

## **AC 2010-506: ALUMNI PERCEPTIONS OF PROJECT MANAGEMENT INSTRUCTION**

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# Alumni Perceptions of Project Management Instruction

## Abstract

After teaching a project-oriented capstone course several semesters, the author observed some teams failed to provide quality solutions for their semester-long, team-based project. The root cause appeared to be poor project management skills. This prompted the author to consider asking alumni, who have demonstrated success leading teams in their careers, what skills they believed were needed to be successful project managers and how they believe project management can be better taught in the university setting.

A population of 34 alumni answered a series of multiple choice and short answer questions through an on-line survey in which the feedback was anonymous to promote candid responses. An online instrument was used to facilitate easy access for participants and automated data retrieval. The work experience of the alumni varied from 16 months to eight years. Their current employment roles varied from junior level engineers to vice president of engineering with a majority serving in some supervisory role.

The survey asked the volunteers to indicate with a Likert scale how well they agreed with the definitions of key project management skills as outlined in the survey instrument. In addition, the volunteers were asked their opinions about how the skill of project management can best be taught and if teamwork skills are the same as project management skills. Finally, volunteers could type out their suggestions for how project management could be better taught in an academic setting.

A significant majority agreed that teamwork skills are essential to success in their job and that they had adequate training on teamwork skills while in college. However, most believed teamwork and project management are not the same skill. An important finding from the study is what the alumni thought about the instruction of project management skills. They believe such skills can be taught in a classroom situation and that the reading of case studies can be somewhat helpful to learn basic concepts. However, they believe the act of managing a project was the best way to learn the skills. In fact, several alumni said that only the team leader of a project is the one learning project management; that the other members are team players, not managers. Consequently, a capstone class, structured as a single project-oriented course, may only be teaching project management to the subset of students who are designated team leaders. A better pedagogy to teach students the essentials of project management, which includes leadership and the accepting of accountability, may be to have smaller scale projects that allow more students to lead the project teams while significant goals are achieved.

## Background and Motivation

The program in which the author teaches is an engineering technology program with the mission of preparing management-oriented engineering technologists. The program contains courses in fluid power, materials, processing, automation, computer-aided design, quality assessment, engineering economics, and management techniques. There is, as well, a capstone class focused upon teams designing and implementing a manufacturing plan that results in a functioning lean production cell. Production rate and product quality are a significant part of the final evaluation of this semester-long project.

Alumni in this study have had at least three types of experience with project management in their academic program. All students have worked several times in small groups, completing laboratory-related course work. All students have also taken a fundamentals of project management course that addresses work breakdown structure, planning, cost estimates, and risk assessment. This course, however, does not have a formal project in which teams of students must execute, monitor, and control a project they planned. Instead, they read case studies and draft a project plan that contains the elements of project management planning. This type of project management course seems to be typical of what is taught in college programs.<sup>1</sup>

Finally, all participants in this study have taken a manufacturing production planning capstone class in which they were assigned complementary roles within a team. Each team is tasked to develop a manufacturing cell layout, fixtures to use in the cell, and work instructions for classmates to use to produce a set of quality products. This is a semester-long exercise in project management that includes planning, cost analysis, execution, monitoring, and control, similar to that employed by others teaching team design projects<sup>2</sup>. Team membership is assigned by the instructor to insure each team has someone competent in computer-aided design, machining, process planning, project documentation, and team leadership. However, the team leader is chosen by the team members. In addition to serving as project manager for the team, the team leader typically undertakes another critical task in the project.

The author found that some teams in the capstone class failed to provide quality solutions for their semester-long team-based project. The cause appeared to be either ineffective teamwork skills or poor project management skills. Were students not being properly trained to work effectively in teams even though they had completed so many small group activities throughout their program? Further, had students not learned how to manage projects after having classroom instruction on the basics of project management?

Effective teamwork is essential to a successfully managed project, but it is not sufficient. Project management requires someone on the team to assume accountability to move the project forward in an efficient and timely manner. Modestly effective teams can be made more effective with proper management. One task of a project manager is to bring team members together at meetings to achieve consensus on how to move forward. Tasks are then assigned to individuals to complete. There is follow-up by the project manager on the quality and delivery of the work associated with the task. If these elements are missing within a capstone team, this could explain why some teams work poorly together.

There has been much written about how to assess and improve teamwork skills in engineering technology programs.<sup>3,4</sup> The author decided to ask alumni how well they thought they learned teamwork and project management skills in their college program in order to determine if the failure seen in the capstone course is attributed to poor teamwork or poor project management. Further, alumni would be asked what changes they would recommend to better teach management-oriented content, including teamwork and project management skills.

## Methods

### *Population*

Alumni were chosen because they are familiar with the curriculum and are professionals with a vested interest in helping the program. Fifty-six alumni were contacted by phone to solicit their participation in the survey. Either a personal connection was made or a message left, giving a brief description of the study and a follow-up phone number. Forty-two alumni contacted by phone volunteered to participate in the survey. Of this number, thirty-four completed the survey. This is an 80% response rate for those voicing willingness to participate and represents a 60% response rate of all the alumni contacted. The author believes the personal communication was critical to the relatively high response rate.

From the background information obtained during the preliminary phone contact, the author knows the work experience of the alumni varied from 16 months to eight years. Their current employment roles varied from junior level engineers to vice president of engineering, with a majority serving in some supervisory role.

### *Instrument*

An on-line survey was developed using the SelectSurvey.net<sup>5</sup> product by ClassApps. The survey consisted of a series of multiple choice Likert scale-type and short answer questions and was configured to allow anonymous input to promote candid responses. The only personal data the alumni provided in the survey was the year of their graduation. The online instrument facilitates easy access for participants and automates the data retrieval and analysis for the researcher.

The survey had two objectives. First, to assess how alumni rated the academic program in delivering relevant skills for their success. This is a program specific goal helpful for general assessment. The latter part of the survey focused upon teamwork and project management. The survey consisted of 75 questions over ten web pages following this outline:

- Mastery of Technical Skills (rating the quality of delivery of technical content)
- Use of Technical Skills (rating the relevance of skill to success in career)
- Mastery of Management-Oriented Skills (rating quality of management-oriented content)
- Use of Management-Oriented Skills (rating relevance of skill to success in career)
- What technical and management-oriented content should be taught today?
- Work emphasis (Is your emphasis technical problem solving or management-oriented?)
- Teamwork Skills (How and when did you learn to be an effective team member?)
- Project Management Skills (How and when did you learn six basic skills?)
- Opinions about learning project management (level of agreement with several statements)
- How can project management be better taught in an academic setting?

Sixteen unique program-level skills were identified. Eight are considered technical and relate to specific learning objectives of the author's program. The others are considered management-oriented and the survey phrasing is similar to the ABET<sup>6</sup> learning objectives *d* through *k*. The wording of the management-oriented skills used are given in Table 1.

Management-Oriented Skills
9. Formulate or design a product, process or program to meet desired needs within realistic constraints such as economic, environmental, health and safety, and manufacturability.
10. Function effectively on teams.
11. Identify, analyze and solve technical problems.
12. Communicate effectively through the use of industry accepted software, verbal and written communication.
13. Recognize the need for and engage in life-long learning.
14. Demonstration of professional and ethical responsibility.
15. Understand the impact of solutions in a global, economic, environmental, and societal context.
16. Committed to quality, timeliness, and continuous improvement.

Table 1 Management-Oriented Skills Assessed During Alumni Survey

A header to each set of questions showed a Likert-type scale to indicate to the participant what their selection indicated. In the sections of the survey asking to rate the curriculum the scale was: 1 - Strongly Agree, 2 - Agree, 3 - Undecided, 4 - Disagree, 5 - Strongly Disagree

For example, when asked to rate how well the academic program **prepared them to master** a specific learning objective, participants were asked to select the appropriate response to the following types of questions (only one from the technical and one from the management-oriented shown):

The program prepared me well in this learning objective.

7. Apply knowledge of mathematics, science, technology, and applied sciences.	1	2	3	4	5
10. Function effectively on teams.	1	2	3	4	5

When asked about the **relevance** of each learning objective, the question phrasing would be:

This learning objective provided skills I needed to be **SUCCESSFUL IN MY CAREER**:

7. Apply knowledge of mathematics, science, technology, and applied sciences.	1	2	3	4	5
10. Function effectively on teams.	1	2	3	4	5

#### *Optional follow-up*

There was an optional follow-up interview where alumni met with the author for two hours, typically at their place of work. The purpose was to have the alumnus show the author first-hand the type of work they do and to allow for a face-to-face discussion of some of their career history and project management experience. Based upon these follow-up interviews, the author learned that the work experience of the respondents ranged from junior process engineers to product designers to production supervisors to a vice president of engineering and production.

## Results and Discussion

The population of respondents varied from 18 months to several years as summarized in Table 2. As mentioned previously, the work experience varied from junior level responsibilities to vice presidential job titles.

Items 1 and 2 in Table 3 show that alumni view themselves as management-oriented technologists. All either strongly agree or agree they are capable of solving technical problems; 91% have similar opinions about their management skills. Overall, technical problem solving and management skills are rated about equally important to their success. Throughout their careers, however, about 70% agree they are assuming more management-oriented responsibilities. During the follow-up interviews, the author learned that the most common job responsibility was that of supervisor.

Graduation Year	Count	
2001	5	15%
2002	2	6%
2003	4	12%
2004	3	9%
2005	9	26%
2006	4	12%
2007	5	15%
2008	2	6%
Total	34	

Table 2 Population

Work Emphasis Questions	strongly agree	agree	undecided	disagree	strongly disagree
1. I am very capable at solving technical problems.	56%	44%	0%	0%	0%
2. I am very capable at managing projects.	56%	32%	9%	0%	3%
3. I am evaluated more for my technical problem solving than for my management-oriented skills.	26%	24%	21%	24%	6%
4. I have assumed more management-oriented (and supervisory) responsibilities over time.	62%	9%	18%	9%	3%

Table 3 Work Emphasis of Alumni

As mentioned earlier, part of the study involved assessing the value of both the technical and management-oriented content in the author's program in meeting the needs of alumni in the workforce. However, only feedback relating to the management-oriented skills is discussed here. Figure 1 illustrates the average ratings alumni gave for the level of mastery they thought they acquired while students, as well as the importance of the learning objective in their career. Note there is a good fit of the level of mastery and importance for all but the latter two: understanding the impact of solutions and commitment to quality. Alumni believe these two skills are important to them in the workforce but not learned well in college. The responses show a statistically significant difference as determined by a dependent group t-test with a 0.05 level of confidence. Table 4 summarizes the t-test data for the management-oriented skill ratings shown in Figure 1. The follow-up interviews also identified the quality assessment skill gap. Many alumni, involved with quality assessment in their job, sensed a deficiency in this area.

The survey addressed a set of six basic project management (PM) skills:

- Understanding Others (listening, communicating)
- Process Planning (scope, schedule)
- Time Management (prioritize, follow-through)
- Negotiation (resolve conflicts over resources)
- Budgeting (cost analysis, procurement)
- Conduct Effective Meetings (agenda, effective decision making)

Edmonson<sup>7</sup> identified a similar skill set for emphasis in a project management course.

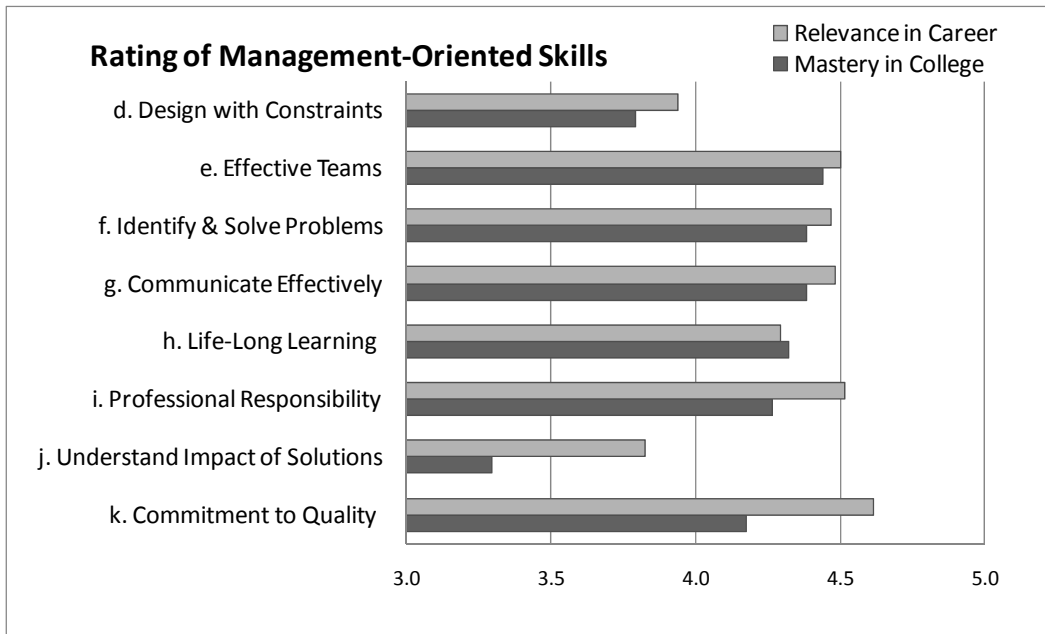


Figure 1 Mastery and Relevance of Management-Oriented Skills

Number = 34, alpha = 0.05	Mean	Std. Dev.	t	P	
<b>d. Design with Constraints</b>	<b>0.147</b>	<b>0.821</b>	<b>1.044</b>	<b>0.297</b>	
<b>e. Effective Teams</b>	<b>0.059</b>	<b>0.649</b>	<b>0.529</b>	<b>0.597</b>	
<b>f. Identify &amp; Solve Problems</b>	<b>0.088</b>	<b>0.570</b>	<b>0.902</b>	<b>0.367</b>	
<b>g. Communicate Effectively</b>	<b>0.103</b>	<b>0.519</b>	<b>1.156</b>	<b>0.247</b>	
<b>h. Life-Long Learning</b>	<b>-0.029</b>	<b>0.460</b>	<b>-0.373</b>	<b>0.709</b>	
<b>i. Professional Responsibility</b>	<b>0.250</b>	<b>0.800</b>	<b>1.822</b>	<b>0.068</b>	
<b>j. Understand Impact of Solutions</b>	<b>0.529</b>	<b>1.051</b>	<b>2.936</b>	<b>0.003</b>	significant
<b>k. Commitment to Quality</b>	<b>0.441</b>	<b>0.860</b>	<b>2.993</b>	<b>0.003</b>	significant

Table 4 T-test summary of Management-Oriented Skills

Table 5 summarizes how important alumni find these PM skills in their career. All respond that time management is either important or very important. Understanding others and process planning also rate highly. Another PM skill rating high in this list is that of "conducting effective meetings", with 94% of respondents saying this was important or very important. The remaining two skills are also judged of importance, with 79% claiming negotiation is either important or very important and 71% claiming budgeting as important or very important.

Importance of PM skills in career	Very Important	Important	Neutral	Unimportant	Very Unimportant
Understanding Others	74%	21%	3%	3%	0%
Process Planning	59%	35%	6%	0%	0%
Time Management	76%	24%	0%	0%	0%
Negotiating	29%	50%	15%	6%	0%
Budgeting	21%	50%	18%	9%	3%
Conducting Effective Meetings	53%	41%	3%	0%	3%

Table 5 Importance of Basic Project Management Skills

Was a foundation for these six basic PM skills laid in college? The data in Figure 2 illustrates the percentage of alumni who checked that particular skill as being learned "during your in-class activities (school projects) while in college". Similar to the findings given in Table 5, the first three skills listed are checked most frequently. Alumni, as shown in Figure 1, believe they received adequate training in teamwork skills. The data in Figure 2 indicate alumni believe they learned less about the PM skills of negotiation, budgeting, and conducting meetings while in college. One way to interpret the trend shown in Figure 2 involves mapping the percentage of responses rating a skill as important or very important against the frequency at which alumni believed they learned those skills in college. This is illustrated in Figure 3. The first three skills are required in teamwork. The latter three skills are labeled Leadership because these require executive-type behavior or more senior level responsibility to complete. A leadership gap is identified in Figure 3. These are project management skills that are not developed as well as they perhaps could be in college.

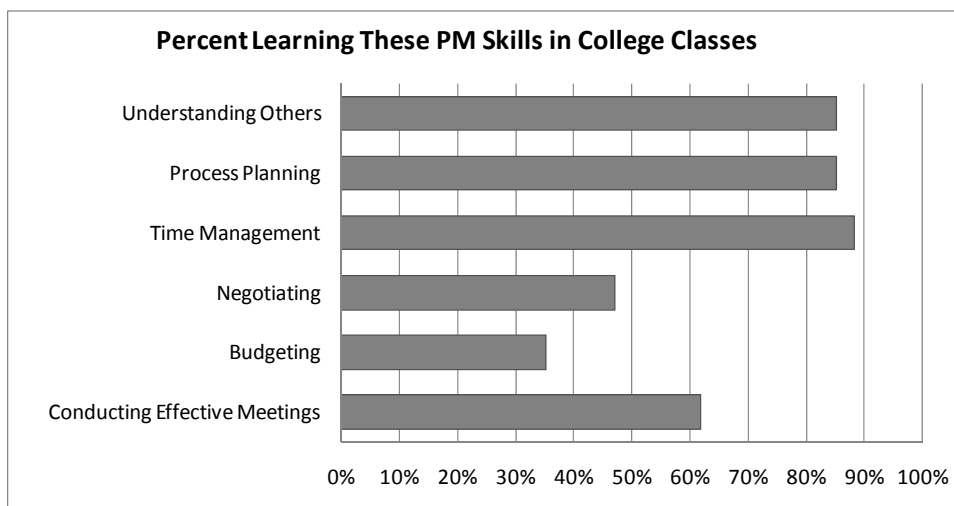


Figure 2 Alumni learning project management skills in college

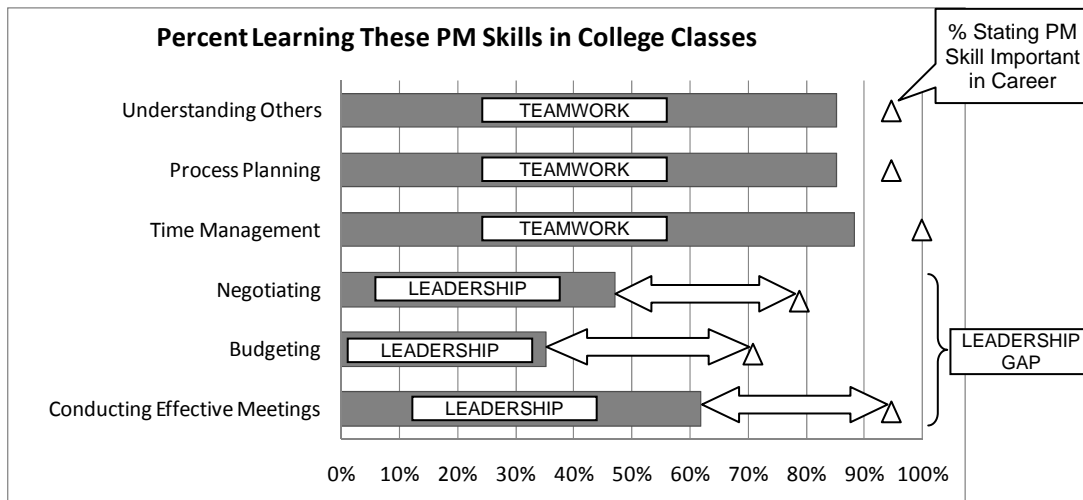


Figure 3 Illustration of Leadership Gap



The final set of questions in the survey asked how project management skills are best learned. The frequency of responses are summarized in Table 5. First note, a 74% majority of alumni believe teamwork skills are not the same as project management skills. This is supported by the data illustrated in Figure 3 as the leadership gap. Second, alumni do believe PM skills can be taught in the classroom with 83% responding yes. Note, for these alumni, "classroom" is understood to mean more than a lecture setting. Approximately one-half of the "classroom" time these alumni had in college was laboratory or teamwork related time. Working on team-based projects would be viewed as "classroom" in this population. The question of learning PM "on the job" was asked in order to verify the responses given about learning in the classroom. A small majority disagree that PM can only be learned on the job. However, with 85% majority agreement, this population believes that case studies alone cannot be used to teach PM skills. Finally, based upon the response to the last question in Table 4, 39% of the alumni believe their project management training could have been better in college.

Learning Project Management (PM) Skills	strongly agree	agree	undecided	disagree	strongly disagree
1. PM can be taught in a classroom setting.	12%	71%	9%	6%	3%
2. PM can ONLY be learned on the job.	3%	12%	21%	62%	3%
3. PM skills are best learned by managing projects NOT by reading case studies.	50%	35%	6%	9%	0%
4. The PM training I received while a student in college was adequate for my entry level job.	12%	50%	24%	15%	0%
5. Teamwork skills are NOT the same as project management skills.	50%	24%	3%	24%	0%

Table 5 Alumni Opinions on how Project Management is Learned

Many alumni wrote comments on how project management could be better taught and what activities they thought would be helpful. Note that in the quotations below when "capstone" is used, it refers to a team-based, semester-long project that is planned, executed, and controlled before being summarized in the form of a final project binder. The term "capstone" does NOT refer to a project management report that includes project planning without execution and control.

Alumni stated that project management is best learned by actually managing a project:

- ... more **capstone classes that are based on a project** would be the best option...
- More **projects similar to the capstone course**. The capstone course teaches project management throughout the entire development of a product.
- The **best experience was in [the capstone class]** where as a group you have to manufacture a product.
- Actually trying to **manage projects and learning first-hand the obstacles** and resolutions required is the best way to **learn, basically through experience**.
- **Project management cannot be solely taught by reading case studies** about how McDonalds is able to coordinate all their various sub-stations and get all their ingredients together so that they can make Cheeseburgers.
- Project management needs to be taught with on-the job experience or, **if in a classroom setting, a project that is based on a real-world project** (i.e. includes budgets, personnel selection and stated goals but not a required path). The best activity to reinforce project management learning is a project for a discerning outside customer...
- I think that throughout the semester each person in the group should be responsible to **lead a project**. **This includes conducting meetings, recording the meeting notes, and setting goals** with specific dates...

- More **mini capstone** type concepts. Include more opportunity for student to be **placed in management type role** not just for the capstone where we monitored the build.
- A lot of the management oriented content that was to be **taught in the project management course is not applied enough during the length of the course to solidify the concepts** that are used in the field. The capstone course did a good job of providing a canvas that one could use to apply and use many of the management techniques that are needed in the real world.

Alumni commented on the importance of a leadership role when learning PM:

- A greater focus on **project leadership** is needed. The majority of group activities prepared me for team participation but not necessarily leadership.
- **Leadership roles** and responsibilities are very important.
- Provide students with the opportunity to manage (communicate, **lead meetings**, schedule.)
- What our curriculum and my employer didn't teach was **leadership skills**, communication skills, and conflict resolution skills.
- The best way to learn this [project management] is by practicing it in increments of **increasing responsibility** and risk.
- I think **basic management skills** should be focused on ... Management skills are primarily what I use in my career on a day to day basis. Issues such as how to deal with employee problems and requests, ..., [and] **leadership are all important basic management skills** that have been learned more on the job.
- Adding more teamwork projects, **assigning a manager** for the team and allowing the students to work together to deal with their project would only benefit the students.

Alumni also believe an internship is an important part of learning project management skills:

- **I believe an internship is the best way to learn these skills, focusing on small projects that can be started and finished within the internship duration. This is the only way to appreciate, learn about and prepare for project management.**
- I believe that an internship or intensive project management program should be required for each student before graduation.
- I did not have an internship until after I had graduated. However, I would have benefited strongly from one.
- I think a coop or an internship would be helpful.
- The internship I had between junior and senior year taught me a lot.
- [An] internship was huge for my growth as an individual and put a lot of things that I learned in college together.

Finally, during the optional face-to-face interviews that followed the on-line survey there were several notable quotes from alumni about their experience learning project management:

- **I was the only person learning project management because I was the team leader. Everyone else was a team member.**
- PM is like learning how to do public speaking. It is not a subject matter, **but a discipline.**
- Teach PM by being forced to manage a team. **Each person should have a shot at management.** Exposure is the best way to learn.
- **Learn by immersion.**
- Learn PM by watching someone perform it well. **Apprenticeship model.** Case studies often have too broad brush treatment. Rarely see situations described in case studies.
- **Retention** of project management principles **will be small if only done by reading, compared to doing.**

## Recommendations

Alumni highly recommend providing more opportunities for students to lead project teams and be involved with implementing real projects. This latter recommendation is supported by Plemmons<sup>8</sup> when he states a general requirement for the learning of project management is that students should be able to **apply** the PM skills of executing, monitoring, and controlling. The

recommendation to increase leadership experience poses a dilemma. The capstone class as currently taught does a good job at providing a reasonable project experience for the teams. The project is complex enough to provide challenging planning and team-oriented problem solving tasks. Further, the project provides the ultimate challenge for any manager; it requires execution and control of the project plan. This "tire hitting the road" experience provides an objective, hard reality deadline for the teams. It makes the work they do reflect a real project, not some report about how a project could be carried out. However, it is difficult to envision how to rotate leadership roles in a meaningful manner. There are at least three options:

1. Have N unique projects for each team where N is the number of team members. In the current capstone, N is 4. This would mean four projects during the semester. Unfortunately, it is unlikely four unique projects of significant complexity could be developed and implemented in the semester time frame.
2. An alternative is to rotate some aspect of team management and require students to assume a greater amount of risk for their contributions. Perhaps there would be a unique team leader for the different stages involved with the project: computer-aided design, process planning, fabrication of fixtures, development of work instructions and plans for the production run. The team leader during a particular stage would document the negotiation and meeting management that occurs during their tenure. This option has merit because the role of team leader in the capstone class has not been one of pure team management. The team leader typically has direct project responsibilities other than monitoring team member needs and finding resources to help team members meet deadlines. Thus it is reasonable to expect different team members to take the lead during a stage of the project that focuses on their critical contribution. Team members would take charge of planning meetings, coordinating efforts to meet the next goal that is their critical area.
3. A third alternative is to utilize only one project manager per team. This person would serve as a full-time project manager for the entire semester-long project and have only that responsibility. The person would be chosen for a demonstrated ability to lead. Others on the team could learn about project management by observing someone on their team who is doing it well. This method was called learning by an apprenticeship model by an alumnus during a follow-up interview.

Alumni also suggest that students complete an internship as part of their mastery of project management skills. This is an outstanding recommendation, but one too seldom realized by students.

#### *Improved quality assessment experience*

The perceived inadequacy of quality assessment will be addressed in the revised capstone course by including a formal Production Part Approval Process<sup>9</sup> (PPAP) document with the projects. The PPAP is a standard quality assurance document used in the automotive as well as many other industries. The majority of alumni met during the optional face-to-face follow-up interview who were involved with quality assessment used this type of document.

## Conclusions

The most important finding from the survey is that alumni give overwhelming support for project management training that involves projects requiring execution, or "full circle" treatment of the project process. The perceived leadership skill gap is one area noted for improvement in the delivery of project management skill training in college. Increasing leadership opportunities may require including more project leadership activities in other classes in addition to considering a rotating leadership role in a semester-long capstone course.

The use of an on-line assessment instrument facilitates getting useful feedback from alumni, assuming there is a personal connection first. Also, the value of an internship to the professional development of a student cannot be overstated. In addition to alumni comments presented in this paper, the author has heard employers relate that a candidate with an internship experience is viewed with a higher level of regard than those without. Finally, the author has seen significant increase in focus by students who return to school after completing an internship during the summer.

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