

## **AC 2007-81: CREATING FLEXIBLE AND DISTINCT ENGINEERING TECHNOLOGY PROGRAMS**

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# Creating Flexible and Distinct Engineering Technology Programs

## Abstract

*The College of Engineering, Technology, and Architecture (CETA) has re-discovered within its technology programs curricular flexibilities that are now being used to attract and retain more students. Students are increasingly aware of the need to broaden their skill base upon graduation and recognize the need to compete for employment on a global scale. This paper describes the Flex Advantage Plan (FAP) at CETA that precisely targets opportunities for complementary areas of study and encourages students to design custom educational plans. FAP lays out specific tracks that add distinction and uniqueness to program majors by presenting students with educational choices. Students can add depth in a chosen discipline and/or pursue another area of study.*

*All engineering technology programs within CETA feature professional electives. Students use elective courses as tools to achieve expanded educational goals and objectives. If electives are chosen properly, students can develop a technical concentration, earn a two-year associates degree or graduate with a minor in another program. The more popular non-technical minors are those in Business in the areas of Entrepreneurial Studies, Management, Marketing or Business Administration.*

*Curriculum flexibility has long been used in the advising process to enhance learning opportunities. We have expanded this beyond advising and have incorporated FAP into our marketing collateral, open house recruiting events, orientation sessions and as a means to engage and retain first-year students. In this paper, we share the specifics of FAP and how it is successfully being used to capture student interest, grow participation, and improve their prospects for lifelong career success.*

## Introduction

Our affiliation is with the University of Hartford which has 4,700 full-time and 880 part-time undergraduate students enrolled as of the fall 2006. We are members of the College of Engineering, Technology and Architecture (CETA) that has a population of about 760 undergraduate students out of which 420 are enrolled in engineering technology (ET) programs. According to recent ASEE statistics, The University of Hartford is ranked fourteenth in the total number of students enrolled. Within CETA, there are three departments that collectively support five four-year ET undergraduate programs.<sup>[1]</sup>

- Architectural Engineering Technology (AET) in the Architecture Department
- Audio (AuET), Electronic (EET) and Computer Engineering Technology (CET) in the Electrical & Computer Engineering Department
- Mechanical Engineering Technology (MET) in Mechanical Engineering Department

The curriculum of each ET program is designed such that students must complete:

- One 4-credit lecture/laboratory course in a basic science elective
- Two 4-credit lecture/laboratory courses in algebra-based physics
- Four 3-credit All University Curriculum (AUC) courses plus one 3-credit elective course in humanities and/or social sciences (H/SS)
- Three 3-credit Technical Communication (TC) courses
- Two to three 4-credit Technical Specialty (TS) upper level courses in the major
- One to four 3-credit Professional Elective (PE) courses

Professional Electives are traditionally chosen from ET, engineering, science, mathematics, business, computer science, music, communication, arts or education offerings. During the advising process, students are counseled to select a PE that contributes to their career goals and objectives. While PEs nourish intellectual curiosity and/or artistic expression beyond one's declared major, they also enable the pursuit of associates degrees, technical concentrations and/or minors. However, the full potential that PE courses offered and their impact both on the ET population and CETA itself was not being fully realized.

Most students want to graduate in the shortest time possible, and faculty advisors generally support this goal so in practice, professional electives were typically undervalued and underutilized. Recognizing this problem as well as the opportunity to implement a more flexible curricular structure, we developed an advising process where the main goals are not only GPA and time to graduation, but also to encourage broader educational outcomes for students to pursue. Based on our shared advising experiences, we developed the Flex Advantage Plan (FAP) that is currently being used within CETA to attract and retain ET students.

This paper describes FAP by first revealing the specific tracks that add distinction and uniqueness to program majors by presenting students with more educational choices. For example, students can choose to add depth in a chosen discipline and/or pursue another area of study. FAP is also integrated into CETA's marketing collateral, open house recruiting events and orientation sessions to engage and retain first-year students. This paper describes the specifics of FAP and how it is successfully being used to stimulate student interest, increase participation, and thus improve their prospects for lifelong career success.

### **Strategic Engineering Technology Program Issues**

A key strategic objective of CETA is to continuously improve enrollment and retention, as well as foster unique and distinctive programs. However, the ET programs within CETA vary widely in enrollment, retention and types of students they attract. Finally, there is a persistent engineering versus engineering technology issue that affects both recruiting and transfer across all programs. Our two largest programs, AET and AuET, are quite unique with more opportunities for students to express creativity in the first two years of study. In contrast, three smaller ET programs, CET, EET, and MET, are offered by many other institutions and perceived as more technically focused and challenging.<sup>[2]</sup>

One consequence of different program enrollments has been a large spread in retention.<sup>[3]</sup> Within larger major-specific communities, study groups and informal support groups were easily formed and sustained. On the other hand, CET/EET/MET students did not engage in such activities and, predictably, retention in these programs was lower. Strategies to increase student retention in these smaller technology majors and improve the first-year freshmen experience are described in detail in Reference 3. To promote bonding among students, CET/EET/MET students were placed in the same set of First-Year Interest Group (FIG) courses as well as a common orientation course, Introduction to Engineering Technology (ET 111).

These smaller engineering technology programs also face other difficulties. Students in these programs typically have lower SAT scores, and many of them were originally engineering applicants who did not meet the entrance requirements. In other cases, well-qualified ET students opt to either transfer to an engineering program within the College or leave to attend another institution. Since ET programs and their engineering counterparts are administered by the same set of departments and are closely related, there is a constant need to maintain distinctiveness. We discovered that one way of doing this was to use the curriculum flexibility inherent in the PE and TS course bundles resident within all ET programs.

### **Improving the Educational Outcomes of Graduates**

Until recently, the systematic use of PEs and TSs in the academic advising process was done by a few self-motivated faculty and students. The authors noticed that CET/EET/MET students were particularly interested in obtaining a minor from the School of Business. In response, we established the goal of identifying a series of options within the ET curricula so as to add educational value with minimal credit overload. What began as an observation by some staff and faculty of the College soon evolved into an effort to plan formal educational pathways for all ET programs. Flexible curricula designed along these lines deliver a richer experience that enables graduates to apply engineering technology knowledge especially in an entrepreneurial setting. Graduates are also better prepared for advanced study such as business administration, management and marketing.

A number of external environmental factors strengthened our belief in the value of flexible curricula. Following the ‘technology bust’ of the late-90s and the economic downturn that began in 2001, we found it difficult to grow enrollment in our CET/EET/MET programs. This was mirrored on a national scale by many other institutions who reported similar results. By 2005, we noticed a reversal of this trend. We began promoting the merits of FAP in recruiting events on a trial basis. As applications to ET programs started to rise, we found that prospective students as well as their parents expressed interest in a more multi-faceted educational experience.

At the same time, there was a growing awareness of workforce globalization especially in such areas as manufacturing, software and other high technology fields. Once we incorporated this notion into our recruiting presentations, the benefits of FAP resonated even stronger. Parents were often surprised to learn that there would be little added tuition cost. Over a two year span, the reception we received at recruiting and orientation events gained momentum. During the 2005 academic year, we finalized the details of FAP and tested its components with a number of

focus groups including prospects as well as first-year and upper term students. We also solicited input and advice from the Industrial Advisory Boards (IABs) of the respective departments.

### **How is FAP Designed?**

Students often discover an interest in additional educational options late in their course of the study. Time and financial constraints limit pursuit of these opportunities. Consequently, a majority of ET graduates receive degrees in their major only. Therefore, it is important to engage students early on to explain the full extent of the educational possibilities available. When students are presented with a clear picture of the available pathways, many become prime movers in developing a plan for earning a multi-faceted degree.

FAP offers a higher degree of curricular flexibility to all ET programs. To accomplish this, elective courses must be used in a systematic way to meet a desired outcome. Within ET programs, there are two types of elective courses: professional electives and technical specialties. Both are contained in each ET program; however, the number of credits varies. Hence, the degree of flexibility that FAP offers depends in part on the number of available elective courses within a major. On the plus side, some program curricula already contain courses that are required for a minor or an associates degree in another discipline.

Within a given major, some pathways have traditionally been more popular than others. This is driven largely by which course bundles best fulfill the student's goals and desires. The design of FAP incorporated these leanings as shown in the Technology Program Matrix shown in Table 1. Three distinct areas of study may be seen: Business Advantage, Arts & Communication and Technical Depth. Customized pathways were developed to meet the needs of each of the five programs.

Within Business Advantage, there are six unique minors available. A subset of these minors, ranging from three to five, is shown by program. This range is driven by the number of available vs. required courses that can be exploited within the curriculum, i.e. particular curricular flexibility. In Arts & Communication, there are four unique minors available. Students majoring in AuET may choose between Communication and Cinema/Film, and AET students may choose between Fine Arts and Art History. Those who want to expand their Technical Depth may choose between a minor or an associates degree. Work is underway to expand the Technical Depth options by offering a concentration in photonics, mechatronics and minors in EET/CET.

It is interesting to note that AuET majors have the most flexibility ranging from a minor in Business to a minor in Arts & Communication or Technical Depth in three disciplines. To date, the most popular choice among AuET majors has been the associates degree in EET since it only requires two additional courses. For MET students, interest appears to be rising for an AS EET degree since their curriculum already contains five electronic courses.

**Table 1 - Specific FAP curriculum options for each ET program.**

<b>Technology Program Matrix</b>			
<b>Program</b>	<b>Business Advantage</b>	<b>Arts &amp; Communication</b>	<b>Technical Depth</b>
<b>MET</b>	<ul style="list-style-type: none"> <li>• <b>Business Admin</b></li> <li>• <b>Management</b></li> <li>• <b>Entrepreneurship</b></li> <li>• <b>Marketing</b></li> </ul>		<ul style="list-style-type: none"> <li>• <b>AS EET</b></li> <li>○ <b>EET minor</b></li> <li>○ <b>Photonics</b></li> <li>○ <b>Mechatronics</b></li> </ul>
<b>EET</b>	<ul style="list-style-type: none"> <li>• <b>Business Admin</b></li> <li>• <b>Management Information Systems</b></li> <li>• <b>Entrepreneurship</b></li> <li>• <b>Management</b></li> <li>• <b>Marketing</b></li> </ul>		<ul style="list-style-type: none"> <li>• <b>AS CET</b></li> <li>• <b>MET minor</b></li> <li>○ <b>AUT minor</b></li> <li>○ <b>CET minor</b></li> </ul>
<b>CET</b>	<ul style="list-style-type: none"> <li>• <b>Business Admin</b></li> <li>• <b>Management Information Systems</b></li> <li>• <b>Entrepreneurship</b></li> <li>• <b>Management</b></li> <li>• <b>Marketing</b></li> </ul>		<ul style="list-style-type: none"> <li>• <b>AS EET</b></li> <li>• <b>Computer Science minor</b></li> <li>• <b>Networking</b></li> <li>○ <b>Mechatronics</b></li> </ul>
<b>AuET</b>	<ul style="list-style-type: none"> <li>• <b>Business Admin</b></li> <li>• <b>Management</b></li> <li>• <b>Marketing</b></li> <li>• <b>Entrepreneurship</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Communication</b></li> <li>• <b>Cinema/Film</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>AS EET</b></li> <li>• <b>AS CET</b></li> <li>• <b>MET minor</b></li> </ul>
<b>AET</b>	<ul style="list-style-type: none"> <li>• <b>Business Admin</b></li> <li>• <b>Marketing</b></li> <li>• <b>Management</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Fine Arts</b></li> <li>• <b>Art History</b></li> </ul>	
Legend: <ul style="list-style-type: none"> <li>• <b>Currently in place</b></li> <li>○ <b>Future offering</b></li> </ul>			

To assist faculty and staff with implementation and tracking, FAP worksheets were created. These worksheets identify the courses required, both within and outside the curriculum, to complete a specific pathway. The worksheet for MET that focuses on a minor in Business Administration is shown in Table 2. Color coding is used to highlight specific course prerequisites and requirements.

**Table 2. Sample worksheet for MET – Business Admin minor.**

Mechanical Engineering Technology B.S.					Bulletin Year: 2006-2007						
Degree Credits: 129					Degree Total Credits 129						
Proposal - MET Flex Plan #1					Credits required: 129						
Business Administration Minor					Completed: 0						
					remaining: 129						
					% completed: 0						
Course	Name	Cr	Inst /Sem	Cr	Grade	Course	Name	Cr	Inst /Sem	Cr	Grade
<b>SEMESTER 1</b>						<b>SEMESTER 2</b>					
EN 111	English I: Expos Comm	3		0		MET 123	Material Sci f/ Eng Tec	3		0	
ET 111	Intro to Eng Tech	1		0		MTH 122	Precalc for Techs	3		0	
MET 116	Manufacturing Process	4		0		ECT 365	Program for Tech	3		0	
MTH 112	Coll Alg for Techs	3		0		PHY 120	Alg-Based Phys I	4		0	
AUC	All-University Curric	3		0		AUC	All-University Curric	3		0	
		14	Credits	0				16	Credits	0	
<b>SEMESTER 3</b>						<b>SEMESTER 4</b>					
CH 110	College Chemistry I	4		0		EN 241	Eng II: Tech Comm	3		0	
MET 236	Statics	3		0		MET 243	Mechan of Mat f/ Tech	4		0	
MTH 232	Calculus I for Techs	3		0		MTH 241	Calculus II for Techs	3		0	
PHY 121	Alg-Based Phys II	4		0		H/SS	H/SS - EC 101	3		0	
AUC	All-University Curric	3		0		AUC	All-University Curric	3		0	
		17	Credits	0				16	Credits	0	
<b>SEMESTER 5</b>						<b>SEMESTER 6</b>					
ECT 245	Elec/Electron Fund	4		0		ECT 355	Indust Elec & Actuator	4		0	
ES 220	Graphic Communication	2		0		ES 221	Adv. Graphic Comm	3		0	
MET 363	Machine Design I	4		0		MET 470	Thermo I for Eng Tech	4		0	
MET 365	Fluid Mechanics I	4		0		TS	Technical Specialty	4		0	
MTH 352	Diff. Equations for Techs	3		0							
						EXTRA	Business Elective	3			
		17	Credits	0				15	18	0	
<b>SEMESTER 7</b>						<b>SEMESTER 8</b>					
ECT 364	Industrial Instrumen	4		0		MET 482	Senior Design Project	3		0	
EN 481	Eng III: Adv Tech Com	3		0		MET 484	Automation Systems	4		0	
MET 475	Kinematics & Dynam	3		0		PE	Prof Elec - MKT 310	3		0	
PE	Prof Elec - AC 210	4		0		PE	Prof Elec - FIN 310	3		0	
PE	Prof Elec - MGT 310	3		0		TS	Technical Specialty	4		0	
		17	Credits	0				17	Credits	0	
<b>Total Credits</b>		<b>129 c plus Bus Elec = 132</b>									
Acceptable											
<b>Business Administration Minor</b>											
<b>Prerequisite Requirements</b>						<b>Courses used for Prerequisites</b>					
M 110	Model'g Elem Func	credit from MTH 112									
CS 110	Intro to Computers	credit from PG 111, CS 111 or ECT 365									
EC 101	Intro to Econ.	H/SS elective									
<b>Requirements for the Minor</b>											
AC 210	Fin Account'g	Prof Elec #1									
MGT 310	Man Org Behavior	Prof Elec #2									
MKT 310	Prin of Market'g	Prof Elec #3									
FIN 310	Bus Finance	Prof Elec #4									
Appvd Bus Elec must take in addition to total MET program											
<b>Total Program Credits</b>		<b>132</b>									

## **How is FAP Being Implemented?**

Ownership by both parents and students is critical to the success of FAP. Hence, its implementation is being done in a comprehensive way rather than simply depending on the advising process to drive participation. Several milestone events have been identified as key opportunities to promote the benefits of FAP and ensure that they are clearly and consistently communicated:

### **1. INFORM PROSPECTIVE STUDENTS ABOUT FAP**

- Marketing Collateral - CETA publishes and distributes program-oriented brochures throughout the academic year. Most are mailed to prospective students or handed out at open house events. All ET brochures contain a section on FAP to stimulate interest and awareness. The College and Department web pages currently under construction will also include FAP specific content.
- Open House Events - During the fall semester, four recruiting events are held. Prospective students and their parents are invited to these one day open house affairs designed to showcase the benefits of attending the University of Hartford. A portion of the day is devoted to the academic offerings of CETA including break-out sessions for those interested in specific ET programs. These sessions feature faculty presentations followed by Q&A. The purpose is to have an informal exchange of information with prospective applicants and their families. Break-out sessions have turned out to be ideal vehicles to discuss the merits of FAP.

### **2. ENGAGE CURRENT FRESHMEN IN CREATING EDUCATIONAL ROAD MAP**

- 1<sup>st</sup> Year Orientation - Another opportunity to communicate FAP occurs during first-year orientation. Students who have committed to attend the University of Hartford along with their parents are invited to attend. The primary purpose of these events is to ensure that the admissions process, financial aid planning and registration for first semester classes are successfully completed. FAP is now included on the agenda for both incoming first-year students and their parents. Beginning in fall 2006, ET freshmen are continuously educated on the benefits of a multi-faceted degree and how important it is to create a personalized road map early.
- ET 111 - Each first-year ET student is required to register for a one-credit freshmen dialog course. Multiple sections of this course are offered so that class size can be kept small. In addition, students from small ET programs are placed in the same orientation section to foster a sense of community and assist them in forming study groups and bonding within their major.

CET, EET, MET, and TBD students were already clustered in the same sections of ET 111 and the FIG for retention purposes. In the designated section of ET 111, we began to provide guidance directed toward the specific majors, possible associate degrees and minors. In ET 111, students learn the importance of course planning and the details of the FAP educational road map. Interested students carefully select a sequence of course

electives that complement other required courses by the major. Initiating this activity during the first year is preferable due to the high credit load required by ET programs.

### 3. ADVISE STUDENTS PARTICIPATING IN TECHNOLOGY MATRIX

- Academic Advising – This is the final opportunity to present and discuss FAP options and follow up on how the student is progressing both within their major as well as with any minor, associates degree or technical concentration they may have chosen to pursue. Worksheets as shown in Table 2 are a valuable resource during the advising process since faculty may not be versed in all FAP pathways. Additional support is available from student services personnel who have in depth knowledge and experience over the full range of academic areas.

### Conclusions

Since formal FAP implementation began in AY 2006-07, we have seen increased enthusiasm and interest from students and parents alike. The number of inquiries and selection of FAP-related options has increased thus helping to stabilize and in some case increase program enrollment. The reception at open house events continues to be strong as we have become more effective at presenting the benefits and extent of the educational choices available.

While many engineering technology programs are experiencing enrollment declines, FAP has helped strengthen several of our majors and created renewed interest in others. It has also enhanced the competitive advantage of our larger ET programs that are experiencing more competition from other institutions.

Our plan is to train faculty and staff to be more effective in informing, engaging and advising prospective and current students, provide additional multi-media materials of FAP's different pathways, and finally, extend FAP to our international student community as a way of bolstering this segment of CETA's population.

### Bibliography

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