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FRANK M. CROFT, JR. is an Associate Professor of Civil & Environmental Engineering and Geodetic Science at The Ohio State University. Prior to assuming this position at OSU, he served on the faculty of the Speed Scientific School, University of Louisville (1976-1984) and West Virginia Institute of Technology(1973-1976). Before beginning his academic career, Croft was an associate engineer/scientist with the Douglas Aircraft Company in Long Beach California (1969-1973). Croft holds abachelor of science degree in aerospace engineering, earned at Indiana Institute of Technology (1969). His advanced degrees are a master of science in engineering (civil engineering) which was received in 1977 from West Virginia College of Graduate Studies, and his Ph.D. degree in Civil Engineering from Clemson University in 1984. Croft has been an active member of ASEE since 1973 and has served as the 1989-1990 chair of the Engineering Design Graphics Division and the 1995-1996 chair of the North Central Section. Also, he served on the ASEE Board of Directors as Zone II Chair from 1998-2000 and was Vice-President of Professional Interest Councils and Professional Interest Council III Chair from 2003-2005. He is currently a Life Member of ASEE and is an ASEE Fellow. Croft has received several awards including the Southeastern Section Dow Outstanding Young Faculty Award in 1982, the North Central Section Best Paper Award at the 1987 NCS Conference, the EDGD Distinguished Service Award in 1997, the North Central Section Distinguished Service Award in 2002, the Charles E. MacQuigg Outstanding Teaching Award at Ohio State in 1994, and in 2009, the Department Outstanding Professor Award (OSU-CEEGS) 2009, and the Orthogonal Medal from North Carolina State University in 2009. Croft has been the lead professor for Engineering Summer Academy, a program designed to attract outstanding high school students to engineering since 1985. He is a registered professional engineer in Kentucky.

Ohio State's First-year Engineering Program

The First-year Engineering Program got its start in 1992. Prior to this date, the first year engineering experience for students was composed of a four credit course in engineering graphics which included instrument drawing and some CADD. At that time, the engineering faculty, felt that students were not getting the proper exposure to what engineering was all about through the graphics course and thought that some alternative could be found that would enhance student retention in engineering. Like a lot of universities, the engineering program at OSU was experiencing high drop-out rates. There were many reasons for this, but the most significant one was that engineering students in the first year were not spending a lot of time in engineering (only the graphics course) and they were having to endure the rigors of physics, math, and chemistry without seeing any connection to engineering.

In the 1990s, The College of Engineering at Ohio State became a part of the Gateway Coalition that was devised to enhance the first year experience. Drexel University, a member of the coalition, initiated what it called the E4 program. In this program, Math and Physics are combined, Chemistry and Biology are combined, Engineering had both a lecture portion and a hands-on lab portion, and humanities were combined with communication and had a technical and non-technical component. The results of implementing the E4 program at Drexel, showed a retention rate of greater that 60% of the first-year engineering students and feedback received from co-op employers was very positive. Seeing these results, OSU decided to adapt the Drexel E4 model in a slightly modified format.

In the early days, the OSU adaption involved a select and dedicated faculty from the College of Engineering and the College of Mathematics and Physical Sciences. Engineering Mechanics was combined with Math with accelerated Calculus, Statics, Particle Dynamics, and Rigid Body Dynamics. Engineering Fundamentals and Graphics as well as the programming course included a hands-on laboratory where students could experience different engineering disciplines throughout the first two quarters and thus they spent more productive time in engineering. First year students were offered the fundamentals and programming classes in two separate sequences: The Fundamentals of Engineering (FE) format and the Fundamentals of Engineering Honors (FEH) format. Both sequences include hands-on labs, with engineering "up-front" and team based design/build introduced early and often.

In the FEH format, the students enrolled had to be admitted to the University Honors Program. This means they had to achieve score of 30 on the ACT, be ranked in the top 10% of their high school graduating class and have a sustained record of extra-curricular activities and demonstrated leadership. In the FE format, students had to be admitted to the College of Engineering.

Historically, the timeline for implementing the First-year Sequences is shown in Figure 1. Planning for FEH and FE began in 1992. From 1992 through 1996, Pilot sections based on the Gateway approach and the Drexel E4 model were introduced along with control sections in order to ascertain the validity of plan. The first section of FEH was approved and offered in 1997. At the same time planning for the FE sections were taking place with pilot studies being conducted in 1997 & 1998. The FE program was approved in 2000 and began operation.

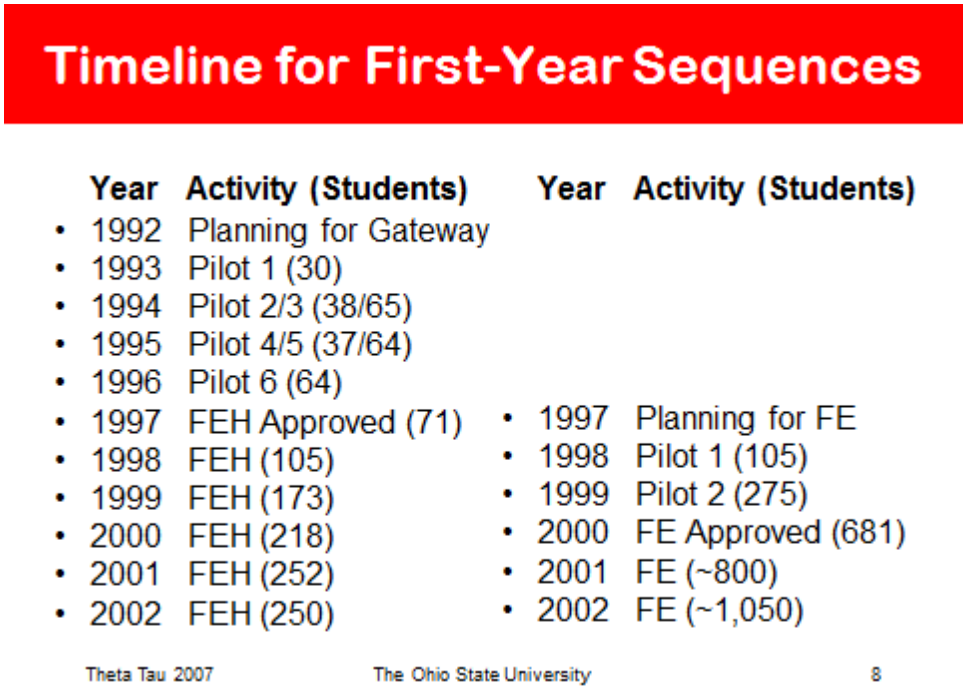

Figure 1. Timeline for implementation of the FEH and FE Sequences

In looking at the FEH sequence and the FE sequence, the following comparison can be made: In FEH, there is an emphasis on hands-on learning and design. There is coordination among the FEH core classes. There are weekly meetings among the faculty involved in teaching physics, math, and engineering to enhance the experience of the students. The courses are very challenging. Students take a 3 course sequence (Engr H191, Engr H192, Engr H193) which account for 12 credit hours over the year. In FE, there is also an emphasis on hands-on learning and design; however, there is no coordination among freshman classes. The courses are challenging, but not to the extent as the FEH classes. Students take a 2 course sequence (Engr 181 and Engr 183). Most also take EG 167, a programming course. The total credit hour count over the year for FE students is 10.

When we look closely at FEH, what makes it special? First it is a three course sequence that is very challenging for the students, but also very rewarding. In the first course, Engr H191, students learn the fundamentals of graphics through sketching and use of Autodesk Inventor, a Geometric Modeling Program. They are introduced to hands-on labs and are required to do extensive lab report writing. There is a project in which two person teams design and build a cardboard mechanism (a bridge for a 16" span, or a Christmas ornament shipping carton). There is a competition involving loading the mechanisms until they break and bonus points are awarded to the winners. The second course, Engr H192, involves C and C++ programming. It also involves additional labs that require the students to do extensive lab reports. Another design project is part of this course as well. In the final course, Engr H193, the students are divided into 3 or 4 person teams and are charged with building an autonomous robot that is required to traverse a course and perform various tasks. The course changes each year as do the tasks. This design and build phase of the program requires the students to use the knowledge that was acquired in the first two courses and also requires them to use teamwork to achieve their final goal. Each team is required to document their designs and to present a formal report at the conclusion of the course. A very special part of this program is that there is coordination between engineering, math, and physics throughout the program. There is a weekly meeting of the faculty involved in the honors program

of engineering, math and physics to discuss issues that have arisen and to be coordinate topics that are being introduced so that they make sense for the entire group of students enrolled in the honors program. One example of coordination is that we make certain that mid-term exams in the three areas do not fall on the same day which enables the students to be better prepared. There is a great amount of effort to ensure that the program is properly administered in all three areas, and we think this is rather unique.

In the early years of the program, our concern was with retention of high quality students in engineering. Figure 2 shows some data with this regard. Prior to 1988, the student retention in engineering was very poor. The baseline data shown in Figure 2 shows that less than 40% of the students starting in engineering made it to graduation 4 or 5 years later. After making the changes and introducing FE and FEH, the data in 1998-1999 shows that the control group (FE) retained 55% over the 4 to 5 year period and the FEH group retained over 70%. When you look at the next year, retention rates got even better. It would appear that introducing hands-on labs and faculty coordination have contributed to the retention success of this program.

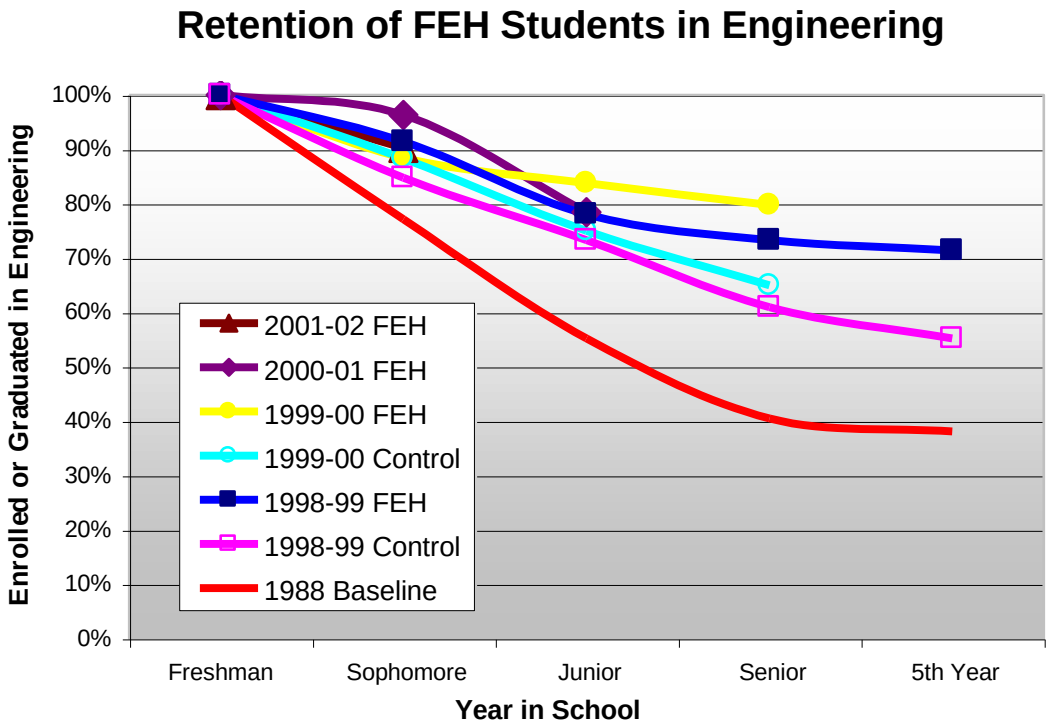

Figure 2. Retention of FEH Students in Engineering

The FE and FEH programs are been evolving since 1997 and some significant changes have taken place. The College of Engineering at Ohio State has created an Engineering Education Innovation Center (EEIC) and the FE and FEH programs are now managed under this umbrella. Managing these programs is not the only task that EEIC has. A new PhD program in Engineering Education has been instituted and it resides in EEIC. EEIC handles the hiring and training of Graduate Teaching Associates (GTAs) and Undergraduate Teaching Associates (UTA or Mentors) that are an integral part of the teaching of FE and FEH. There are over 140 GTAs and UTAs that enable us to run these programs efficiently.

EEIC has expanded its administrative handling of all the programs shown in Figure 3. This incorporates Fundamentals of Engineering, Fundamentals of Engineering for Scholars, Fundamentals of Engineering for Transfers, Fundamentals of Engineering for Honors, and Engineering Graphics. There are still engineering graphics courses offered especially for technology education and a technical elective AutoCad course.

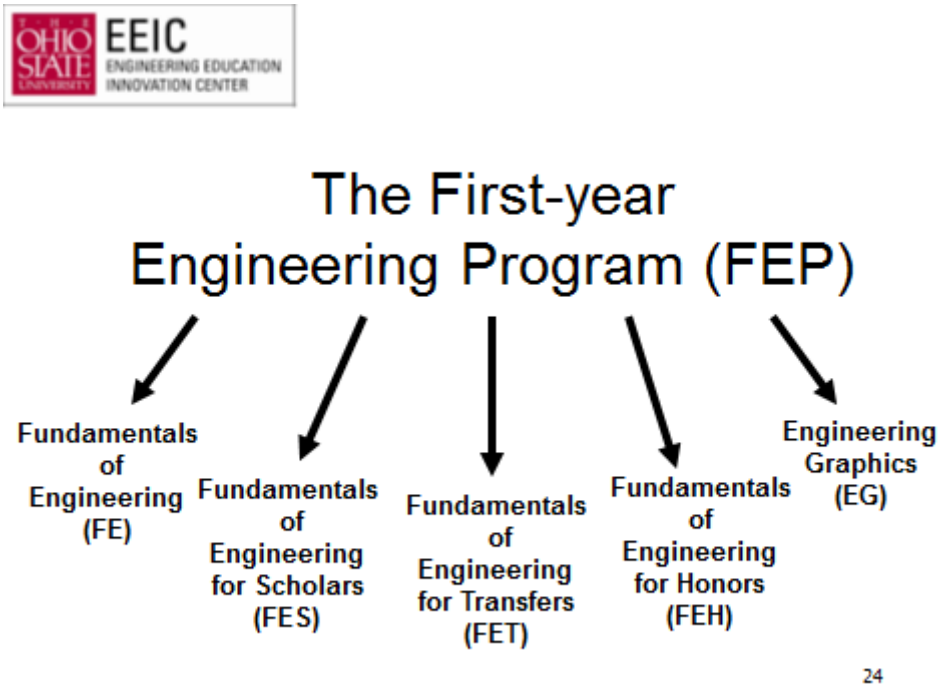

Figure 3. The First-year Engineering Program.

The retention rate of students in engineering has been fairly steady over the past decade since the change-over to FE and FEH. Figure 4 shows the retention numbers for 2009-2010 and 2010-2011 for the programs Data for FE was not available for 2010-2011 for FE. Retention for FE and FEH remains constant at 80% for 2009-2010. The total for all programs in FEP is also over 80%. In 2010-2011, FEH was over 80% as well. These retention numbers speaks volumes with regard to the success of the program and the achievement that was sought in retention.

FEP Course Retention in 2009-2010

Course	Started	Finished	Retained
181	1391	1319	94.8%
183	1169	1113	95.2%
FE Total	**1391**	**1113**	**80.0%**
191H	431	429	99.5%
192H	382	365	95.5%
193H	359	357	99.4%
FEH Total	**431**	**357**	**82.8%**
FEP Total	**1822**	**1470**	**80.7%**

Of the 69 who did not finish FEH, ~half remained in Engineering 26

FEP Course Retention in 2010-2011

Course	Started	Finished	Retained
181			
183			
FE Total			
191H	416	416	100.0%
192H	367	357	97.3%
193H	339	337	99.4%
FEH Total	**416**	**337**	**81.0%**
FEP Total			

Of the 79 who did not finish FEH, ~half remained in Engineering 27

Figure 4. FEP Course Retention Rates for the Past Two Years.

Numbers for the 2011-2012 year indicate that engineering at OSU is growing and is a popular program. During the course of regular and transfer orientation sessions held between May and September, 2011, the College of Engineering welcomed new students into engineering as follows:

New First Quarter First Year Student (NFQF)	~1575
Number of Transfers	~ 100
Total	1677

Compared to 1563 in Au 2010

Based on the retention numbers that we have seen in this presentation, it can be said that the FE and FEH programs are very successful. In FEH we have managed to retain some our best students. Industry recognizes the knowledge and skills developed in FEH as they have made significant contributions of funds and gifts-in-kind to the program. FEH has the faculties of Math, Physics, and Engineering working together for a common goal. The program helps to recruit good students. The success of the program has taken a great deal of hard work from a lot of dedicated faculty, graduate students, and undergraduate mentors. The Administration of the College recognizes the importance that all the components of FEP is to our over-all program.