AC 2009-190: STUDENT EVALUATIONS OF SPONSOR INTERACTION IN A CAPSTONE INTERDISCIPLINARY SENIOR DESIGN PROGRAM

Peter Schmidt, University of North Carolina at Charlotte

Peter L. Schmidt received his bachelor's degree in mechanical engineering from the University of Louisville, a master's degree in mechanical engineering from the Rose-Hulman Institute of Technology and his doctorate degree in mechanical engineering from Vanderbilt University. He is currently an assistant professor at the University of North Carolina at Charlotte. He has served as a research associate and as an instructor at Vanderbilt University. He has also worked at the Naval Surface Warfare Center in Crane, Indiana; at Precision Rubber, now part of Parker Hannifin in Lebanon, Tennessee; for CDAI in Atlanta, Georgia and at UTC / Carrier in Lewisburg, Tennessee. Dr. Schmidt is a member of the ASEE and a licensed professional engineer in Tennessee and Georgia. He is also a member of ASME, ASHRAE, ASA and INCE. Dr. Schmidt's research interests include aeroacoustics and ultrasonics, and has authored several journal and conference papers on these subjects.

James Conrad, University of North Carolina at Charlotte

James M. Conrad received his bachelor's degree in computer science from the University of Illinois, Urbana, and his master's and doctorate degrees in computer engineering from North Carolina State University. He is currently an associate professor at the University of North Carolina at Charlotte. He has served as an assistant professor at the University of Arkansas and as an instructor at North Carolina State University. He has also worked at IBM in Research Triangle Park, North Carolina, and Houston, Texas; at Ericsson/Sony Ericsson in Research Triangle Park, North Carolina; and at BPM Technology in Greenville, South Carolina. Dr. Conrad is a Senior Member of the IEEE and a Certified Project Management Professional (PMP). He is also a member of ASEE, Eta Kappa Nu, the Project Management Institute, and the IEEE Computer Society. He is the author of numerous books, book chapters, journal articles, and conference papers in the areas of robotics, parallel processing, artificial intelligence, and engineering education.

William Heybruck, University of North Carolina at Charlotte

William Heybruck received his Ph.D. in Electrical Engineering from the University of North Carolina at Charlotte in 2001. Prior to becoming the Director of the UNC Charlotte College of Engineering Industrial Solutions Laboratory he was a Senior Engineer for Hitachi Global Storage Technologies specializing in the Microdrive and automotive hard disk drives. Prior to Hitachi, he was Product Development Manager for the Wireless products at IBM. He has three patents in the field of test technology.

Daniel Hoch, University of North Carolina at Charlotte

Dan Hoch is a faculty associate in the Engineering Technology Department at the University of North Carolina at Charlotte. He teaches courses in the Mechanical Engineering Technology department such as machining practices, senior design, and thermodynamics. Dan's areas of interest are related to thermal fluid design, internal combustion engines, and energy conversion. Prior to his current position at UNC-Charlotte, Dan worked for Mercury Marine in Fond du lac, Wisconsin developing 2-stroke and 4-stroke engines and propulsion systems. After completing his graduate studies at the University of Wisconsin, Madison, Dan spent two years working as a research engineer in the Mechanical Engineering Department at the UW-Madison focusing on cryogenic and thermal fluid systems.

Deborah Sharer, University of North Carolina at Charlotte

Deborah Sharer earned her B.S., M.S. and Ph.D. from the University of North Carolina at Charlotte. Dr. Sharer is currently an Associate Professor in the Engineering Technology

department at UNC-Charlotte. Dr. Sharer was the first woman Ph.D. graduate from the Lee College of Engineering at UNC-Charlotte. Prior to joining the faculty in 2001, She was an assistant Professor of Electrical Engineering at John C. Smith University. She has also worked as a Test Engineer at the Electrical Power Research Institute (EPRI) in Charlotte. Dr. Sharer's research interests include assessment and modeling of the behavior of microelectronic devices and solid state materials. She has served in numerous mentoring and educational roles for undergraduates, high school and middle school students.

Linda Thurman, University of North Carolina at Charlotte

Linda Thurman is currently the Faculty Associate for Student Professional Development and Student Success for the Lee College of Engineering at The University of North Carolina at Charlotte. She has nine years of experience in higher ed. Prior to coming to the university she held positions as a technical recruiter and a senior account executive in the technical recruiting and sales industry for companies in both Chicago and Charlotte. She completed her graduate internship at United Airlines-Chicago O'Hare Airport and at their headquarters. Ms. Thurman holds a Masters degree in Industrial/Organizational Psychology from Roosevelt University, Chicago, Illinois. She is a member of NACE (National Associate of Colleges and Employers) and served as the 2007-2008 president of the American Business Women's Association (ABWA) University Chapter.

Nabila (Nan) BouSaba, University of North Carolina at Charlotte

Nan is a faculty associate in the Electrical and Computer Engineering department at the University of North Carolina at Charlotte. She teaches courses in Computer engineering and Senior Design. Nan's area of interest is in computer security. Nan receive her B.S. in Electrical Engineering and her M.S. in Computer and Electrical Engineering from North Carolina A&T University. Prior to joining the faculty at UNC-Charlotte, Nan worked in development and test engineering for Solectron Technology , and for IBM Corporation in Charlotte.

Patricia Tolley, University of North Carolina at Charlotte

Patricia Tolley is Assistant Dean for Student Development and Success in the Lee College of Engineering at the University of North Carolina at Charlotte. Ms. Tolley also holds an appointment as an Associate professor in the Engineering Technology Department. She received a BS in Mechanical Engineering and an MS in Mechanical Engineering from UNC Charlotte in 1988 and 1991, respectively. She is a registered Professional Engineer in NC. Prior to coming to UNC-Charlotte, she worked as a practicing engineer, consultant, and manager for Duke Energy.

Martin Kane, University of North Carolina at Charlotte

Martin Kane earned his Ph.D. degree in Civil Engineering from Michigan State University (East Lansing, Michigan) in 1995. He also earned his BS in Civil Engineering (1990) and MS in Civil Engineering (1991) from the College of Engineering at MSU. Dr. Kane is currently an associate professor and Undergraduate Director in the Department of Civil and Environmental Engineering at the University of North Carolina at Charlotte. His research interests include Highway Operations, Transportation and Urban Planning, Human Factors in Transportation, Public Transportation, Traffic Engineering, and Aviation infrastructure. Dr. Kane is an Eno Fellow, and is a member of ASEE, ASCE, ITE, Sigma Xi, and Chi Epsilon.

Student Evaluations of Sponsor Interaction in a Capstone Interdisciplinary Senior Design Program

Abstract

One possible benefit to students of an industrially sponsored capstone senior design program is the ability to try working with a particular organization prior to committing to full time employment. This can also be viewed as an incentive to sponsoring organizations as a way to observe students before making a permanent hiring decision. The student population in the program analyzed is composed of Millennial generation students (born between 1982 and 2002), who expect a fun work environment, competitive compensation and benefits, company paid training and travel opportunities along with a flexible work schedule. As experience in the classroom has shown, the Millennial student does not respond to traditional instructional techniques as past experience might indicate. This readjustment must also be made by employers in general and by first line managers in particular.

Assessing the experience that students had with an interdisciplinary capstone senior design course provides valuable insight into workforce expectations and areas for management style adaptation to maximize retention of technical staff. This work details and evaluates the responses received from students taking an anonymous survey of their experiences working with technical contacts associated with sponsored design projects. This body of knowledge is important for faculty in capstone design programs to understand, and more importantly, to communicate to sponsoring organizations when soliciting involvement with their programs. The authors make specific recommendations for managers of Millennial students based on these surveys and end-of-project discussions with industry participants. The major observation is that students had a poor impression of the management they experienced during these projects, and few would consider employment with the organization sponsoring their projects. Lessons learned in developing and implementing an Interdisciplinary Senior Design Program that meets learning objectives, prepares students to successfully transition into the workplace, and meets employers' needs is shared.

Introduction and Class Overview

This study takes place at the William States Lee School of Engineering at the University of North Carolina at Charlotte. The program discussed in this work is designed to be an introduction to workplace practices and expectations for students during their senior year of study at the undergraduate level in Engineering and Engineering Technology. The authors participate in two roles in the program, as instructors and as faculty mentors for individual projects.

Each project in the program is composed of a team of Engineering and Engineering Technology students as dictated by the scope of work generated by the project sponsor and approved by the

faculty. These teams are usually, but not always, multidisciplinary in nature. Project teams are a minimum of two students and a maximum of four students. A typical organizational structure is shown in Figure 1.

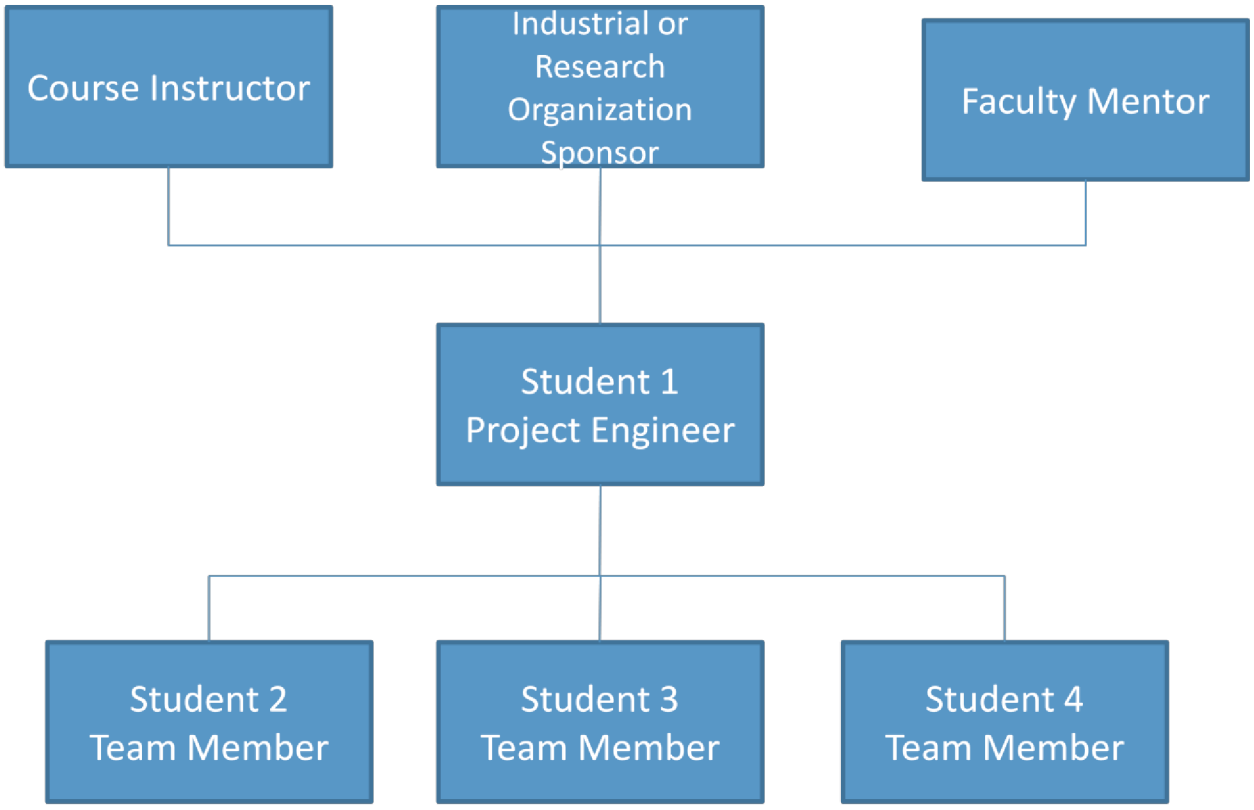

Figure 1. Project Group Organizational Structure

This program is a two semester series, with conference style poster presentations expected of the students at the termination of each semester. The work over the two semester sequence is composed of a project management component, a technical design component and an implementation of design component. Students are assessed on all three components, as well as peer assessments at the end of each semester of the sequence.

The class is structured in a lecture format meeting once per week in the first semester, and twice per week in the second semester. The lectures introduce students to the project planning and management documents that they will produce during the two course sequence, as well as reviewing technical writing, revisiting the engineering design process as well as a session on determining project requirements and defining functionality.

As shown in Figure 1, each project team interacts with three counselors: the course instructor, the faculty mentor and the industrial or research organization sponsor. The course instructor provides feedback and assessment of the quality of the individual assignments from the viewpoint of an external technical reviewer. The faculty mentor provides guidance on the

technical progress of the project from an academic standpoint and the organization sponsor provides feedback from the viewpoint of the end user of the work. The faculty mentor provides assistance with technical communication between students and organizational sponsors, acting to ensure that the instructions and requests flowing from an external sponsor are in alignment with the academic goals and expectations associated with the class sequence. The faculty mentor provides guidance on proper technical communications in a professional environment. The faculty mentor also attends meetings with the student group and the organizational sponsor.

Survey Demographics

The general demographics of the College of Engineering where this survey was conducted are as follows:

The student population for the William States Lee College of Engineering is 80% White, 7% Black, 1% Native American, 3% Hispanic and 9% other, with 88% male students[1]. The program admits freshmen and non-traditional students, so ages range from 18 to mid 30s.

The students participating in this survey were divided between seven engineering and engineering technology majors: Civil Engineering, Civil Engineering Technology, Computer Engineering, Electrical Engineering, Electrical Engineering Technology, Mechanical Engineering and Mechanical Engineering Technology. The distribution of students is shown in Figure 2. A total of 30 students responded to the survey, yielding a response rate of about 20%. The low number of Electrical Engineering Technology students is attributable to the fact that this course sequence was added to their curriculum during the time that the study was conducted, leaving few students the option of participating while staying on schedule for graduation. These students comprise 18% of the current program population.

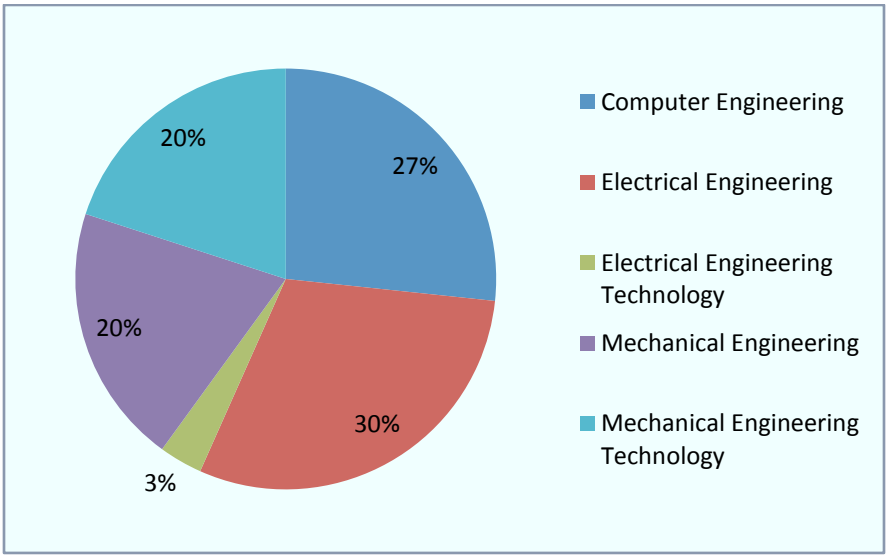

Figure 2. Distribution of respondents by discipline.

Development of the Survey

In an effort to improve the curriculum for students[2] and to provide an attractive outcome for the sponsoring organizations, the committee that runs the capstone program decided to obtain feedback from students on their experiences with the sponsoring organizations. This feedback would then be employed to improve the program results through management of student expectations by faculty and incorporation of helpful information into the sponsor mentoring information distributed to participating organizations.

Since the industrially sponsored program was a new undertaking at the university, no existing survey instrument was available. Rather than trying to find and adapt an instrument in use elsewhere, the committee decided to generate a new survey that would provide feedback that was deemed important to the success of the program. The committee was trying to establish understanding in two basic areas:

Are the students getting quality mentoring from the sponsoring organizations that supports their academic goals?

Are the sponsoring organizations creating opportunities for recruitment from these interactions or are they providing a disincentive for students to choose employment with their organizations?

A first draft of the survey was developed by one of the authors. This survey was then discussed with the committee membership, including tenured faculty, tenure track faculty, non-tenure track faculty, university administration and representatives from the professional development office. Based on the input from these stakeholders, the final survey was produced.

The survey was presented to students via an anonymous web based survey service. The survey was available to students who had finished the two semester sequence for a period of one week after the conclusion of the final design demonstration event. The students were offered no incentive for participation, nor were they penalized for not participating. The relatively low number of participants can be attributed to the voluntary nature of participation, coupled with the fact that the students were in their final semester before graduation. Here is the verbiage used in the survey to encourage the students to participate:

Dear **** Student: We are interested in your perceptions and experiences in the industry sponsored senior design project. Please take 5-10 minutes to participate in a brief survey. Results will be used to identify opportunities to improve the experience for future students. Any information about your participation, including your identity, is completely anonymous. You will not be personally identified in any of the results. Because your responses are anonymous, your final course grade will not be affected by your participation. Although your participation is voluntary, your feedback is critical in helping us identify opportunities for improving the experience for future students. By clicking on the link below, you voluntarily consent to participate in the survey. Thank you for taking time to provide us with valuable information. Best wishes as you prepare for final exams!

Results

Communication Frequency and Modalities

The students' experience with sponsor communication was judged to be one of the most critical aspects of a successfully executed project. This judgment was based on anecdotal evidence gathered from instructors with experience with the predecessor to this program, an ad hoc use of external funding obtained via individual faculty for individual projects. The students were asked how often they communicated with their industry sponsors in person. This kind of direction is important to Millennial students because of their need for attention as well as their generally positive disposition toward adults[3]. Figure 3 shows the frequency of communication that students had with their industrial sponsors.

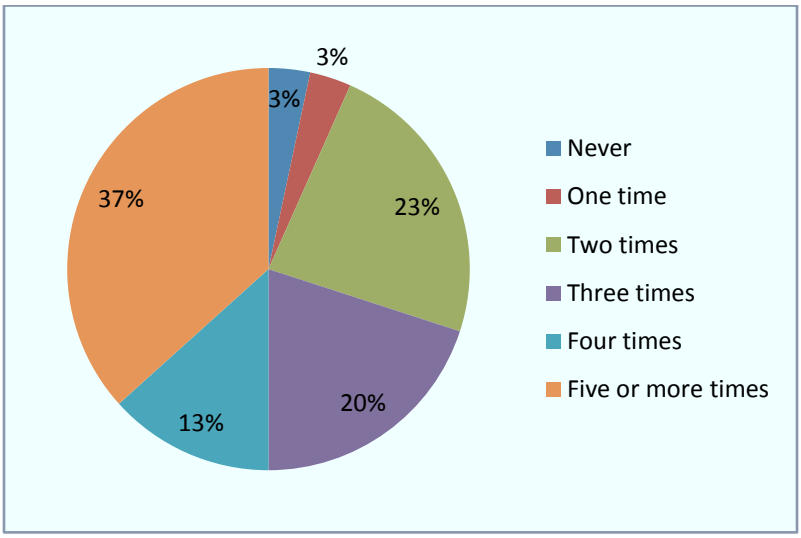

Figure 3. Frequency of personal meetings with project sponsor

This communication frequency was driven by the need for students to produce and submit a progress report every two weeks during the course of the second semester of the program, and the need to communicate with their sponsoring organization about the production of project management documents (schedule, budget, work breakdown structure, etc.) during the first semester.

It is important to identify non-communicative sponsoring organizations from this survey. If sponsoring organizations are found to provide contact representatives who do not support student learning, then these organizations are excluded from participation during the next course sequence if remedial action is not taken. Guidance on participation expectation is always provided to sponsoring organizations before their projects are staffed with students.

The Millennial generation, especially when compared to previous generations of engineering students, is very communicative. In addition to personal interaction with sponsors, these students were using other modes of communication to communicate with project stakeholders. Figure 4 shows the frequency of non-personal interaction with sponsors, and Figure 5 shows the distribution of the types of communication modalities employed by the students.

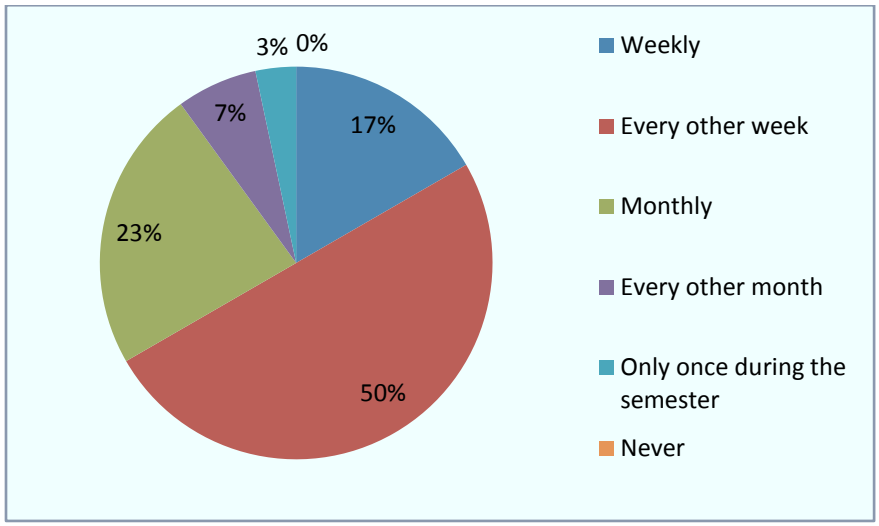

Figure 4. Frequency of communication with project sponsor

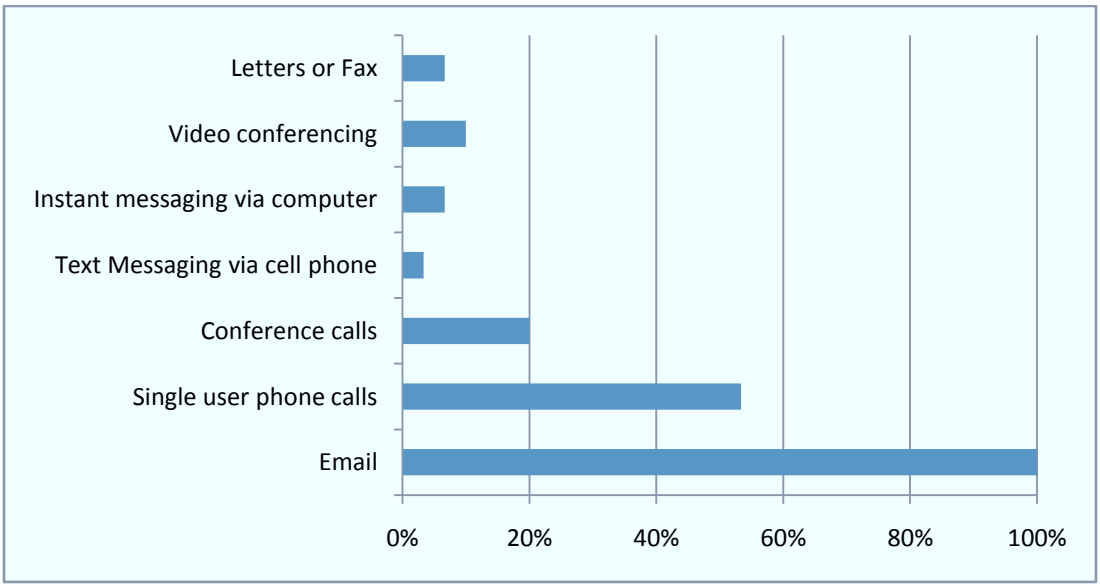

Figure 5. Utilization distribution of selected communications modalities

Communication Quality

The respondents were asked to rate the quality of the communications they received from their industry mentors in terms of timeliness of responses, the completeness of the responses and the

helpfulness of the responses. Millenial students expect that everyone they encounter is plugged in and online 24/7[4]. While the pressures of modern business may require this of higher level managers, line level managers in engineering organizations may not always be amenable to this level of availability[5]. When reviewing these results, it is important to remember that this is a survey of student perceptions. It is those perceptions which will drive the students' opinions of the interaction with sponsors.

Figure 6 details the students' responses to: The industry contact responded to requests for information in a timely manner.

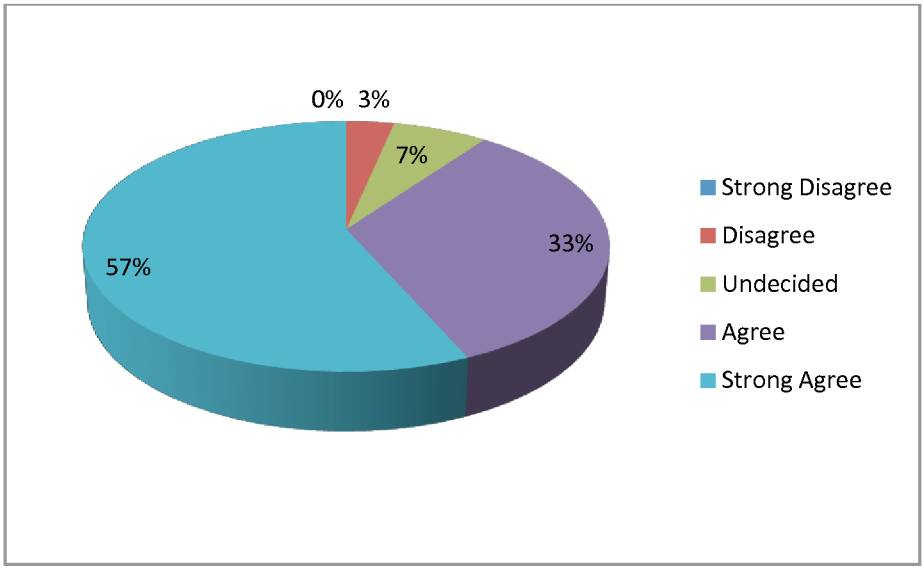

Figure 6. Timeliness of industrial sponsor replies

Figure 7 shows the students' sense of the completeness of the communications they received from their industry sponsor.

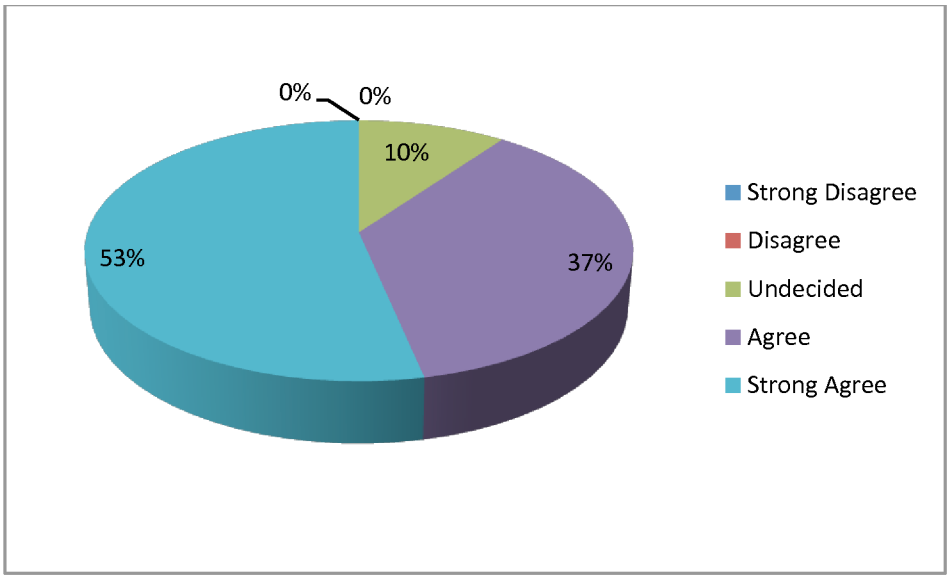

Figure 7. Completeness of industrial sponsor replies

The quality of the guidance received from the industrial contact, as perceived by the students is shown in Figure 8.

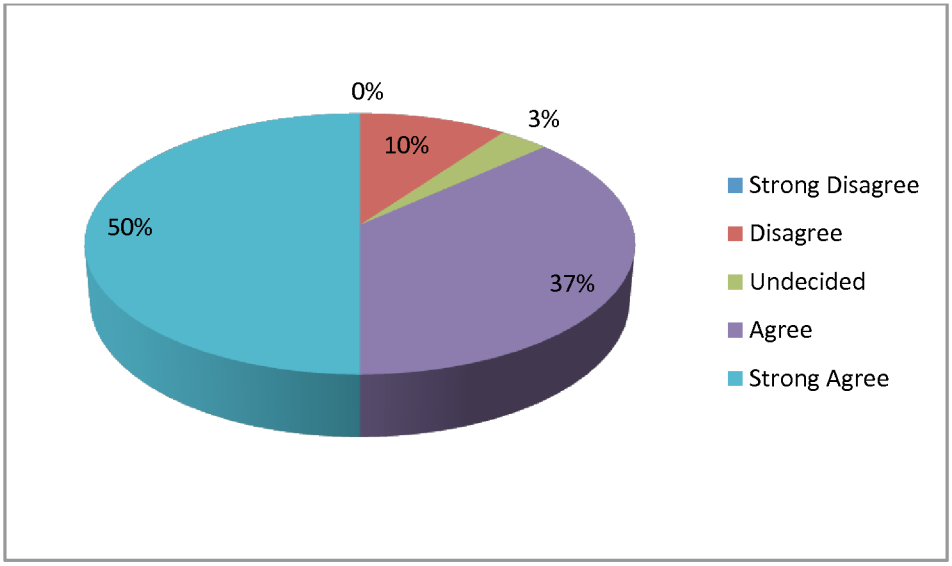

Figure 8. Assessment of helpfulness of industrial sponsor communications

Workplace Comparison

As mentioned in the demographics section, a 90% of the students enrolled in this program have some sort of work experience. Figure 9 shows the data for the respondents. The students were asked to consider work experience that was direct technical exposure to engineering work or positions that were associated with technical work, such as fabrication, manufacturing or other work that would be assigned to technicians.

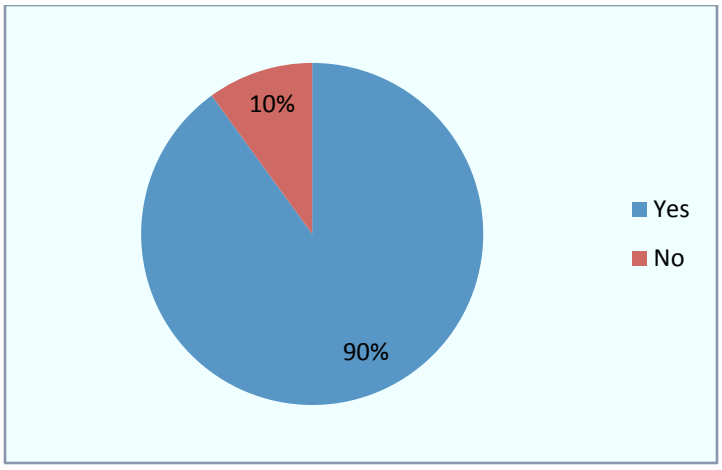

Figure 9. Engineering related work experience of survey respondents

It is important for engineering organizations to be able to compete for workers as the number of available employees shrinks over the next 15 – 20 years. Past practices of technical staff layoffs, assigning engineering staff to non-technical duties and lack of regard for institutional knowledge are now impacting the ability of organizations to perform engineering functions[6]. Traditionally, corporate entities could rely on immigrants to fill engineering positions at attractive wages. New laws, limiting immigration from societies who traditionally supplied these workers, along with increased competition for their services in their home countries has begun to impact the availability of technical workers[7]. The Millennial generation has seen the way their parents were treated by employers and have no delusions about loyalty to any organization. This makes engaging and retaining them a challenge when older styles of management prevail[8].

The students were asked to compare the direction and support they received in this program to what they had already experienced on the job[9]. Millennial students are also looking for nurturing atmospheres in the workplace[10]. Figure 10 details the level of encouragement that respondents received from their industry sponsors.

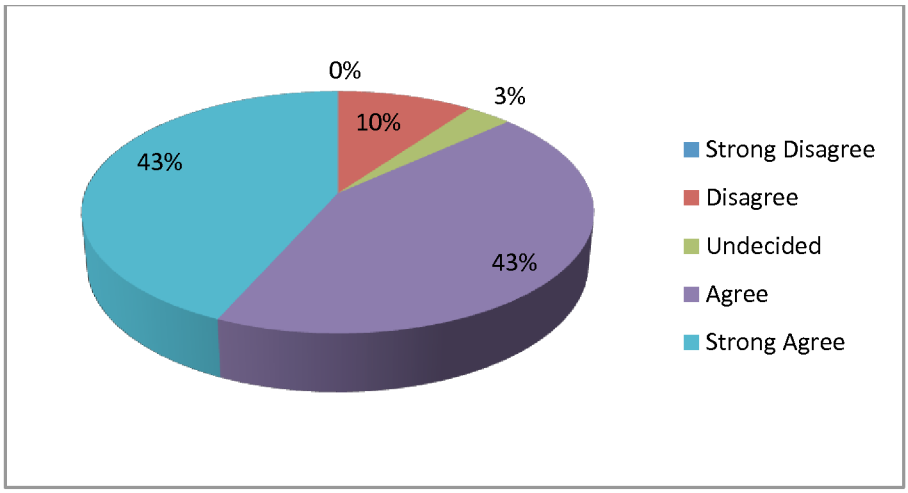

Figure 10. Respondent's assessment of encouragement from industrial sponsors

Figure 11 shows the respondents assessment of the feedback style of their industrial sponsor. Millennial students crave feedback, positive or negative, and react negatively when none is provided[11]. Figure 10 shows the students' assessment of the constructive nature of the feedback they received.

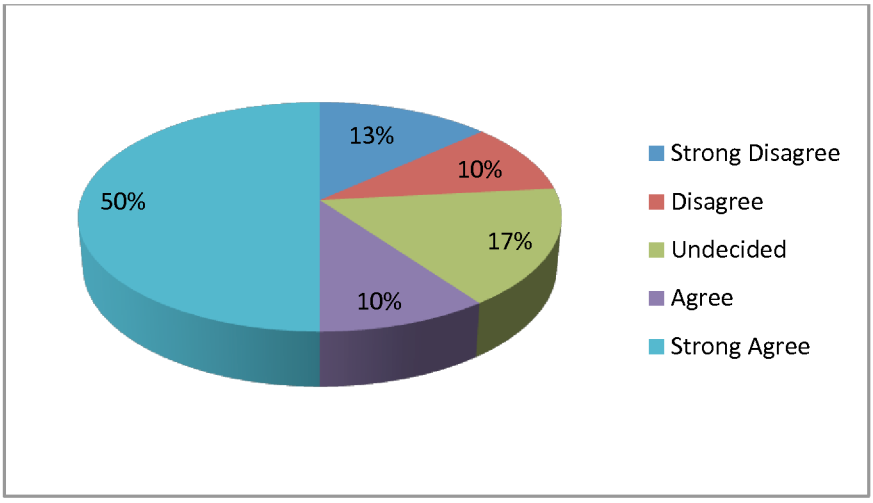

Figure 11. Assessment of whether industrial sponsor's feedback was constructive

Students were also questioned about the interest of their sponsor in their personal professional development. As mentioned previously, Millennial students expect that company paid training will be provided when they accept full time positions. Figure 12 shows their impressions of the sponsor's interest in their professional development. Note that opinions were strong, with 0% showing undecided. The large percentage of students who agreed that their sponsor was interested in their professional development is attributable to the excellent quality, in general, of the contact personnel that have been provided by sponsoring organizations for this program. Conversations with student participants have indicated that the sponsor's contact person is either

very engaged in their work due to the fact that it is a project that they would like to have time to do, or the sponsor's mentor is disengaged due to their high workload.

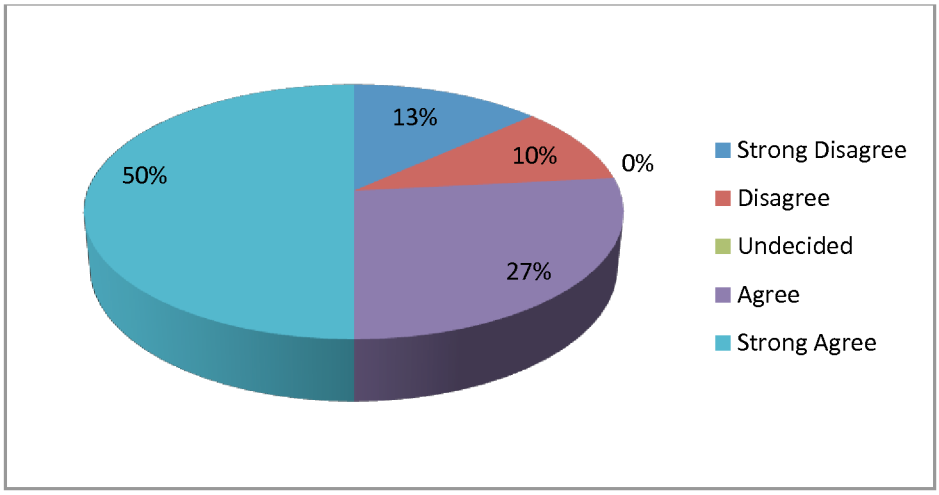

Figure 12. Assessment of sponsor interest in student professional development.

Survey respondents were asked to rate their overall experiences with their sponsors as managers as compared to jobs they were currently holding or had held in the past. Figure 13 describes their responses.

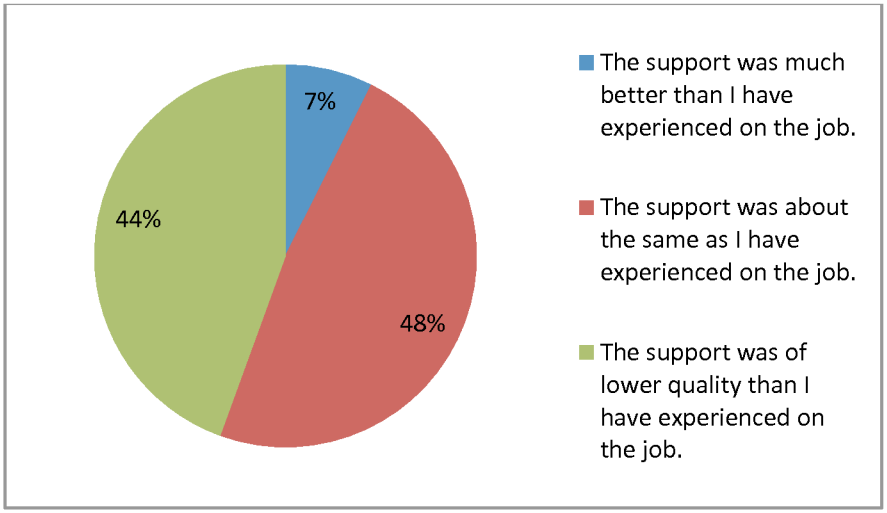

Figure 13. Comparison of sponsor management with past experience

One rationale for participating in this program is for employers to evaluate students as potential hires with minimal monetary risk. The buy in for this program is $5k for a two semester project with 3 to 4 students (roughly equivalent to $5/hour). This compares to a salary for a single student cooperative internship of about $10 - $18 per hour.

The students were asked if they would consider employment with their sponsoring organization, if they had interviewed with anyone and if they had a job offer. Figure 14 shows their opinion.

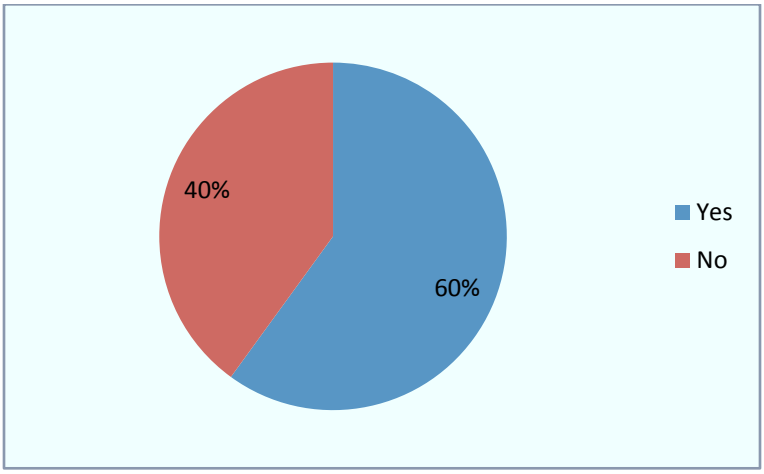

Figure 14. Would you consider full time employment with your industrial sponsor?

After giving consideration to working with their sponsor, students would need to seek employment there actively by submitting resumes or applications via the particular organization's system. A relatively small percentage of students have set up formal interviews with their sponsors, as shown in Figure 15. This could be attributable to sponsors having negative opinions of the students working on their projects or lack of available positions. At the time this survey was conducted, economic conditions were favorable for finding work, with 60% of graduating seniors finding employment or being accepted for graduate study by the time this survey was administered.

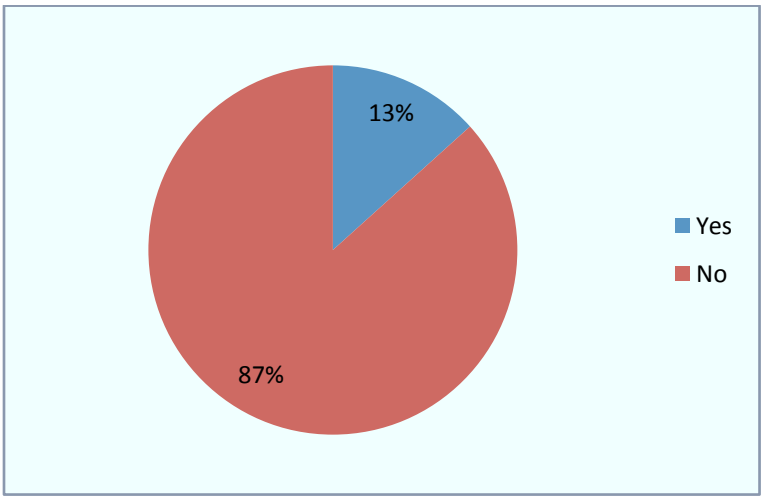

Figure 15. Do you have an interview scheduled with your sponsor's organization?

Sponsoring organizations have had minimal success in recruiting students working on their projects over the period encompassed by this survey, as shown in Figure 16.

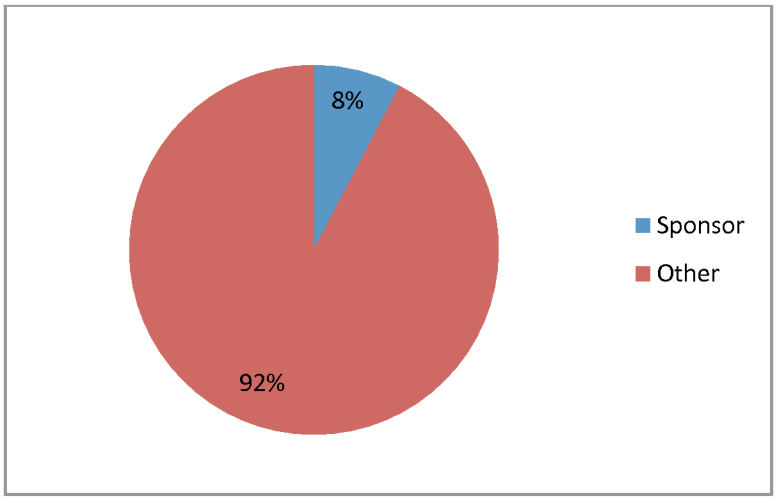

Figure 16. Distribution of accepted job offers

Project Relevance

While the recruitment aspect of these projects is important, it is also important to the students that they be working on projects that they perceive to be real. One of the attractions of this sequence is that the students get to work on real world projects rather than the idealized cases they study in class. It is the responsibility of managers to convey the importance of the work the students are doing. Figure 17 shows the distribution of student perceptions about the importance of their work to sponsoring entities.

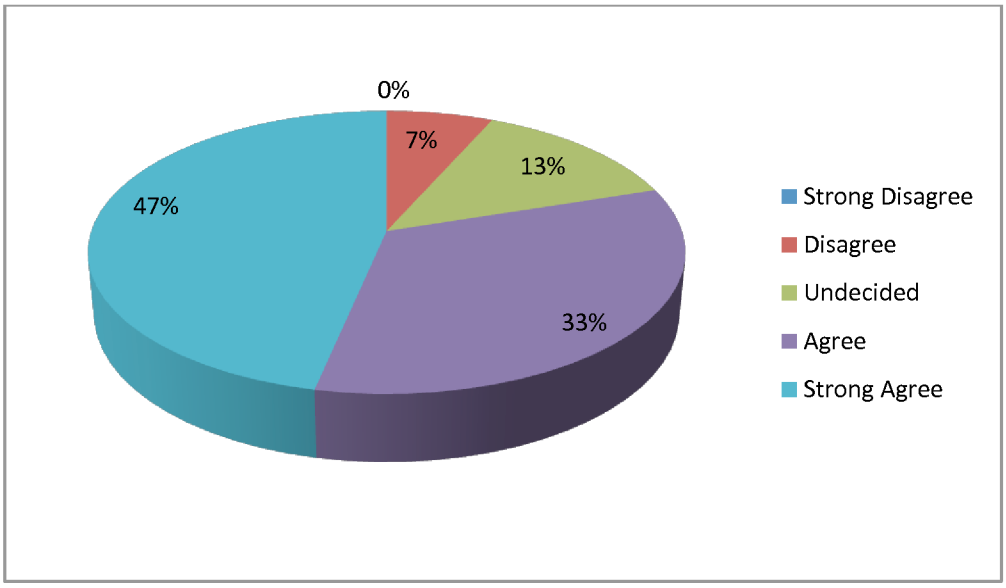

Figure 17. Perception of importance of projects to sponsoring organizations

Respondents were also asked to indicate their perception of the relevance of their projects. Students draw conclusions about the importance of their work based on their understanding of the timeline for implementation of any project (See Figure 18) they are assigned. Note the agreement between the percentage of students who thought their project was "busy work" and the analogous disagreement with perception of project importance.

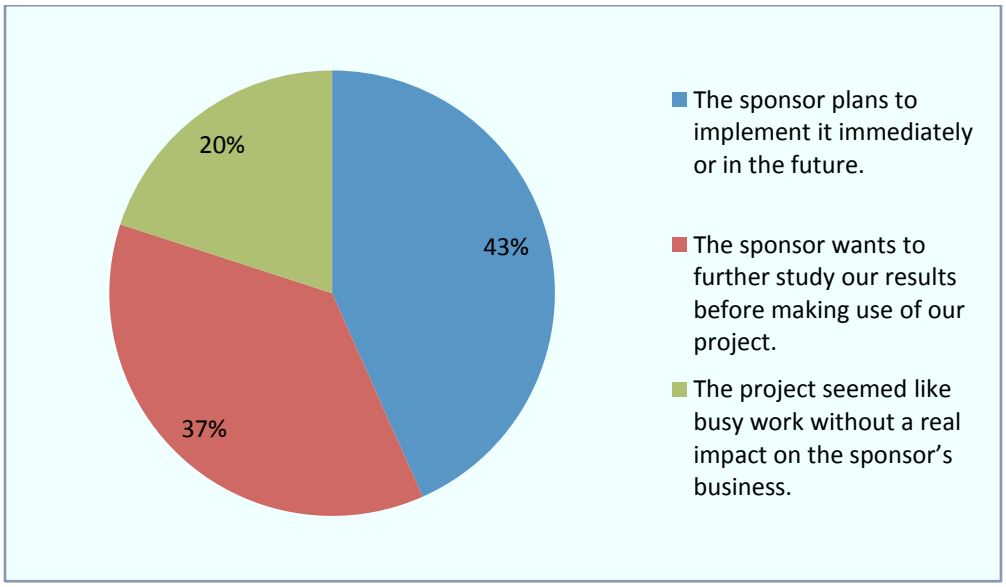

Figure 18. Student perception of relevance of sponsored projects

Discussion of Results

Overall, the sponsoring organizations seem to be doing a good job of communicating with the groups studied within this student cohort. Frequent communication is important to assure that the students stay on task and deliver what the sponsor wants, rather than what they feel is correct.

The preponderance of email communication is surprising, given the fact that these students regularly use text messaging and instant messaging in their conduct of daily life. Perhaps this is a self imposed barrier to keep work and personal matter separate, or it may be a reflection of the lack of integration of these tools into the business world. It is also encouraging that the students feel able to make telephone calls to their sponsors to discuss issues, rather than filtering them through email.

The sponsoring organizations are also doing a good job of making their communications timely, helpful and complete. Students in this program are required to keep project notebooks of the type normally used to document work for a patent. This requirement was reinforced during a meeting with a group and their industry contact, when the industry person produced a similar notebook in which he kept his meeting notes to the amazement of the students in attendance. The industry

sponsor stressed the importance of proper record-keeping and communication to the students that obviously made more of an impression than the lecture they received on project documentation.

An area for improvement from the sponsoring organizations is demonstrated by the lack of encouragement and constructive feedback supplied to a large fraction of respondents. By making more of an effort to recognize desired behaviors and couch feedback in a constructive manner, sponsoring organizations should be able to improve on the results shown in Figure 13. The authors believe that this metric is directly correlated to the willingness of the students to accept jobs with their sponsoring organization.

Recruitment of participating students can also be improved in the area of project relevance. When 1/5 of students feel like their project is irrelevant to the business, they are not engaged, and therefore less likely to be drawn to work for the sponsor. For example, one project currently in progress is for a food manufacturer. This sponsor has effectively communicated that though the project is a mundane exercise in handling packaging, the cost savings realized by smoothing the flow of materials through a warehouse translates to over $2M per year. The students on the project are engaged, and have spoken with material handling equipment manufacturers outside the scope of their project as a result. This quote from a respondent was especially interesting: "Working with an Industrial Sponsor adds the aspect of corporate interaction to the project. [There] is a real chance that the designs and ideas that you form will be utilized by the sponsor and this provides a drive to work hard and produce results."

Conclusions

Survey results for two groups of students participating in the two semester senior design program, (i.e., students from 2 full years of the program) have been presented and discussed. It is suggested that by incorporating a more positive management feedback style, increased student recruitment can be achieved. The following set of guidelines is recommended as a part of structuring a capstone senior design program, based on the feedback obtained during this study:

For Instructors / Faculty Mentors

- Communicate with industrial sponsors about the challenges and rewards associated with working with the Millennial generation of students. Some organizations will have already started training their employees for this change in approach, while others will be taken aback by the challenges presented. Knowledge of organizational culture will be helpful in managing expectations.
- Monitor the communications between the group and the Sponsor. This can be as simple as insisting on being copied on all email communications.
- Encourage the team. Use your experience with longer term projects to help students begin to think in terms of real workplace timescales and expectations.

- Filter negative feedback from the Sponsor. Use your position as a faculty member to deliver negative news in a way that will not damage student confidence or enthusiasm.

For Industrial or Research Project Sponsors

- Facilitate communications whenever possible. Respond in a timely and complete manner to student requests for information.
- Try new technologies. Students are versed in more than just email.
- Encourage the team. Your positive words mean more than you can imagine.
- Praise good work, and be careful with negative feedback.
- Put your best managerial foot forward. The students with work experience will be judging your performance against their favorite supervisor. Talk to students about professional development.
- Make the project relevant. Don't select make-work type projects for students, but select something that they can see will be helpful to your organization.
- Make sure you communicate the project's importance. Back-burner types of work don't get anyone excited.

References

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