
AC 2011-499: LESSONS LEARNED OFFERING A COMBINED BS ENGINEERING (WITH COOPERATIVE EDUCATION) AND MBA

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Abstract

The development and implementation of a combined Bachelor of Science in Engineering with a Master of Business Administration program is described. The paper articulates the characteristics of combined degree programs and enumerates the lessons learned in the implementation so that other universities interested in pursuing a similar approach can learn from this experience. The first cohort of students graduate June of 2011 and their reflections on the program are provided.

Background

With the support of the Industrial Advisory Board, the College of Engineering & Applied Science at the University of Cincinnati created the **Accelerated Engineering Degree (ACCEND)**^{1,2} programs in 2002 to provide opportunities for students to complete both a Bachelor of Science and Master of Science in engineering disciplines. The programs take advantage of the structure of the cooperative education program to provide both experience in the profession and the opportunity to accelerate degree completion. The ACCEND programs require that students meet all the requirements of the undergraduate degree and the graduate degree, however, students accelerate the completion of both the BS and MS through three mechanisms:

1. Students typically enter the University with advanced placement through participation in AP coursework or Post-Secondary Education Opportunities
2. Students participate in 5 terms of cooperative education, as compared to 6 for traditional students. ACCEND students thus have one additional term of coursework.
3. ACCEND students take a course through distance learning while on cooperative work assignments

The ACCEND programs are a significant factor in the College's efforts to meet the goals of the University's Academic Master Plan. In particular, these programs encourage academic excellence, create additional academic opportunity for students, and provide a mechanism to increase enrollment, particularly enrollment of domestic students in graduate programs.

With the encouragement of the College's Industrial Advisory Board and building on the success of combined BS Engineering with MS Engineering programs, the University initiated a combined BS Engineering with Master of Business Administration program in the fall of 2006.

Program Description

The College offers undergraduate engineering degrees in nine programs. All programs have a mandatory co-operative education component and require five years to complete. The Engineering – MBA ACCEND programs combine the undergraduate engineering degree with the Master of Business Administration so that students can complete both degrees in 5 years by

accelerating degree completion through the mechanisms described above. An example curriculum for the EE – MBA program is provided in Figure 1.

Freshman Year											
Summer			Autumn			Winter			Spring		
Advanced credits (e.g. ENGL 101, 102 and 12 cr BoKs)	18		CHEM 101	Chemistry I	4	CHEM 102	Chemistry II	4	MATH 253	Calculus III	4
			EECE 150	Intro to ECE	1	MATH 252	Calculus II	4	MATH 257	Calculus Lab III	1
			EECE 151	EECE Lab	2	MATH 256	Calculus Lab I	1	EECE 175	DigSysDes	4
			Math 251	Calculus I	5	PHYS 201	Gen Physics	4	PHYS 202	Gen Phys	4
			BoK		3	PHYS 211	Gen Phys Lab	1	PHYS 212	Gen Phys Lab	1
						EECE 180	SW Meth	4	BoK		3
									COOP 120	Prof Devel I	1
	18				15			18			18
Sophomore Year											
Summer			Autumn			Winter			Spring		
			PHYS 203	Gen Phys	4	Co-OP/DLC			STAT 361	Prob & Stats I	3
			PHYS 213	Lab	1				MATH 273	Diff Equations	5
			EECE 250	Network Anal I	4		BOK	3	EECE 338	Micro Des&Int	4
			ENGL 492	Technical Writ	3				EECE 251	Network Anal II	4
			MATH 264	Calc & Anal IV	5				COOP 120	Prac Eval	
					17			3			16
Pre-Junior Year											
Summer			Autumn			Winter			Spring		
Co-op/DLC			EECE 473	EM Fields I	4	Co-OP/DLC			EECE 352	Elec. II	4
			EECE 351	Electronics	4				EECE 474	EM Fields II	3
			EECE 343	Sig & Sys I	4		Qual Control	3	EECE 490	Control Sys	3
			EECE 349	Meas. Lab	3		(Tech Elect)		EECE344	Sig & Sys II	4
			PHYS 276	Mod Phys Engr	3					MBA Course	4
			COOP 120	Prac Eval					COOP 120	Prac Eval	
	0				18			3			18
Junior Year											
Summer			Autumn			Winter			Spring		
Co-op/DLC				Prof Option	3	Co-op/DLC			EECE 482	Solid State II	3
			EECE 481	Solid State Elec	3				EECE 466	Elec Des Lab	3
ENGR 613	EngEconAnal	3	EECE 465	Elect Lab	3		Eff Tech Orgs	3	EECE 501	EE Sr. Proj	3
	(Tech Elect)			EE Sr Elect	3		(Prof Option)			MBA Course	4
				MBA Course	4					MBA Course	4
			COOP120	Prac Eval					COOP 120	Prac Eval	1
	3				16			3			18
Senior Year											
Summer			Autumn			Winter			Spring		
EECE 502-3	EE Sr. Proj	6		EE Sr. Elect	3		EE Sr Elect	3		MBA Course	4
MATH 410	Discrete Math	3		EE Sr Elect	3		EE Sr Elect	3		MBA Course	4
	MBA Course	4		EE Sr Elect	3		MBA Course	4		MBA Course	4
	MBA Course	4		MBA Course	4		MBA Course	4		MBA Course	4
				MBA Course	4		MBA Course	4		MBA Course	4
		17			17			18			20

Figure 1 BS Electrical Engineering & Master of Business Administration

While there are some variations among programs based on the undergraduate curriculum, all follow a similar pattern. There are five quarters when the student is on a co-operative education work assignment. In the EE – MBA program, a student will take a distance learning course during four of the co-op terms. Students are permitted to begin the graduate coursework prior to

completing all undergraduate degree requirements. The first MBA course is typically taken during the student's third year but there is considerable variability in this schedule based on both the discipline curriculum and the student's preparation.

The MBA courses are not specifically called out in the program curricula. Because of the variability in when the MBA courses are first taken, academic advisors in the MBA program work with each student to determine the appropriate course.

Transition from Undergrad Status to Graduate Status

In all the ACCEND programs there comes a point in completion of the curriculum that a student's status changes from an undergraduate student to a graduate student. In almost every case this happens prior to the student completing all of the undergraduate degree requirements. There are a number of factors that need to be considered as to when this transition occurs including: scholarship and financial aid needs, undergraduate curriculum completion, undergraduate vs. graduate tuition rates, and external factors.

Students in the ACCEND programs are not required to complete a graduate application to be admitted into the graduate program. To be admitted, students must be in good academic standing (cumulative gpa of 3.0 or better and no course deficiencies), they must submit GMAT scores, and they must complete a University "transition form".

Students in the Engineering – MBA program are transitioned from undergraduate status to graduate status prior to the start of the autumn term of the 5th year. A significant factor in this decision was the acknowledgement that MBA programs are evaluated based on enrollments in the fall of the year. Engineering students typically have higher than average scores on the GMAT test. The group of Engineering – MBA students had an average GMAT score of 654 while the average score for the remainder of the incoming students was 558. Thus it is a significant advantage to the MBA program to have a cohort of engineering students enrolled in the fall. Transcript records reflect the students' undergraduate coursework and grades in the engineering program and the coursework and associated grades in the MBA program.

Issues to Consider

There are a variety of issues and characteristics that must be dealt with in order to have a successful program. Many were identified during the program development but others only became apparent during program implementation. These are discussed below.

Curriculum Development – The obvious challenge is developing a plan that allows students to work ahead of the traditional schedule without requiring additional courses to be taught or significant changes to the traditional curriculum. A related consideration is to construct the curricula of the various disciplines (Electrical, Mechanical, etc.) such that the timing of the MBA courses (that is when during the curriculum they are required) varied as little as possible. Consistency enables the College of Business to offer the needed courses most efficiently.

One issue with allowing students to work ahead of the traditional curriculum is the possibility that students complete undergraduate requirements early then leave the program without completing the graduate degree. While there are certainly situations where this scenario is

appropriate, it can be a disadvantage to the student and the college for students to leave prior to completing both degrees. A student who leaves early will have to finish on a part-time basis often in another location where there may be issues getting particular courses. When a student leaves early, the program completion rate suffers and there is lost income to the college. As the curricula were developed, consideration was given to keeping required undergraduate courses throughout the last year of the program. The senior design project usually provides this constraint in that it may not be possible to offer that course(s) out of sequence. In the case of the Electrical – MBA program in Figure 1, it is typically not possible to complete all of the Senior Electives (EE Sr Elec) prior to the 5th year.

Advanced Placement – Completing both degrees in five years requires that students are ahead of the traditional curriculum. Students are best able to complete the program on time if they enter the college with advanced placement. Many students have significant advanced placement, but not all. On advice of the University Admissions Office, the College did not make advanced placement a requirement for admission to the ACCEND programs. Since some high school students (typically in urban or rural settings) do not have opportunity to participate in advanced placement programs, requiring advanced placement could be viewed as a form of discrimination that selectively discriminates against certain groups.

Students who do not have advanced placement have several options for completing the program. Students can add an academic term between the 1st and 2nd year, students can take additional courses during the academic terms, and / or students can take an additional quarter and finish after the summer of the 5th year. In general, students are discouraged from the first option since it would result in 5 – 6 academic quarters with no break. For most students this leads to “burn out” and a greater propensity to leave the program. Since MBA courses are available during the summer, the option to stay for one additional term is usually the best option.

Academic Advising – Given the curriculum constraints described above and the varying levels of advanced standing of entering students, academic advising becomes both more difficult and more necessary if students are to complete the program per the established schedule. The College has a Director of ACCEND Programs who provides “big picture” advising that is available to all students. Discipline specific academic advising is also provided by having a faculty member responsible for this function in each program. These faculty advisors consistently describe the difficulty of this function. Students consistently describe the lack of this function as one of the most significant issues they face.

Retention – Persistence of students in engineering programs is always a significant issue. Measuring and understanding persistence in a dual degree program is perhaps more multi-faceted than traditional programs. Students can be admitted directly into the traditional major or the dual degree programs. A straight “cohort retention” analysis of students who enter in year one and are retained in the same program in years two and three indicates that fewer students are retained in the dual degree programs than in traditional programs. For example, in the dual degree program in Civil Engineering 53.3% of the initial cohort returned to the program in year 2 and 20.0% of the initial cohort returned in year 3. For the traditional Civil Engineering program, 80.6% of the initial cohort returned in year 2 and 71.0% of the initial cohort returned in year 3. However, an analysis of students who enter a dual degree program in year one and stay in the

college indicates that the retention is as good as or better than retention rates in traditional programs. For example, in the dual degree program in Civil Engineering 86.7% of the initial cohort returned to the college in year 2 and 73.3% of the initial cohort returned in year 3.

A student who is admitted into a dual degree program has made a decision as a 17 or 18 year old that they want to obtain specific undergraduate and graduate degrees. While some fraction of those who are admitted have a good understanding of the academic workload and career opportunities, most students do not. It is not surprising then when a student elects to change programs from the dual degree program (say BS Mechanical Engineering –with MBA) to the traditional program (BS Mechanical Engineering). Some faculty in the college take the point of view that a low retention rate in the dual degree programs indicates that students are misled. The program director takes the point of view that what matters is college retention, not program retention. This continues to be a topic of discussion.

Student Information – There are a host of issues related to student tracking that are a result of the nature of the program and the design of data tracking systems. Several examples are provided. While students are admitted to a dual degree program, within the data tracking system used by the University, a student can only be undergraduate status or graduate status. This becomes an issue when a student transitions from undergraduate status to graduate status but has not yet completed graduation requirements for the undergraduate program. Several actions are taken at the University level based on enrollments in programs. Email listservs are updated each academic term and students who have transitioned to graduate status will not be included on undergraduate listservs even though it is essential that they still receive undergraduate-specific information. This requires manual intervention to maintain the proper lists.

Receiving honors at graduation and certain other distinctions are dependent on a student's grade point average. Graduate courses do not count toward a student's cumulative undergraduate GPA however. Students in the dual degree programs will have completed a number of graduate courses prior to completing the undergraduate degree requirements. The data tracking system is not robust enough to differentiate between an undergraduate GPA and the graduate GPA so this must be done by hand calculations. Since students in the dual degree programs are some of the most academically successful students, this is an important consideration.

Participating in certain University organizations is dependent upon a student's status. To be part of the student government for example, a student needs to be an undergraduate. Students in the dual degree programs who have transitioned to graduate status have been flagged as ineligible for student government posts they have been elected to. This requires coordination and communication to address.

Scholarships and Financial Aid – Many of the dual degree program students receive university scholarships that are renewable based on academic credentials. These are directly tied to student status, so a student who transitions from undergraduate status to graduate status will likely lose the university scholarship. While students in graduate engineering programs typically receive a university graduate scholarship, engineering students who pursue MBA program typically do not even though they have very similar undergraduate academic records to those in graduate engineering programs. This can lead to the situation where a student is “penalized” (by not

receiving the graduate scholarship) for being a strong academic student in a prestigious program. Within this situation there are many things to consider including the value of obtaining both degrees in an accelerated fashion, student out-of-pocket costs, availability of other scholarships, and the message sent to prospective students.

Government oversight of federal financial aid looks for potential abuse of aid programs. A situation where students are allowed to receive aid they don't deserve based on their status is considered problematic. This and other considerations result in University financial aid offices valuing consistency. This level of consistency is difficult when students have varying amounts of advanced placement and therefore potentially transition to grad status at varying times. The fact that some students transition to graduate status during academic terms different than other students is a source of contention between the College and the financial aid office.

Cost and Value of the Program - Tuition for the MBA program is almost twice that of undergraduate tuition rates so the change to graduate status results in a significantly greater financial burden for students. A typical MBA program requires at least 4 terms of full-time enrollment. In the ACCEND programs, a student is typically an undergraduate for 10 academic terms and a graduate student for 3 academic terms so the total cost for both degrees is significantly lower than if both were earned sequentially. A student however, may overlook the value received and focus instead on the situation that his peers in traditional programs are paying about half what he is paying during the 5th year.

Historically, state subsidy for programs has been based on full time equivalent enrollment in specific courses. Subsidy for engineering programs is significantly higher than subsidy for business programs, even at the Master's level. In considering how income derived from enrollments is split between two colleges a thorough understanding of income generated from tuition and subsidy is needed as well as the cost of instruction in the two colleges. For this program, the University was not willing to modify standard accounting models that would permit an equitable distribution of funds. The two colleges developed a memorandum of understanding between them that permits distribution of resources based upon a mutually agreeable model.

Lessons Learned

For Colleges interested in developing dual degree programs, especially programs that span two Colleges, the following are offered to help facilitate program development and implementation.

- Identify all units that need to have input on curriculum, scheduling and other academic issues and include these units in the program approval process. These units include: program faculty (from both Colleges), College curriculum committees, the individual or unit who certifies students for graduation, and potentially the Provost's office.
- Identify all units that make decisions and take action based on student data. These include: the academic program, College administration, the Registrar's Office, the Bursar's office, the Financial Aid office, the Admissions office and potentially libraries, athletics, and recreation. Keep these units informed about the program and student status in the program.

- Communicate frequently and sufficiently so as to keep everyone informed. This will be the most difficult task to do well.
- Establish purposeful and appropriate academic advising for students. Individuals who provide this function must be well versed in the curriculum with a complete understanding of pre-requisites and course sequencing.
- Facilitate group meetings for all students in the program. Bright students will figure out how to overcome many issues and they are best equipped to communicate this information to peers. Provide opportunities for this type of information sharing and for students to hear the questions and concerns raised by other students.
- Develop an appropriate and accurate program description for prospective students. Try to convey the value as well as the cost of the program. Also help students and families clearly understand program rigor, course requirements, and opportunities provided. Establish routine communication with the Admissions office to ensure information is being accurately conveyed to prospective students.
- Develop a financial plan that accounts for program income and expenditures so that a clear picture of the value of the program is understood prior to launching the program. Share a draft of the plan with other university units who may identify characteristics you have not included.
- If the program will have students change to graduate status prior to completing undergraduate degree requirements, establish a process that provides an appropriate demarcation between the two programs and informs all who need to know of the change in the student's status.
- Strive for as much consistency as possible among programs.
- Have one individual serve as the "point person" or program manager who can take the lead when unforeseen issues arise; because they will occur. A responsible individual provides a consistent source of information regarding the program and will be more efficient at addressing problems as they occur. Important decisions will require the approval of college faculty and administration but a program manager can facilitate data collection and a decision making process.

Student Success

In the fall of 2006 fifty-one students were admitted into the first cohort of Engineering – MBA programs. Twenty-five students (49% of the initial cohort) are scheduled to graduate in the spring or summer of 2011 after completion of both the undergraduate program and the MBA. Of the twenty-six who left the program, sixteen transitioned to traditional programs in the College (total of 80% graduating from engineering). The average freshmen to graduation retention rate in the college is 58%.

A focus group was held with the students who will be completing the programs in 2011. Items that the students highlighted as significant are summarized below.

The MBA coursework has already proven to be beneficial in their co-operative work assignments. The content and knowledge gained through business courses has helped in the work setting and enabled students to identify broader solutions / approaches to work problems than they could with only the engineering perspective. These items are consistent with other studies of characteristics that help engineers be effective in the workplace.³

Co-operative education provides sufficient experience in the workforce to have a context and an appreciation for MBA coursework.

They observe that the methods of teaching and pedagogy used in business courses differs substantially from engineering courses. The differences and the mix of pedagogies are appreciated and enliven the students' academic experience.

Academic advising has been an issue for some, particularly in the early days of the program when some faculty were not familiar with the program. Likewise understanding if an academic question should be addressed to Engineering or Business was an issue at times.

The most significant issue was knowing the actual cost of the program: when did undergrad rates apply and when did grad rates apply? What scholarships were available and for what terms? (Authors note – the university administration of this type of program went through significant revision during the past 4 years).

Communication on expectations and schedule requirements could be improved. This was particularly true of the transition from undergraduate to graduate status.

When students selected the program as high school seniors most choose the option because the opportunity sounded attractive and the value provided through an accelerated completion of degree requirements was compelling. A smaller number indicated they selected the program because they wanted to have the skills to be an entrepreneur.

As they are completing the program, the students indicate that the program provides a better breadth to contribute to the workforce and opens opportunities for their careers. One student related that when a recruiter realized the student would have both degrees the recruiter indicated that the range of positions open to that student was about double that of a student with just the Bachelor of Science degree. Another student related that his employer offered 10% more in salary because of the MBA.

All students indicated that peers (working professionals) recognized the value of the combined degree and encouraged students toward completion.

Conclusion

The combined BS Engineering with MBA has attracted strong student interest and appears to be valued by potential employers. Students in the program were able to complete both degrees in

the same 5 year time frame that their peers in the traditional programs completed just their undergraduate degree. Co-operative education is a significant factor in providing an appropriate context for the program because it provides a necessary framework for understanding the workplace. Students in a program that did not include co-operative education would be at a disadvantage. The College will continue to develop the combined Engineering – MBA programs so the combination is available in every undergraduate major. In addition, working with industry partners the Engineering and Business colleges will continue to refine and improve the program so that students and employers receive the maximum benefit possible.

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