Imparting teamwork skills across the business-Engineering interface

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ABSTRACT

Auburn University's Business-Engineering-Technology (B-E-T) minor enrolls selected business and engineering students. It is intended to diminish the silos mindset and teaches "Launching of new products in cross-functional teams." This two-year, lock-step minor (1) promotes teamwork across the business-engineering interface, (2) encourages learning among students, and (3) imparts entrepreneurship skills. Evidence from data shows that, over a two year period, B-E-T graduates show measurably better teamwork skills over peers, and business students learn from engineers and vice versa. Conclusions are: cross-functional teamwork skills can be developed among students of distant and diverse disciplines over long periods (two years) of teamwork on multiple projects.

Key words: Business-engineering interface, cross-disciplinary teamwork; engineering and business students.

INTRODUCTION

Engineers and business professionals make decisions and work together in technology firms. However, colleges of business and engineering have become examples of the worst form of silos and inculcate a silos mind-set in their respective graduates. Practitioners lament that it takes them years to strip the silos mentality from new hires from colleges through their on-the-job training and experience. Teamwork is the key to the success of multi-disciplinary decision making. However, it is uncommon to find business and engineering students working together for a sustained period of time.

WHAT IS THE INNOVATION HERE?

A two-year, lock-step, six-course, sixteen-credit, joint minor for business and engineering students to teach “launching new products through cross-functional teamwork” is innovative. This program’s innovation lies in overcoming traditional obstacles such as:

1. The silo mindset that prevails in colleges,
2. a sense among engineering students that business subjects are too “soft,”
3. a sense among business students that engineering is too mathematical and see no value in working with engineers,
4. the challenge of team-teaching courses with senior business and engineering faculty,
5. the “ice” between business and engineering students that needs to be broken as they learn to work harmoniously with each other,

6. the time needed on the part of students to work on numerous team projects which are more time consuming that an average individual class assignment,
7. producing graduates who have gained measurable skills in teamwork with students from another college.

The following are key items that led to the success of this program:

1. Support of both deans—both believers and one of them a champion of the program.
2. A small core of six faculty members from among 350 strong faculty members in both colleges combined designed and delivered the program.
3. An independent Center positioned in-between the two colleges directs the program. Student applications are invited; admitted students are high achievers.
4. Six courses were carefully designed by the team of six faculty members. The courses ensured that students learned to "launch new products through teamwork."
5. Students were trained in teamwork.

A JOINT PROGRAM FOR BUSINESS AND ENGINEERING STUDENTS

The program has two major components; one addresses sustained development of cross-functional teamwork skills among business and engineering students, and the other imparts business and engineering knowledge to build a foundation of entrepreneurial skills in the students. The unique two-year, lock-step program (16 semester credits) for business and engineering students in their junior and senior years is offered through a Center with links to both colleges. This program, which began in fall 2001, is a joint effort of the colleges of business and engineering. The program admits equal number of business and engineering students to the program that starts each fall lasting two years (four semesters). The program now has a capacity of 20 business and 20 engineering entering students each year.

The students must apply to this competitive program in their sophomore year (classes begin in their junior year) and have a minimum GPA of 3.0 and the class average GPA of the two entering classes has been about 3.5 (average GPA for the colleges is about 2.8). Over the two-year period, the students are expected to:

1. Develop cross-functional teaming knowledge, skills and abilities (KSA).
2. Learn to depend on team members from other disciplines.
3. Business students learn to understand engineering students and learn to ask the right questions about engineering problems and vice versa. Business students begin to understand how engineers "think" and vice versa.
4. Show marked improvement in the confidence with which students handle problems that have a mixture of engineering and business content regardless of their major.
5. Pick up the necessary skills to address engineering and business issues necessary to be a successful independent entrepreneur, or an intrapreneur within large corporations.

A program to impart sustained cross-functional teamwork in students

The two-year B-E-T program strives to build strong and lasting cross-functional teamwork skills among cohorts over a two-year period. Cross-functional teamwork skills in B-E-T students are developed through workshops, instruction, and several team projects in the six courses forming the B-E-T minor. The program courses are:

ENGR/BUSI 3510: **Introduction to Business and Engineering**
ENGR/BUSI 3520: **Integrating Business and Engineering Theory and Practice**
BUSI 3530: **Entrepreneurship and E-Commerce**
BUSI 4540: **Strategic Management of Technology and Innovation**
ENGR/BUSI 4970 and 4980: **Capstone Project I (1 credit) and II (3 credits)**

Program delivery

A summery of the program as delivered is itemized below.

1. Engineering and business students are jointly enrolled in and learn in cross-functional teams in six custom-designed courses that are taught by engineering and business faculty teams.
2. The program requires *collaboration among faculty from engineering and business*. As many as 10 teachers from the two colleges participate in the program.
3. The program used extracurricular day-and-half-long summer retreats for students to develop their teamwork and leadership skills.

Step-wise Teambuilding and Teamwork

In the B-E-T program, a step-wise approach is taken for building teamwork skills and abilities. The steps are:

1. The program starts with an outdoor teamwork retreat (low-ropes course).
2. Each semester, multi-disciplinary student teams are assigned to several product development and decision-making team projects in teams.
3. On the average, during the two years of the B-E-T program, graduates in 2004 reported that they worked in 25 student team projects versus eight for the average graduate from the two colleges (see Table 2, Row 11). Some courses such as the Capstone Projects I and II are mostly or exclusively team-project based. They parallel the “senior design projects” required of all engineering students in engineering colleges.

OVERVIEW OF THE STUDY AND METHOD

The study’s goals were to assess what the program accomplished in regards to:

1. Statistically measurable teamwork skills acquired by B-E-T students (multi-disciplinary team skills).
2. Information source for student team members on business and engineering topics.

Establishing Auburn University norms on teamwork skills

In order to study Item 1 above, data were collected from graduates in spring 2003 and 2004 on questions 1 through 10 in Tables 1 and 2; norms for Auburn University graduating seniors who are peers to BET students compares BET students against the norm. Item 2 was studied using two questions shown in Appendix I. The norms were derived from responses from non-BET graduating students in the colleges of business and engineering in 2003 and 2004. This approach to assessment has been used by others [2].

Questionnaire

Survey questionnaire was administered to graduating seniors at the end of the academic years 2002-2003 and 2003-2004, when the first and second cohorts of BET students graduated. The questionnaire items are included in Tables 1 and 2, which compare BET students against the norm developed in 2003 and 2004. As regards the questions on teamwork, Item 1 in Table 1 is similar to a question in Wang and Kleppe's [2] questionnaire .

In 2003, data were gathered from 97 engineering, 157 business students and 11 B-E-T students a week before graduation, and in 2004, data were gathered from 67 engineering, 102 business students, and 19 B-E-T students. BET student responses are compared against Auburn University norms in Tables 1 and 2.

FINDINGS

BET students score significantly higher than their peers in teamwork skills

Table 1 compares BET graduates of 2003 against the norm on teamwork skills. Based on the t-scores reported in the table, BET students have scored themselves statistically higher on items 4, 5, 7 and 10; which are:

1. I encouraged all team members to participate in team decisions (Item 4; p =.08).
2. I used "active listening" techniques in the team (Item 5, p = .09).
3. I helped to define individual and shared responsibilities in the team (Item 7; p = .007)
4. I strived for consensus in our team decisions (Item 10, p = .025).

Table 2 compares BET graduates of 2004 against their peers from the two colleges. The statistical significances for the items 1-10 reported in Table 2 shows that BET students show marked differences from their peers in regards to ALL items except Item 8, which reads, ""I volunteered for team duties and roles." This is not necessarily a learned "skill."

One question raised by the study: Why are the B-E-T graduates in 2004 significantly different in 9 items versus only four in 2003? The sample size of B-E-T students being 11 in 2003 may explain the lack of significance partly. The larger sample of 19 in 2004 brings out the difference in 9 out of the first 10 items.

Students' source of information on business and engineering issues

In response to the questions in Appendix I we found that the library is never used by members of student teams (multiple responses allowed, n= 19):

Information source	Engineering information	Business information
Internet	17	12
Lectures, etc.	5	10
Library	0	0
Engineering students	8	1
Business students	0	7

Clearly, the Internet is the primary source of information to B-E-T teams, more so for engineering information than business information. It is notable that lectures provided business information to relatively high number (10) of students while lectures were a source of

information to only five students. Note that a large proportion of students provided information to team members on engineering or business issues. In an end-of-semester debriefing, students were emphatic about the value of learning from team members from distant disciplines; often engineering students were cited as the source of engineering information for business students.

CONCLUSIONS

Rarely, if ever, undergraduates from business and engineering colleges are prepared to work together in the workplace for technology-intensive firms of the 21st century economy. It is quite a challenge to bring about a smoothly working collaboration between two colleges given to a silo mindset. The B-E-T program has succeeded in imparting teamwork skills in students from the two colleges. It is our hope that it would be a model for other institutions interested in building teamwork among business and engineering students. We also hope that the product development slant of the program would serve as a model for other institutions considering a joint program.

The study reported here provides evidence over two consecutive years that the program graduates consider themselves better equipped with teamwork skills to work in diverse multi-disciplinary teams composed of business and engineering students; we hope it will help them make easy transition into the workplace. Anecdotal evidence from our graduates indicates that they fit into teams in the workplace faster than their peers and are able to take on responsibilities faster. The evidence provided here should interest other engineering and business colleges in the USA to work together in preparing the workforce for technology-intensive firms.

We found that the success of the program depends on academically above average students (GPA of >3.0). The challenge of working with students from another college and the challenges of product design in such teams cause students with lesser GPA to drop out after the first semester.

In summary, we have succeeded in teaching teamwork for sustained periods in a joint program for business and engineering students. It is our hope that other campuses would follow this lead.

References: (may be obtained by contacting the lead author)

Appendix I

Q1. When faced with difficulties related to decision making or solving problems in BET courses or projects that require engineering related information, which of the following sources of information do you prefer to utilize (pick one) ? Choices were: The Internet; Information from BET course lectures; The library; Engineering students; Business students; Other sources not listed above.

Q2. When faced with difficulties related to decision making or solving problems in BET courses or projects that require business related information, which of the following sources of information do you prefer to utilize? – **Same options as Q1.**

Table 1: BET students against Auburn University norms on teamwork 2003.

Scale: 1 = I strongly disagree; 10 = I strongly agree

	Questionnaire items	Bus n = 157	Engg n = 97	BET n = 11	All n = 252	BET vs All (t-test)	Signi-ficance
1	I felt comfortable among my team members	8.9	8.5	9.4	8.7	-2.1	0.56
2	I discouraged undesirable conflicts in the team	7.8	8.1	7.8	7.9	0.1	0.91
3	I was effective in managing conflicts within our team	8.1	7.9	8.1	8.0	-0.13	0.90
4	I encouraged all team members to participated in team decisions	8.1	8.1	8.9	8.1	-1.9	0.08*
5	I used "active listening" techniques in the team	8.4	8.0	8.8	8.3	-1.8	0.09*
6	I was able to monitor and provide feedback to individuals on individual team member performance	8.1	8.0	8.1	8.0	-0.1	0.92
7	I helped define individual and shared responsibilities in the team.	8.5	8.1	9.0	8.3	-3.0[a]	0.007***
8	I volunteered for team duties and roles	8.9	8.6	8.9	8.8	-0.4	0.72
9	I helped team members to stay on the task (agenda) during meetings	8.2	8.0	8.1	8.1	-0.0	0.99
10	I strived for consensus in our team decisions	8.4	8.4	9.1	8.4	-2.5[a]	0.025**

[a] = equal variance; * = p < 0.1; ** = p < 0.05; * **= p < 0.01

Table 2: BET students against Auburn University norms on teamwork skills, 2004.

	Questionnaire items	Bus n = 102	Engg n = 67	BET n = 19	All n = 188	BET vs All (t-test)	Signi-ficance
1	I felt comfortable among my team members	8.45	8.67	9.53	8.64	4.2	<0.01***
2	I discouraged undesirable conflicts in the team	7.32	7.64	8.74	7.53	1.82	0.04**
3	I was effective in managing conflicts within our team	8.05	8.15	9.39	8.03	2.58	<0.01***
4	I encouraged all team members to participated in team decisions	8.22	8.21	9.05	8.29	5.2	<.01***
5	I used "active listening" techniques in the team	8.05	7.68	8.74	8.02	4.96	<0.01***
6	I was able to monitor and provide feedback to individuals on individual team member performance	7.92	7.92	8.89	7.97	2.32	<0.01***
7	I helped define individual and shared responsibilities in the team.	8.06	8.31	8.72	8.16	2.85	<0.01***
8	I volunteered for team duties and roles	8.42	8.85	8.74	8.56	-0.10	0.45
9	I helped team members to stay on the task (agenda) during meetings	7.68	8.12	8.84	7.86	3.2	<0.01***
10	I strived for consensus in our team decisions	7.89	8.12	8.84	8.03	2.77	<0.01***
11	Teams I participated in the last 2 years	5.43	7.34	25.83	7.89	10.35	<0.01

* = p < 0.1; ** = p < 0.05; * **= p < 0.01