



## Assessing the Effectiveness of Leadership Education for Engineering Students

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## Abstract

Regardless of the approach taken to help engineering student develop their leadership potential, the engineering leadership development community faces challenges in assessing the effectiveness of the educational approach. Soft skills, while assessable, are much more challenging to quantify objectively and consistently. Simply put, one assessor's understanding of leadership is likely to be different from another's. As a result, improvements of curricula, pedagogy, and development of rich "leadership experiences" that depend on assessment results may be negatively affected by poor data. Further, allocation of scarce instructional resources may also be adversely affected by incomplete assessment data.

This paper presents descriptions of assessment efforts and results related to engineering leadership educational efforts over a period of more than a decade. The original purpose of the effort was to develop data to determine whether the current leadership development effort was meeting its stated goals and whether expansion of the effort to a certificate program was needed. The results to be discussed include formal assessment by students of experiential learning, compilation of data from six years of class exit interviews, '360 degree' assessments of student leadership efforts, and alumni surveys. In addition to the results and methodology, preliminary conclusions will be discussed related to the curriculum and structure of the current leadership development program.

## Introduction

Leadership education for engineers is a rapidly expanding and developing field, as evidenced by the formation of a constituent committee within ASEE in 2012 and over 200 affiliated members by 2013. With many programs and approaches, specific outcomes for each of these efforts vary. However, there are similar underlying goals. The purpose of this paper is to discuss how to assess the long term effectiveness of university-based leadership education for engineering students in meeting those goals. In doing so, it is hoped that the engineering leadership community, which is outstanding at assessing programmatic outcomes, will turn some attention to this effort in order to provide foundational data for broader acceptance in the engineering education community of our common leadership development efforts.

## Background

Assessing the effectiveness of leadership development over a long time intervals (5-10 years) is a daunting task. Not only is leadership effectiveness situation in nature (and thus often short-term), but leadership skills are developed throughout life, making the effect of specific "training" or education difficult to isolate over years of accumulated experiences. However, the long term effectiveness of leadership education for engineers is potentially a key factor in persuading the larger engineering education community of the value of such efforts. In a survey done by (*team affiliated with the author*) of 49 engineering educators with self-reported skepticism for the value of leadership development for engineers, 34 reported their key concern was redirecting educational resources from technical skill development to "soft-skill" development that would

otherwise happen during professional practice. While not conclusive, this anecdotal evidence strongly suggests that the engineering leadership development community must at least address the concern regarding assessing the long term potential effects of engineering leadership development and if it really has any long term value.

It should be noted that this long term effect is clearly differentiated in the survey from short-term effects. When presented with assessment data of several engineering leadership programs that were presented at the 2013 ASEE Annual Conference [1-5], 42 of the 49 respondents indicated that there was sufficient data to indicate that key programmatic outcomes of leadership development (including personal communication skills, development of vision, importance of integrity, and ability to work with others for a common goal) were being addressed by existing programs. However, as mentioned previously, this did not persuade many of the respondents as to the long term value of such education.

To address the need for long term effectiveness assessment, three actions have been taken related to work done by (*specific program information*). The first action was the compilation of five years of assessment data, based on exit interviews and surveys, of recent graduates of (*specific program information*) since 2008. This information, presented in this paper, provides baseline data for a longitudinal study of engineering leadership education, as well as a snapshot of program effectiveness relative to the student's overall leadership development at that time.

The second action was the compilation of overall program effectiveness from a survey of 56 of the program's alumni over seventeen years (for a response rate of 68%). While this provides a broader view of the effectiveness of leadership education related to the program with respect to specific outcomes, it does not specifically differentiate the value of the leadership development from the program compared to other potential leadership development received by the respondents. This was the focus of third assessment effort – a specific attempt at surveying alumni with more than eight years of separation from the program as to the value of the program in their leadership development.

### **Review of the Leadership Program**

While greater detail of the engineering leadership program at (*specific program name*) are detailed elsewhere (*reference to be provided after blind review*)

The selected students are then given readings and an assignment to evaluate critically aspects of the readings before the start of class. Examples of these readings range from Sample to Goleman. [6-10] Assigned summer readings are designed to help understand the terminology, concepts, and framework of successful leadership. The summer readings are often the first time the students have critically considered concepts such as “competence,” “character,” “vision,” along with “knowing and dealing with self,” “continuously listening and learning from those around you,” “communicating and inspiring a shared vision with others,” and finally “enlisting, engaging and empowering followers.”

### *Learning Outcomes*

The course learning outcomes are explicitly given to the students before the class. They include

- Differentiate between leadership and management.
- Learn the fundamentals of leadership and the skills needed to become real and effective leaders.
- Learn lessons of leadership by listening to and asking probing questions from a select group of speakers who have served in various leadership roles in their careers.
- Interact and bond with other members of the class.
- Improve the class with your studies, reflections on the class, and recommendations.
- Learn to be better observers and learners of leadership lessons in current and future venues.

### *Class Assignments and Activities*

Before the first day of class, students are given electronic access to the class information and their own electronic journal (e-board) for their daily leadership reflections. The class information includes the syllabus and structure of the seminar, expected daily activities, brief biographies of the visiting speakers, and resumes and pictures of the scholars. Course booklets since 2008 have been kept as .pdf files and are available from the author via email request.

Students are also asked to prepare an autobiography of themselves before the first day of class. The autobiography is the first of several assignments to help the students more fully understand themselves and their leadership styles. The value and benefit of each student writing about their own lives helps them start to understand the importance of “getting to know themselves,” relating to “emotional intelligence” and “understanding and dealing with self.” This exercise also helps the instructor learn more about each student.

The first two lectures of the class are devoted to reviewing summer reading and discussions of the autobiographies. As the class is highly interactive, the discussion is generally student-led, with the instructor acting as facilitator. These discussions help the students develop a common framework for understanding leadership and learning about other members of the “team.” At the conclusion of the review of the summer reading, the students are provided an overview power-point presentation summarizing some of the key leadership characteristics and concepts. As with the course booklet, these slides are available from the author via email request.

Students also spend significant time on development of emotional intelligence, with at least two behavior inventories (such as True Colors or Myers-Briggs Type Indicator test) and discuss results in class. Building strong interpersonal skills requires the students to understand their own behavior pattern to recognize their own strengths and weaknesses. Also from this, they learn the styles of others and how these styles interact with their own personal style. This effort gives the student framework for the application of different leadership styles based on the personalities of their followers, as well as teach them why they make certain decisions. Note that while students may think this effort is repetitive at first (one inventory exercise is the same as another), if they are challenged to find the differences, they can critically understand the importance of each effort designed to help them learn more about themselves.

As soon as can be scheduled after the first week, the students participate in a four-hour team-building exercise run by Ohio University's Campus Recreation Department. Generally speaking, before the exercise, the students know little about anyone else in the class. After the intense common experience, the class comes closer together, making it easier for them to envision themselves as a team, thereby immediately improving class discussion and speaker interviews.

The team concept is a fundamental building block of the seminar. Not only is the concept of team used to emphasize the importance of participation and interaction, but it is critical in the early speaker interviews. It may be intimidating for the students to ask probing and sometimes uncomfortable questions of company executives that could be their boss's boss next year. Understanding that they are a team takes the pressure off the individual student, allows them to focus on learning, and helps with the overall class atmosphere. The team culture emphasizes that no one wants to be the weak link in the discussion, encouraging the participants to prepare thoroughly for each speaker and assignment so that they can make a relevant contribution.

In addition to autobiographical work, students are asked to research and analyze the leadership of a well-known leader or even an historical leader figure. This could be a leader from their own engineering field or just one acceptable to both the student and the instructor. The students are asked to write a paper on the leadership of their selected person using key events from their life to describe or illustrate the subject's leadership styles. By presenting their subjects to the class at the end of the term and letting the other students ask questions about the chosen leader, the other students benefited from the work of other students in the class. It also was a final exercise in promoting the asking of good questions, an important skill for any leader.

The differences between leadership and management are also presented. This element differentiates the two aspects in several ways, but also emphasizes the inherent symbiotic relationship. Successful leaders cultivate quality managers to execute their vision. Therefore leaders must be knowledgeable of the role of managers, both in fostering them as potential leaders for their organization and to understand the capacity of the organization to implement the vision of the leader. It is also stressed that leadership can be demonstrated by non-management personnel (anyone) and that leadership and entrepreneurial spirit should be fostered.

### *Guest Speakers*

The heart of the fall seminar is the interaction between the RLI Scholars and the guest speakers for two+ hour "interview" sessions (classes). Because these speakers are often active CEOs, presidents, or executives of various operations, and because there are typically ten speakers per seminar, scheduling is critical. Speaker scheduling matters to the development of the scholars. The order of guest speakers will create a leadership story and provide reinforcement of concepts to maximize learning of leadership characteristics and development for the students. More seasoned leaders who have developed methods for "teaching" leadership should be scheduled later. Less experienced leaders or leaders who are comfortable making a specific point (or points) to emphasize recent learning in the classroom are scheduled earlier in the seminar. Keep in mind that because schedules are very tight, such scheduling may or may not be possible. Further, it is a good idea for the instructor to talk with the speakers before formally inviting them to describe the scope of their interactions with the students and the overall goals of the course.

Students must be instructed on how to interview the guest speakers; discussing proper etiquette, as well as general types of questions they could pose to learn more about the leadership style of each speaker. Immediately after that preparation, a “practice” guest speaker comes to the class; usually the instructor. The preparation of the students to ask good questions is significantly enhanced by asking one student to introduce a speaker for the session. This gives each student the valuable experience of talking to the speaker before the seminar.

The willingness of the speakers to educate the next generation of leaders is the single most important element of the class. Nearly to a person, the speakers need to believe in the importance of leadership development – not only for their organization, but for society. A good speaker is highly invigorated by sharing their personal experiences with the students. If they are willing to share their life and leadership experiences with the students, many positives can occur and leave a lasting impression on the students.

The combination of a group of eager future leaders interviewing a seasoned leader who wants to share “real world” experiences and help further knowledge of leadership makes for an ideal learning experience. It surpasses any learning the students could gain through reading, as mentioned in numerous end of class surveys. However, it is important to remember that speakers should be scheduled to meet with seminar class only after readings, discussions, and other preparations have been made to assure the students are prepared to benefit from the speakers.

To deliver the optimal overall message about leadership, there needs to be diversity of speakers in age, gender, venues, as well as experiences. This diversity can help the students understand that leadership development is a lifelong effort. It can also help the students understand that “they too can do it,” but they must continuously strive to become better. Further, annual variety is also an important factor in keeping the course “fresh.” Over the course of seventeen years, the program seminar has hosted more than 70 different speakers.

### *Reflections*

Daily reflection of leadership lessons learned and periodic discussion of the speakers is a key component of class learning. The discussion and reflection helps the students articulate what they have learned and also most importantly helps students learn from each other. Also it helps each student learn the importance of listening to others and not get fixed on just their own points of views. Two class periods and several assignments are devoted to evaluating critically the speaker’s styles, leadership characteristics, and lessons learned from the interviews. This generally requires the students to not only evaluate their daily journal reflections, but also to review the key aspects of the summer reading to frame their responses.

The classroom discussion assessing the lessons learned from the speakers is held after the students submit initial answers to some critical review questions. The students then hold an open discussion on each question, allowing everyone to make their answers known and present justifications for those answers. These review sessions tend to be quite lively, with very well-reasoned debates. Students generally have reflected that these sessions helped them focus their understanding of the speakers beyond what they attained through their own journal reflections.

## Assessment Results

As described in the “Background,” three assessment instruments were used to quantify the effectiveness of the program. The first action was the compilation of five years of assessment data, based on exit interviews and surveys, of recent graduates of (specific program information) since 2008. This information, shown in Table 1 along with the Z value calculated based on difference from a neutral score, provides baseline data for a longitudinal study of engineering leadership education, as well as a snapshot of program effectiveness relative to the student’s overall leadership development at that time.

The assessment survey for the data in Table 1 asked students to rate their development in leadership skills compared to when they entered the program. A rating of 1 was a negative response and a rating of 5 was a maximum positive response. The survey asked the following:

- 1 a. You are more aware of the actions you take in leading others*
- 1 b. You employ critical thinking in your leadership actions*
- 1 c. You are more intentional in your use of leadership styles*
- 1 d. You understand your personality and self better*
- 1 e. You understand and recognize personality traits in others*
- 1 f. You are able to flex leadership styles to influence others based on your understanding of yourself and the personalities of others*
- 1 g. You are able to differentiating between leadership and management*
- 1 h. You are a more effective listener*
- 1 i. You are able to communicate your vision (solution to problem) more effectively*

Table 1. Exit survey results 2008-2012 and Z value based on difference from a neutral score

Exit Survey 2008-2012			
	Average	Std. Dev.	Z
1 a.	4.46	0.48	24.71
1 b.	4.19	0.61	15.98
1 c.	4.55	0.53	24.00
1 d.	4.58	0.44	29.18
1 e.	3.82	0.72	9.31
1 f.	4.30	0.55	19.31
1 g.	4.76	0.29	49.20
1 h.	4.42	0.65	17.82
1 i.	4.27	0.52	19.88

The second action was the compilation of overall program effectiveness from a survey of 56 of the program’s alumni over seventeen years (for a response rate of 68%) in 2012 and 33 taken in

2008. The results, shown in Table 2, are for two years – one survey taken by alumni in 2008 and one in 2012. The survey asked for nine responses to rate the effectiveness of the program in developing the respondent’s leadership skills in specific areas.

- 2 a. *Development of critical thinking about leadership*
- 2 b. *Learning leadership styles*
- 2 c. *Understanding the role of emotional intelligence in leadership*
- 2 d. *Team-building skills*
- 2 e. *Interfacing with others as you lead*
- 2 f. *Differentiating between leadership and management*
- 2 g. *Listening skills*
- 2 h. *Leadership application in your profession*
- 2 i. *Leadership applications in your personal life*

Table 2. Alumni Survey Data for 2008 (N=33) and 2012 (N=56)

	2012 Survey	2012 Survey	2008 Survey
	Average	Std. Dev.	Average
2 a.	4.50	0.45	4.35
2 b.	4.51	0.31	4.21
2 c.	4.27	0.45	4.21
2 d.	4.07	0.61	3.71
2 e.	4.16	0.56	4.12
2 f.	4.68	0.23	4.41
2 g.	4.41	0.43	4.24
2 h.	4.09	0.53	4.18
2 i.	4.00	0.51	3.97

The results indicate that the program has been effective as assessed by the students, with statistically insignificant increases in effectiveness over the last five years. However, while this provides a broader view of the effectiveness of leadership education related to the program with respect to specific outcomes, it does not specifically differentiate the value of the leadership development from the program compared to other leadership experiences or development received by the respondents.

Assessing the specific value of the program to the development of the respondent was the focus of third assessment effort – a specific attempt at surveying alumni with more than eight years of separation from the program as to the value of the program in their leadership development. Specifically, the respondents (23 responded, 45% response rate) were asked to assess the value of the leadership development received in the program vs leadership development or experiences they have received since beginning professional practice. On a scale of 1 to 5, with 5 being the highest contribution from the program development and 1 being the highest development during professional practice, the respondents were asked to evaluate the contributions in these areas:



- 3 a. *Awareness of the actions you take in leading others*
- 3 b. *Critical thinking in your leadership actions*
- 3 c. *Intentional use of leadership styles*
- 3 d. *Understanding your personality and self better*
- 3 e. *Understanding and recognizing personality traits in others*
- 3 f. *Flexing leadership styles to influence others based on your understanding of yourself and the personalities of others*
- 3 g. *Differentiating between leadership and management*
- 3 h. *Effective listening*
- 3 i. *Communication of your vision (solution to problem)*

The results, including a Z value for comparison to a neutral result are shown in Table 3. Even with the relatively neutral appearing results, the statistical analysis of the data indicate that all responses were statistically significant compared to a neutral (even) result and extremely significant compare to the case of only professional practice development of leadership skills.

Table 3. Eight+ year alumni survey data (N=23)

	Average	Std. Dev.	Z
3 a.	3.48	0.50	4.59
3 b.	3.43	0.71	2.95
3 c.	3.74	0.62	5.70
3 d.	3.83	0.54	7.38
3 e.	3.30	0.45	3.27
3 f.	3.39	0.64	2.93
3 g.	4.13	0.37	14.68
3 h.	3.52	0.52	4.79
3 i.	3.48	0.50	4.59

## Conclusions

The data presented in Table 1, 2, and 3 show some positive trends indicating there was real value to the leadership program in developing student leadership skills. The strongest conclusions can be drawn from data in Table 1, which shows a statistically significant improvement over no development in students just completing the program. However, the value of the course in developing leadership skills was not in question. What was in question was the value of the course over leadership skills the students would have otherwise developed in professional practice. Data from Table 2 does not clearly answer that question, although the respondents did strongly see the value of the course in their leadership development. However, the data in Table 3 provides the clearest picture of whether the program offered long term value to the respondents in their leadership development. In this case, while the number of survey responses is very low

(23), the data still indicates that the program had a statistically significant effect on the leadership development of the respondents.

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