A Fire Safety Engineering Technology Program for the 21st Century

Jeffrey Kimble
The University of North Carolina Charlotte

Abstract:

A baccalaureate program in Fire Safety Engineering Technology (FSET) was recently initiated at UNC Charlotte in response to the needs of the fire service in North Carolina. This paper describes how the program's curriculum was established and how state-of-the-art technology is used to deliver courses via distance education over the Internet using a combination of synchronous and asynchronous web delivery. The program is unique in several aspects:

- The program includes a balanced mix of technical and non-technical classes. (Technical classes are the classes that deal with the science, physics and engineering of fire protection. The non-technical classes are those which deal with the administrative and managerial aspects of the fire service.)
- The technical portion of the curriculum is based on the International Association of Fire Safety Science model curriculum. It includes many technical classes dealing with Fire Behavior, Fire Science and Fire Protection/Suppression.
- The program includes classes dealing with command and administrative issues.
- The curriculum also includes nine hours of political science classes including, state politics and urban politics.
- The curriculum includes six hours of organizational psychology.
- The on-campus classes are set up in a unique fashion to accommodate fire service employees who work rotating 24-hour shifts.
- The program is also offered as an individual access, distance learning degree program using state-of-the-art distance leaning technology.

The Distance Education classes are a combination of asynchronous and synchronous web based delivery using WebCT® and Centra Symposium.®

Introduction:

The Fire Safety Engineering Technology program at UNC Charlotte was created in response to the needs of the Fire Chief's Association and Firemen's Association of North Carolina. Pressure to hire only chief officers who have a baccalaureate degree was creating anxiety among the ranks in the North Carolina fire service. The fire service is steeped in tradition, and in the past, the chief officers have usually come from within the ranks. However, this shift toward seeking only degreed persons in hiring practices had led to several outsiders or "non fire service personnel" being named as the chief in many departments. Fire departments are paramilitary in organization and "civilians" coming in without having been tried by fire (pardon the pun) tended to ruffle the collective feathers of the troops. The lack of baccalaureate degree programs relating to the fire service, and the lack of programs that could accommodate the rotating work schedules of

firefighters meant that few firefighters had degrees beyond the associate level. In addition, the few programs that existed were well beyond commuting distance and lacked distance learning that satisfied the needs of the firefighters in North Carolina. To this end, the idea of starting a program for the firefighters in North Carolina was born.

History:

The initial idea for the program was brought to UNC Charlotte in the 1990s by Luther Fincher, Chief for the city of Charlotte, NC Fire Department. However, in the initial presentation to the University, the program was perceived to be more of a training program rather than education so the University stated it was not interested. Then the idea was brought back to the University in the mid 1990's by Chiefs Holloway and Proctor of the Concord, NC Fire Department. The initial contact was to the College of Business Administration as the Concord chiefs felt that the program should be primarily an administrative program. The College of Business Administration also expressed no interest in taking on a program of this nature.

Not willing to drop the idea of creating a program, Chief Proctor and Chief Holloway considered another option. Although the program was envisioned to be an administrative one, it did contain some technical aspects. Because of this, the fire chiefs contacted the Chair of the Department of Engineering Technology, Ed Braun. After some discussions, it was decided that the program was a perfect fit for Engineering Technology. At that time, the Engineering Technology program at UNC Charlotte had four programs, Civil Engineering Technology, Mechanical Engineering Technology, Electrical Engineering Technology, and Manufacturing Engineering Technology. Each of these programs was a two plus two program, meaning that the students complete an Associate degree at a community college then transfer to UNC Charlotte for the last two years to complete the Bachelors degree. In 1999, North Carolina had eight schools that were offering Associate degrees in Fire Protection, and it was only logical to extend this two plus two arrangement to the existing degree programs.

Chairman Braun then made contact with the coordinator of the two-year fire protection programs to see how a partnership could be agreed upon. As it happens, the two-year programs were just beginning to make the shift from a quarter-based schedule to a semester-based schedule. This pending change not only fit the University's semester based system better, but it also provided an opportunity to develop a uniform curriculum for all the Associate degree programs and put in place the prerequisites for the baccalaureate program.

Chairman Braun then surveyed similar programs at four other institutions. (To the author's knowledge, only six such programs are in place at this time in the United States). Braun also established an advisory council made up of local fire chiefs. (This advisory council was expanded in the fall of 1999 to include chiefs from across the state as well as representatives tasked with safety supervision in industry.) With information gleaned from the surveys and input from the advisory council, a curriculum proposal was drafted.

The proposed curriculum included both technical and non-technical content. The technical content was of the rigor to make for a good Engineering Technology program and the non-technical content included several Political Science, Psychology and Management oriented

classes to round out the administrative needs of the program. Chairman Braun stepped down from the position as Department Chair but remained committed to the creation of the new program.

Fortunately, the new Department Chair, Cheng Liu, was also in favor of the new program. In January of 1999, the advisory council of fire chiefs, met with the Deans of the College of Engineering and the College of Arts and Sciences and with the University's Chancellor to discuss the proposal. The proposal was presented with two main components, a traditional on-campus component and a distance-learning component so that the program would be accessible to fire service personnel all across the state of North Carolina. The Deans and the University's Chancellor were in favor if funding outside of the University's current budget could be secured for the program. The North Carolina Fire Chief's Association and the North Carolina Fireman's Association had also taken an interest in the program, and the program was being promoted through these organizations. These particular associations were successful in lobbying the North Carolina State Legislature in the spring of 1999 for funding of this program. The curriculum was finalized, reviewed, and approved in record time. The money became available July 1, 1999 and the program began in the fall of 1999.

Jeff Kimble was hired as the first faculty member in July of 1999. Professor Kimble came to the program having been a firefighter for almost twenty years. The search committee felt incoming students would relate well to someone with a similar background. In addition, Professor Kimble also had Bachelors degree in Fire Safety Engineering Technology, a Masters degree in Industrial Training, and had just completed the course work on an Education Doctorate in Instructional Design. All of these factors would be vital in getting a new program going. Twenty-eight students were enrolled in the first two classes in the fall of 1999.

Curriculum Development:

While a curriculum had been developed for the program proposal, the Engineering Technology Department felt that someone with expertise in the fire service arena should revise the curriculum so that it would be as beneficial as possible to the students. Professor Kimble began the revision in the spring of 2000. Interviews for the second faculty member were ongoing, and it was decided to wait until the second faculty member was on board to finalize the curriculum revision. Dr. Marc Janssens was hired in the summer of 2000. Marc came to UNC Charlotte with an extensive background in fire research and testing. Most recently, Marc was the Manager of the Material Flammability Section at Southwest Research Institute in San Antonio, Texas. Professor Kimble and Professor Janssens decided to base the curriculum revision on the Model Curriculum for A Fire Safety Engineering program developed by the International Association of Fire Safety Science[1] (IAFSS). The IAFSS model consists of the following components:

Background Course - 4 Modules (17 credit hours)

1. Fluid Mechanics (5 credits)
2. Heat and Mass Transfer in Fire (4 credits)
3. Classical Thermodynamics (3 credits)
4. Solid Mechanics (5 credits)

Fundamental Course – 5 Modules (23 credit hours)

1. Fire Fundamentals (5 credits plus 1 lab)

2. Enclosure Fire Dynamics (5 credits plus 1 lab)
3. Active Fire Protection (6 credits)
4. Passive Fire Protection (1 credit)
5. Interaction Between Fire and People (4 credits)

Applied Course - 2 Modules (3 credit hours)

1. Risk Management for Fire and Explosions; Design Based on Performance (3 credits)
2. Industrial Fire Protection and Explosion Protection (3 hours)

With this model curriculum to serve as a guideline, Professors Kimble and Janssens decided to re-survey all of the community colleges in North Carolina with two-year Fire Protection programs to see how much of the model curriculum was being covered in the lower division. With this information, Kimble and Janssens would incorporate the remaining modules into the upper division of the program at UNC Charlotte. In addition, several meetings with the program directors of the community college fire protection programs were held. It was agreed upon that students who were considering continuing on to the UNC Charlotte FSET after completing their AAS would be required take at least three hours of college algebra as a minimum. The University currently requires six hours of "problem solving", three hours of which must be a college level math and three hours of which can be statistics or logic. Another concern that had to be factored in was that the program had to maintain some administrative "flavor". There still had to be some management and administrative type classes in the program. It was decided to strike a balance between technical and non-technical classes and hopefully provide a program that would prepare the Fire Safety Engineering Technologists of the 21st century.

Revised FSET Curriculum

Technical Courses

FSET3103	Principles of Fire Behavior	3 hrs
FSET3113	Building Fire Safety	3 hrs
FSET3123	Industrial Hazards & Electricity	3 hrs
FSET3144	Active Fire Protection	3 hrs
FSET3183	Fire Safety Engineering Problem Analysis	3 hrs
FSET3233	Applied Fire Engineering Design & Analysis	3 hrs

Non -Technical Courses

FSET3124	Risk Management for Emergency Services	3 hrs
FSET3611	Professional Leadership Seminar	1 hrs
FSET4123	Command & Control of Major Disasters	3 hrs
FSET4323	Advanced Fire Service Administration	3 hrs
FSET4243	Research Investigation	3 hrs
EGET3222	Engineering Economics	2 hrs
POLS3119	State Politics	3 hrs
POLS3121	Urban Politics	3 hrs
POLS3126	Administrative Behavior	3 hrs
PSYC2171	Introduction to Organizational Psychology	3 hrs
PSYC3174	Organizational Psychology	3 hrs

General Education 12 hrs

Ongoing at the same time was the initiative of the National Fire Academy (NFA) in Emmitsburg MD, to develop a model for baccalaureate programs for the fire service. The National Fire Academy is looked to as the definitive source for fire service training and education in the United Sates. It is funded by the United States Fire Administration, a branch of the Federal Emergency Management Agency, and holds a highly regarded status in the fire service. Work on the proposal takes place at the Fire and Emergency Services Higher Education conference held each June at the National Fire Academy. (UNC Charlotte takes part each year in this conference.) Thus far, the NFA proposed model has divided the fire-related curriculums into two categories depending on where they are housed at their respective college or university. The models are for a program either in a business or administrative college or a technical or engineering college. The two models are labeled as either Management Focus or Technology Focus. The influence of UNC Charlotte's revised FSET curriculum is evident in the technology focus model being considered by the NFA. The technology focus model consists of the following components:

Safety and Risk Reduction
Management of Large Scale Emergencies
Fire Dynamics
Active Protection
Building and Fire Safety Codes
Industrial Hazard Control
Analytical Approach to Fire Protection
Independent or Applied Research (Capstone Experience)
Areas of Specialization
Budget and Finance
Organizational Management and Theory
Intergovernmental
Business/Technical Communications
Social Science
-Political Science
-Psychology

Accommodation of Unique Work Schedules for On Campus Students

Firefighters are faced with a unique challenge as far as class attendance goes. Their schedules tend to be different from almost any other profession. The standard shift for a firefighter is twenty-four hours on duty and forty-eight hours off duty. The majority of departments work this schedule or some variant of this schedule. Also, most departments work with three shifts, usually called A, B, and C, shift, respectively. In each FSET class there would be members from each shift. This presents a problem because there is never a specific night when all firefighters could be there. For example if Shift A works Monday, the next Monday B Shift works, then the next week C Shift works Monday. So in a 16-week semester, each shift could miss as many as five classes. One shift/schedule variant could cause a single shift to miss as many as ten times per

semester. Since regular class attendance is necessary for successful completion of the courses, a way to accommodate this rotating work schedule had to be devised. The solution arrived at is called a flip-flop schedule. Each class is repeated on the following day and kept in lock step sequence. The same material is covered and at the same pace. So, either day that students come, they get the same information. Since all of our students are part-time and take from two to four classes, the flip-flop seems to work fine. For example, Class A is taught Monday afternoon from 2:00 pm – 5:00 pm, and then Class B is taught from 6:00 pm – 9:00 pm. On the following day, Class B is taught in the afternoon from 2:00 pm – 5:00 pm and Class A is taught from 6:00 pm – 9:00 pm. Students can come either day for both classes, or come for two consecutive days at the same time. See Table 1 below.

	2:00 – 5:00	6:00 – 9:00
Monday	Class A	Class B
Tuesday	Class B	Class A

Table 1 Flip-Flop class Schedule

Distance Education Delivery

As mentioned earlier in this paper, a requirement for the funding of the program was that it be made available statewide. That in and of itself would not have been that difficult, but the advisory council of fire chiefs were adamant that the program could not consist of "canned courses" such as videotapes or other non-interactive or asynchronous delivery methods. Also, the instruction was to take into consideration the work schedules mentioned previously. And finally, the fire chiefs wanted to avoid having to travel to "site" based classes. Several ideas were suggested and studied for feasibility. Ultimately, a hybrid approach to web based delivery was decided upon.

The distance learning would be individual access. It was to be delivered via the Internet, as this is one of the most readily available means of moving media and content from place to place. The hybrid part comes from the fact the classes are divided into two components, an asynchronous component and a live component. The asynchronous portion consists of course material being developed as web pages or documents and then being made accessible through a course management software program.

The distance education program delivered the first class in the fall of 2000. The current program in use for course management is WebCT®. WebCT® allows the instructor to post materials, post on line quizzes, and have threaded discussions or chats as well as many other functions to help deliver course content.

The unique part of the FSET program is the live session held each week. For each three-hour class, the students have a one-hour live session via the Internet using Centra Symposium®. In the

live sessions, students log on and participate via a virtual classroom. Students can hear and see the instructor through streaming audio and video. Students are given a list of minimum specifications for equipment for participating in the program. With a mid level computer, students can participate in the program, and having the ability to "pass" the audio and video among themselves (controlled by the instructor). This allows students to not only hear but also see their classmates who are at locations all across the state. The live sessions are recorded for students who are absent to view at a later time. The students and instructor have a very intuitive and easy to use interface that allow for a great deal of interaction. Application sharing is another unique feature, which again opens the door for more interaction between students. Centra Symposium® will operate effectively on a 28.8kbps dial up; however, the faster the connection, the more efficiently the program will run. Audio has priority over video, and the video is slowed down in the event of congested bandwidth. With cable modems, DSL, or other broadband, the video component is almost seamless.

A written paper cannot do justice to the capability of the software. A more complete description of the product can be found at the web page (www.centra.com) and demonstration of the software can also be found there. There is also a one minute and thirty second news clip showing the software being used in the classroom available from the UNC Charlotte Fire Safety web pages at (www.et.uncc.edu/fire_safety). While it is not the perfect substitution for a classroom, it is an acceptable alternative. The students and the advisory council have all had praise for the delivery method.

Fire Research

While the FSET program at UNC Charlotte is only two and one half years old, research is underway. There is a belief by those in the department that research is a key factor in staying current and in providing valuable learning opportunities for the students. Two of the students' classes require some exposure to the research element. Once the labs are fully functional, distance education students will be required to attend laboratory sessions for one week each semester during their research classes. The University was reluctant to put the research lab for the program on campus, as it would be cost prohibitive to retrofit a building to handle the equipment and to install smoke scrubbers so that room size experiments could take place. The Charlotte Fire Department made available to the program temporary housing for the lab equipment, and the department is in the process of building a 25 by 80 ft. structure in which to house the lab. Some of the equipment the program now has for use includes:

- NBS/IMO smoke chamber (ASTM E 662 & ASTM E 1995)
- LIFT flame spread apparatus (ASTM E 1317 & ASTM 1321)
- Cone Calorimeter (ASTM E 1354 / ISO 5660)
- Room Corner Test Apparatus (ISO 9705 / NFPA 265 & 286)
- ICAL Test Apparatus (ASTM E 1623)

More than $250,000.00 has gone toward equipment purchases for the new lab.

In addition, several research grants have also been awarded to the faculty in the program. Some of the grants include:

- Navy DURIP ($220,000)
- NAVY STTR Phase 1 ($31,000)

- NIST ($207,000)

In addition, over $500,000.00 more dollars worth of grants have been applied for.

Conclusions

While the Fire Safety Engineering Technology program is less than three years old, it is poised to be a leader in the coming years as a top FSET program. The curriculum has been developed to meet the needs of the fire service leaders of today as well as tomorrow. The faculty is working hard to meet the needs of the students and continuing to improve the delivery of course content. The research component is being put into place to provide students with not only the classroom lectures but also some real world applications of the knowledge from the classes. A proposal is currently being developed to create a lower division for the current program. This would eliminate the need for students to complete the AAS degree prior to enrolling and would open the door for traditional students (those straight from high school) to enroll. In addition, a proposal to create a second track or "emphasis" in industrial safety is currently being considered by the departmental faculty. The College of Engineering and more specifically, the Department of Engineering Technology, maintains that the mission of the Engineering Technology program is to provide competent engineering technologists to meet the needs of the surrounding area. The expansion of the Fire Safety program into a full four-year program, and the creation of the emphasis in industrial safety will help the college fulfill its mission. If both of these planned expansions take place, the enrollment in the FSET program should exceed 100 students in the next 5 to 10 years. The program at UNC Charlotte is a Fire Safety Engineering Technology program for the 21st Century.

Bibliographic Information

1. A Proposal For A Model Curriculum In Fire Safety Engineering, Fire Safety Journal, Vol. 25, 1995

Biographical Information

JEFFREY (JEFF) T. KIMBLE, Assistant Professor and Program Coordinator, Fire Safety Engineering Technology, UNC Charlotte (1999-)