education tools.

The Master's degree offered is a regular Civil Engineering Master's degree which includes 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 students 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. 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 employees pursuing their master's degree started in 1998 and 10-15 new students joined the program. This experiment has gotten a very positive reputation around Florida, and other organizations like the Department of Transportation, public works organizations (Sarasota County) are trying to participate in similar programs. In Table 1 is presented a typical Master's program of 32 credits. Table 2 presents an example of course outline.

Table 1: Typical Master's program without thesis

<b><u>Civil Engineering Management</u></b>		
<b>Technical Management</b>		
CGN 6155	Civil Engineering Practice 1	2
CGN 6156	Civil Engineering Practice 2	2
CCE 6037	Civil Engineering Operations 1	2
CCE 5035	Construction planning and Scheduling	2
CGN 5125	Legal aspects of Civil Engineering	3
CGN 5135	Value Engineering	3
CGN 5115	Civil Engineering Feasibility Analysis	3
CGN 6974	Master of Engineering	2
<b>Technical Engineering</b>		
CEG 6015	Advanced Soil Mechanics	3
CEG 6125	Soil stabilization	2
TTE 5835	Pavement design	2
<b>Management Related</b>		
MAN 3021	Principles of Management	3
MAN 3151	Organizational Behavior	3
MAN 4310	Problems in Personnel Management	4
<b>Total Required Credits</b>		<b>32</b>

### **Lecturing Tools Used In The Program**

The lecturing tools used in the Master's program are:

- Distance traveling,
- Video courses (FEEDS) and
- Internet courses.

Their advantages and disadvantages will be discussed further on.

Table 2: Example of course outline

<b>UNIVERSITY OF FLORIDA</b>									
<b>DEPARTMENT OF CIVIL ENGINEERING</b>									
<b>COURSE SYLLABUS</b>									
<b>FALL 2001</b>									
<b>I.</b>	<b>Course Number and Title</b> CCE 5035 Construction Planning and Scheduling Thursday 2-3 period, 210 Weil Hall Occasionally on Tuesday 2-3 period, 210 Weil Hall								
<b>II.</b>	<b>Course Description</b> Planning, scheduling, organizing, and control of civil engineering projects with CPM and PERT. Application of optimization techniques								
<b>III.</b>	<b>Professor and Office Hours</b> Dr. Zohar Herbsman 522 Nuclear Science Building (NSB) T & R 10:30 a.m. - 12:00 p.m. (Other times may be arranged by appointment)								
<b>IV.</b>	<b>General Requirements</b> Students are expected to complete all class assignments prior to class. Reading assignments should be completed before class. Homework problems and written reports are due at the beginning of the period on the due date. Work not turned in by the time the class starts will be counted as late. Late work is eligible for ½ credit maximum. No assignment will be accepted after one week of its due date.								
<b>V.</b>	<b>Grading</b> <table><tr><td>Tests</td><td>60%</td></tr><tr><td>Homework</td><td>10%</td></tr><tr><td>Term project I</td><td>15%</td></tr><tr><td>Term project II</td><td>15%</td></tr></table>	Tests	60%	Homework	10%	Term project I	15%	Term project II	15%
Tests	60%								
Homework	10%								
Term project I	15%								
Term project II	15%								
<b>VI.</b>	<b>Required Text</b> Hinze, Jimmie W., <u>Construction Planning and Scheduling</u> , Prentice Hall, New Jersey, 1998.								
<b>VII.</b>	<b>Course Web Page</b> <a href="http://www.ce.ufl.edu/~aelia/">http://www.ce.ufl.edu/~aelia/</a>								

## Distance Traveling

Some professors traveled to Jacksonville to lecture in-house graduate courses. The distance (see map in Figure 1) 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 lecturer's fee included (over the regular salary), travel, per diem and administrative cost. When the course was a requirement, 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 was acceptable for the Army.

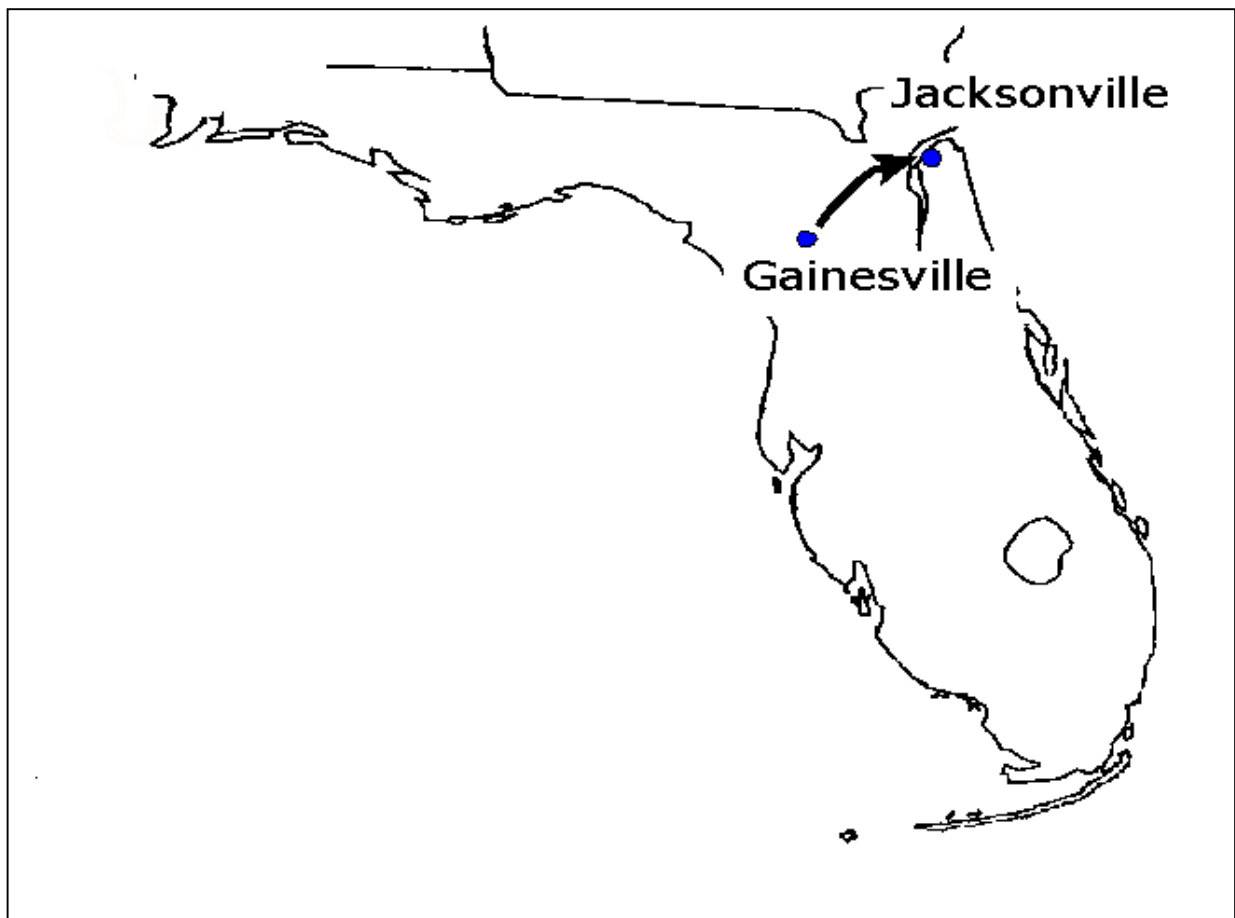


Figure 1: Traveling distance Gainesville - Jacksonville

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 ready to continue doing it in the future.

### **FEEDS (Florida Engineering Education Delivery Systems)**

University of Florida has offered for many years courses that were taped in studios in Gainesville. The videos were later sent by mail to various locations, which enabled the students to watch the tape at home or at work and participate in the class. Homeworks were sent to the lecturer by mail while tests were done in-house using a security system.

Economically this system is very efficient. The cost for the students was like a 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 the lack of any direct interaction professor - students. Both students and professors admitted that this way of teaching is less beneficial than regular teaching.

Videoconferencing method was also used, where the lecturer was teaching his regular courses for the full time students at Gainesville. The course was being taught in the distance education studio. The lecture was then transferred to the Army studio in Jacksonville, FL. by using telephone connections

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 the 2 studios is substantial but it can be distributed over many courses and for many years. The major disadvantage of this tool is that the professors have to get used to the new media. More training and more preparation time is needed.

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.

### **On-line Courses**

A few professors are developing courses on Internet (Figure 2). 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. This method has many advantages if the right type of course is chosen. It will fit to those courses that are well defined and have less need of discussions and opinions. Authors' opinion is that courses like cost estimate, scheduling, legal aspects, and similar courses are suited to this media. The major disadvantage of Internet courses is that substantial resources

(time, money,) are needed in order to develop a good course of 2-3 credits. From the authors' experience it takes at least a year of hard work to develop a course using Internet [1].

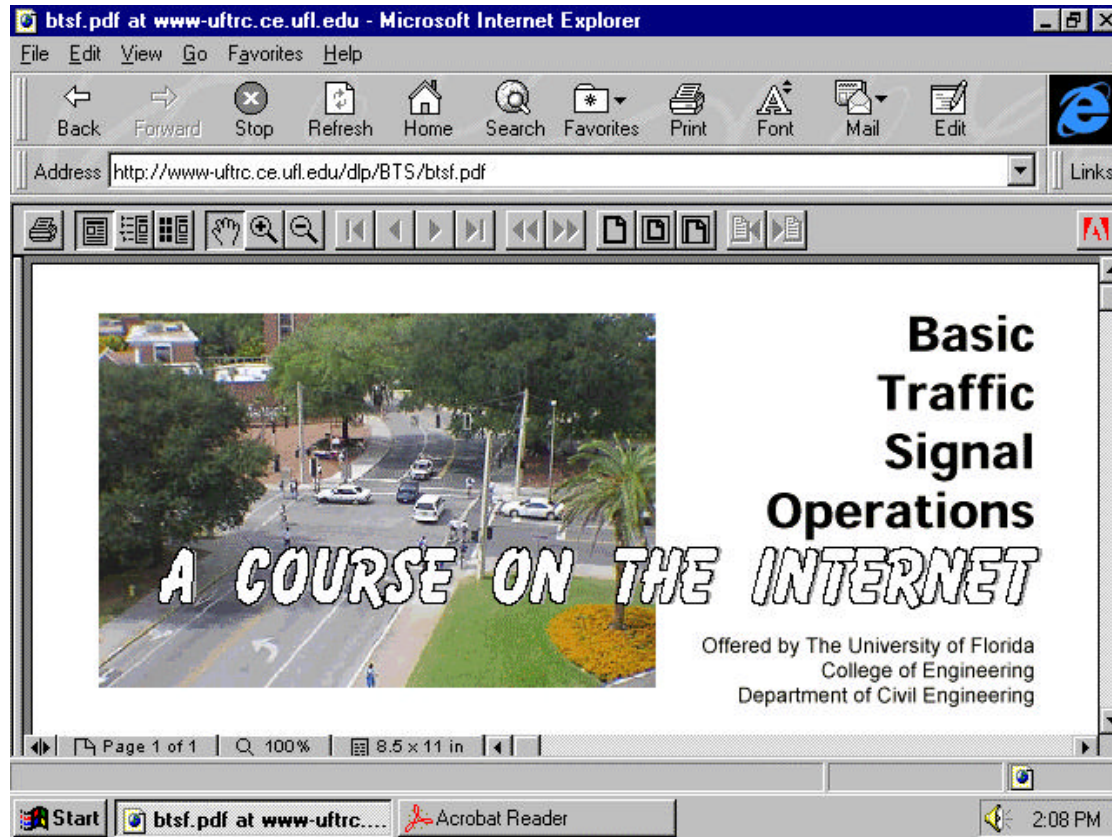


Figure 2: An Internet Course Offered by University of Florida

### The U.S. Army Corps of Engineers View Point

The U.S. Army Corps of Engineers Jacksonville District's 232 person Engineering Division has a large, diversified and complex civil works program. Major engineering features in their \$59 million program include flood control, navigation, beach erosion, concrete, rock and earth-fill dams, jetties, levees, dikes, bridges and environmental restoration engineering. The Division utilizes professionals with expertise in hydrology and hydraulics, soil engineering, geology, surveying and mapping, cost engineering, structural, mechanical, electrical, and civil engineering and architecture. Approximately 50% of the Division's work is accomplished by other Corps' districts or private sector Architect Engineering firms operating under the direction of the Division's technical staff. High technology computer equipment is used to develop complex models for conceptual planning, analysis, visualization and detailed design.

Management recognized that education is a critical variable for this professional engineer based organization. An assessment revealed the following:

- Lack of advanced degrees or course work by many of the current staff.
- Lack of graduate training opportunities in engineering and engineering management in the Jacksonville area.



- Concern over the expense of sending students out of the city for graduate courses.
- Unwillingness of the students to take all or most of their courses by video tape distance learning.
- Potential recruits increasingly expressing the desire to locate where they can continue their education.
- Existing staff's strong desire for graduate training indicating such a program would serve as a retention tool.
- Recognition that many of the people that we deal with from outside the Corps have graduate degrees.

Management had a strong desire for the local courses to become part of a larger continuous learning initiative utilizing multiple forms of training. The University graduate courses offered both locally and by long distance complemented training offered by the Corps and available short courses. These training opportunities were incorporated into a training plan for upgrading each individual's skills. Where possible the University Professors would spend periods of time working at the Corps. This had a dual benefit. It provides the Professor the opportunity to work on real world problems and it provides the student with an opportunity to interact with the Professor in applying higher level considerations to their regular problem solving.

Management was pleased with the graduate training that people have received as well as the interest in all advanced training that this program has helped foster. Four students received their Masters Degree and several others are moving in that direction. There is a high level of interest in learning and over 60 students explore participating in the after work graduate classes. After much effort by all, the in-house degree program has more than met the expectations.

### **Conclusions and Recommendations**

From the seven 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.
- Special equipment and technical expertise is required. A cost – benefit analysis is needed.
- The use of a combination of tools would be a better solution. 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. Periodical meeting, tests, or any other arrangements would be a solution. However it is essential to organize these meetings.

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

1. How to compensate the lecturers involved in distance education?
2. Are there any restrictions related to location?
3. Will degree recognition raise any problems?
4. Security problem of tests, homework, etc.
5. How to evaluate the quality of distance education as compared to regular teaching?

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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### **ZOHAR J. HERBSMAN**

Zohar J. Herbsman is currently a professor and head of construction management in the Department of Civil Engineering at the University of Florida in Gainesville. He earned his Ph.D. from the Technion Institute of Technology in Haifa, Israel. Dr. Herbsman has published more than 50 papers on various subjects in construction management as well as developing software for estimating and scheduling. During the last 10 years, Dr. Herbsman has given dozens of presentations and conducted numerous seminars for the construction industry. Dr. Herbsman is a member of several national committees of the ASCE, AACE, PMI, and TRB, and he is the only academician on the National Task Force on Innovation of Contract Administration for the FHWA.

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### **CRISTINA COSMA**

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