AC 2011-142: DEVELOPING LEADERSHIP ATTITUDES AND SKILLS IN WORKING ADULT TECHNICAL GRADUATE STUDENTS: RESEARCH INTERVIEW RESULTS WITH ALUMNI

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Developing Leadership Attitudes and Skills in Working Adult Technical Graduate Students Research Interview Results with Alumni

Abstract

Many individuals educated as engineers find their careers take them into management positions. Despite the EAC of ABET program outcome requirements of *Criterion 3 for Student Outcomes,* few are prepared by their formal education to lead with confidence, and few have been prepared by their companies to develop the skills and attitudes necessary to be good leaders in their organizations. Leaders are needed at all levels in these organizations, not just in the executive suite.

Leadership requires not only a set of skills; it also requires an expanded set of attitudes. This paper documents the success of developing leadership skills and attitudes in graduate engineering students who are also full-time working adults in industry, and outlines one proven process for delivering graduate leadership education to engineers. Individual cases based on interviews with alumni are used and explained in the context of their learning experience. It also demonstrates the need to expand leadership education to other practicing engineers who are the emerging leaders in their organizations, provides suggestions for alternative approaches and identifies a resource for self directed study.

This paper focuses on results achieved in developing leaders as evaluated through interviews with alumni. While the paper does discuss the classes created and implemented to build leadership abilities and attitudes in students, it does not emphasize the details of the courses, which can be found in the syllabi[7].

Description of Graduate Student Population

Graduates from the master's degree programs in the School of Engineering at the University of St. Thomas are primarily working adults in the 30 to 50 year age group. Historically they have had 10 years or more of industry experience before entering the program. However, this is decreasing as more graduates of the bachelor engineering programs enter the graduate programs. Typically it takes students three to five years to complete the master's program.

Most of the students in the graduate programs have bachelor's degrees in engineering. However, some have degrees in science, mathematics or engineering technology and some have liberal arts degrees. The result is a built-in multi-disciplinary nature of the programs and of the individual classes.

These students work for a wide range of companies in the metropolitan Minneapolis/St. Paul area. Some work for large technical companies like 3M, Medtronic, Honeywell, Lockheed Martin and Goodrich Aerospace; others for companies not thought of as technical such as Target, Prudential Insurance and US Bank; and many are employed by smaller manufacturing, engineering, insurance, banking and retail companies.

These students take courses in the evening and on weekends. They have many demands on their time, from work to family to community, in addition to their educational commitment. Most are under great pressure to balance their life and add value to their organizations, and they expect a lot from investing in continuing their education. They are highly motivated and want to make a difference. These working adults come to the University of St. Thomas School of Engineering graduate programs to learn to think differently, to see more possibilities in the complex global economic environment in which they are immersed, to become more innovative, and to identify and develop their inherent leadership potential.

The Need for Leadership Education

A logical question would be "why is it important for technically skilled engineers to have leadership attributes? They already have strong technical abilities, isn't that enough? "There are a number of reasons driven by the Engineering Accreditation Commission of ABET criteria, NSF data on engineers going into management, results of interviews with alumni and survey results from engineering schools. A brief discussion of each follows.

EAC of ABET Criterion 3 Program Outcomes[1]

Of the programs accredited by the Engineering Accreditation Commission (EAC) of ABET, most are bachelor degree programs. However, there are a number of master's programs that are accredited, including the Master of Manufacturing Systems Engineering program at the University of St. Thomas. We use results of the leadership courses to demonstrate compliance with several of the program outcomes.

The EAC of ABET requires that engineering programs must demonstrate the fulfillment of a set of criteria. One of those criteria, *Criterion 3 Program Outcomes*, requires that engineering programs must demonstrate that their students attain eleven outcomes, often referred to as 'a-k'. The six specific outcomes that the leadership courses address are:

d) an ability to function on multidisciplinary teams
f) an understanding of professional and ethical responsibility
g) an ability to communicate effectively
h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i) a recognition of the need for, and an ability to engage in life-long learning
j) a knowledge of contemporary issues

The EAC of ABET also requires that programs establish longer term objectives in *Criterion 2 Program Educational Objectives* (PEOs). We have established Program Educational Objectives not only for the EAC of ABET accredited Master of Manufacturing Systems Engineering (MMSE) program, but for all master's programs in the school.

The Program Educational Objectives for the MMSE program are as follows:

Use knowledge of people and manufacturing principles to create, develop, and implement systems for the manufacture of products that meet articulated and unarticulated needs of society and improve the quality of all of their lives in a sustainable way.

Increase personal knowledge and skill through graduate or professional study, appropriate certifications, and work assignments.

Contribute time, knowledge, and skills to the profession, community, and the world.

Serve as a team member or team leader, demonstrating ethical behavior, social sensitivity, and professional responsibility.

The Leveraging Leadership for a Lifetime (LLL) series of courses provides a launching site for preparing alumni to meet the PEOs, and the interviews conducted as part of the recent research provide a mechanism for evaluation and assessment of achievement of them.

NSF Data

In Figure 1, National Science Foundation[2] data shows that significant numbers of engineering graduates leave the direct practice of engineering over time and increasingly move into management. This has implications for the need to build leadership understanding and skills into all engineers, and to emphasize continuing education for all. Within 35 years of graduation, more than 25% of those educated as engineers have management roles. Evidence from interviews with alumni suggests that most are not well prepared by either their education or employers for the leadership demands of these positions. Even to be a good team member and follower, an understanding of leadership by all is essential for a high-performance team.

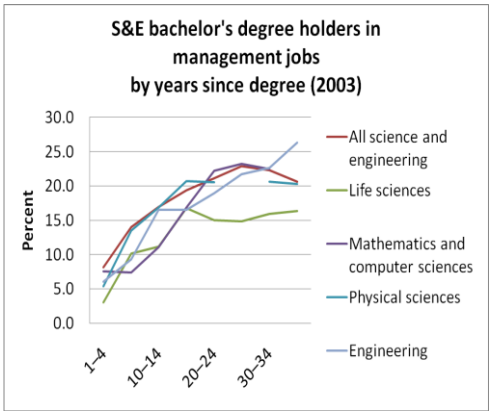

Figure 1. S&E bachelor's degree holders in management jobs by years since degree (2003)

Interviews with Alumni

During the year 2010, the authors conducted a series of interviews with alumni of the masters programs from the School of Engineering. We interviewed over 50 alumni to document leadership progress after graduation. As noted earlier, we had speculated on long-term results in the earlier paper from data collected while the students were still in the program and wanted to validate or refute our early assumptions by direct evidence.

In order to establish a baseline, we included in those interviewed some alumni who had graduated prior to the creation of the Leveraging Leadership for a Lifetime course. Among the questions asked of these alumni were: 1) when you have received promotions or assignments with more responsibility, were you told why you were chosen? and 2) Were you given education or training to assume these new management or leadership positions? With rare exceptions, the answer to both questions was 'no'. These alumni were not told why they were chosen for these new roles of responsibility. They made guesses, but never really knew. With the exception of superficial training in management topics, they also were not given the knowledge and tools needed to do the job.

Survey of Engineering Deans

With the generous assistance of ASEE and leadership of the Engineering Deans Council, in 2009 we sent a survey[3] to deans of engineering programs in the United States, asking whether they offered leadership education in their programs, and whether they believed leadership education was important for engineers.

A total of 48 responses have been received. The results show that 100% of respondents believe leadership education is important for engineers, yet only 46% include leadership education in undergraduate programs and just 21% in the graduate curriculum. Those who reported offering leadership education indicated that collectively more than 1400 students were in those courses.

While believing strongly in the importance of this topic, the major reason given why more programs do not include leadership is that it is difficult to fit into the curriculum. With the rapid expansion of knowledge in all fields of engineering, and with the constraints on credit hours, leadership often takes a back seat. Those that are not providing leadership education are asking how this problem can be solved.

It is clear that there is a need for leadership education for engineers based on requirements in the marketplace. A recent article in MarketWatch discusses this need.[4]

> John Shinal writes in his column for MarketWatch /FINS (1/2), "Rather than focusing strictly on business acumen or technical skill, companies want top managers who can persuade as well as lead, and communicate as well as command." Recruiting expert Kelly Kay explained, "It's a different type of skill set than the traditional command-and-control personality." Companies are "looking for a more subtle, sophisticated type, someone who is an influencer," she said. The trend is driven by "the increasing complexity of companies," which are also marketing "a broader line of products than in years past and increasingly competing with each other in new markets." This requires a higher level of team compatibility from

> workers, and as a result "companies are now instructing executive recruiters to look for candidates with expertise in so-called soft or intangible skills such as communication and a high 'EQ,' or emotional quotient."

Measuring and understanding EQ or emotional intelligence is part of our leadership program, as shown below. It is interesting to note that emotional intelligence is learned, unlike IQ, and EQ growth is possible for everyone, making a measureable impact in the management of relationships in organizations, a must for leaders. This critical area of understanding was recently emphasized by Bill George, former CEO of Medtronic and currently professor of management practice at Harvard Business School.[5] In that article George states "In observing leaders for 40 years, I have never seen someone fail for lack of IQ. But I have seen hundreds fail who lacked emotional intelligence (EQ)."

Summary of 2004 Paper

At the ASEE annual conference in 2004, a paper titled "*Beyond Professionalism to Leadership: Leveraging Leadership for a Lifetime"* was presented by the authors on the motivation for a course that helped working adult graduate students assess their leadership capacity and skills, discussed the nature of the course and reported the results observed at that time.[6]

The idea for this course series began in 2000 when our Industry Advisory Board was reviewing the program objectives and mission. They asked the questions, "How can we measure whether these goals are being achieved?" and "Is our program making a difference?" This discussion of assessment ranged into the definition of leadership and professionalism. At the same time we began a benchmarking initiative of six other university engineering schools, searching for best practices. These benchmarking visits provided ideas that we incorporated into our plan for a new approach to assessing the effectiveness of our Master of Science in Technology Management (MSTM) program.

After considerable discussion and input from employers, students and the Advisory Board, we created a new three-part course titled "Leveraging Leadership for a Lifetime" (LLL-I, II, III). This sequence of three one-credit courses, spread throughout the full MSTM degree program, was designed to provide the student with an ongoing close look at herself/himself as a learner, a leader, and the person in charge of her/his life-long plan. The series intended to answer the question, "How do I get the best possible results for my life goals from this graduate program?"

With faculty and industry engagement, we identified specific learning outcomes for the leadership series, critical features for the process and expected outcomes for each of the courses. We used a set of critical design assumptions as our guide for development. These assumptions were based on adult learning theory as well as motivational theory. Furthermore, we felt the student should take personal responsibility to be actively involved in their learning agenda, shape a vision for his/her leadership and learning that would guide their planning process while they deliberately focused on increasing their self-awareness and understanding of a leader's social/ethical responsibilities.

The three-course series began with a thorough base-line assessment of the individual graduate student's competencies, personal values, learning style, leadership aptitude and other data (both qualitative and quantitative) regarding their personality profile and emotional intelligence. Each of these areas was seen as a critical ingredient contributing to the leadership capacity building process. The student used the data as a foundational building block in designing their roadmap for learning and leading.

Several assessment tools were reviewed and carefully selected that would provide reliable and valid measures of each of these areas. Each student engaged with others in his/her workplace to gather feedback and inputs that would give him/her others' perceptions of their leadership characteristics and capabilities. Some of these same people were invited to be ongoing supports for the student's learning process, continually providing feedback on demonstrated progress. Key support people including a mentor were selected by the student, most often from his/her workplace, the students' advisor and others who worked closely with the student.

In January of 2003, the first class of 22 students began the series of LLL courses. The students represented a broad array of occupations and industries including IT, manufacturing, banking, law, public government, medical technology, product design and development, electrical engineering and engineering management to name a few. The students were invited immediately to work in small teams to share experiences, identify common goals and shape their notions of leadership for their graduate program outcomes.

Each student received data from five separate assessment processes: leadership potential, emotional intelligence, personality preferences, learning styles and competencies reflecting MSTM program objectives. Students carefully reviewed their data, looked for correlations across the data and began to shape goals for their learning process that would enhance their strengths and eliminate gaps between their ideals and their present capabilities.

The specific assessment tools that are used across the series of courses include:

- Myers Briggs Type Indicator (MBTI) preference and its use in learning/leading
- Folkman-Zenger Extraordinary Leader 360 Assessment (measures extraordinary leader competencies directly related to the nature and demands of leadership)
- Life Review Questionnaire (self assessment of ten learning/life dimensions)
- Emotional Intelligence via the EQ In Action Profile (measures eight areas of emotional capacity—self regulation, self control, empathy, intensity, relationship management, self/other balance, positive vs. negative focus)
- Kolb's Learning Styles (measures preferences for how one takes in information and learns from it)

Through interactive explorations (individual and small groups), they shaped a collective definition of leadership, received interpretative guidance on four of the assessment instruments, assessing strengths, talents, values and learning styles. All of this was integrated with leadership and learning theory to shape an individualized plan of action. The plan flowed naturally from their uniquely articulated vision for the kind of leader the student had chosen as their ideal. This expressed vision and accompanying roadmap was articulated in a final writing assignment as well as a presentation to fellow classmates.

Students learned coaching skills to help one another identify appropriate milestones to accomplish their goals, both personal and professional. The final session in the class became a forum for sharing their proposed plans, sharing how they would hold themselves accountable and how they proposed to use their support structure. Students felt extremely positive about their initial experience in the series. Many said, "I can't wait for next class…this was the best class I've ever had."

At the time of the 2004 paper, 51 students had completed the first of the required series of Leveraging Leadership for a Lifetime courses. Each of these students worked with their mentors, advisors and Board of Directors to follow their plan of action to become a more intentional leader in their workplace, their social environments and their families. There was excitement, high energy and serious commitment.

Several of these students had completed approximately five other courses within their graduate programs and were registered for the second of the series of LLL courses. In this second course, LLL-II, the students reviewed and measured their progress in all areas, adjusted their learning plans accordingly, expanded their leadership capacity building to include team effectiveness and organizational influence.

Students also identified a real-time action learning project to be undertaken within their companies. This team-led project was to be completed by the time the student returned for LLL-III, the final in the series. The student would report on the results of the action learning project at that time, share what they had learned in their leadership of that project, and how they has impacted their organization through their leadership of the team. Finally, the students were asked to continually update their plans to reflect new learning, new progress and new information about themselves, integrating new knowledge and lessons from experience.

At that time, much remained to be done in order to know the overall impact of this innovative design. As we looked to the future, we had some hunches about overall outcomes. It was our intention to continue to monitor the individual and collective outcomes as the students moved forward in their learning pursuits. We felt that documentation of results would be important in order to understand what worked well and why as well as what might be improved. The students played a key role in this process, reflecting on their experience both on-the-job and in the classroom and providing ongoing feedback. A focus on documenting the students' stories of real-time learning and leading would help everyone know just how this process will affect life-long results. That is what we have done with this most recent work.

Description of Leveraging Leadership for a Lifetime I, II, III (ETLS 550,650,850)[7]

This series of three one-credit courses is now a requirement for graduate students in all the master degree programs. Details of each course can be found on the University of St. Thomas website.[7] The series, which wraps the entire program, aims to provide the student with an ongoing close look at oneself as a learner, a leader and the person in charge of his/her life-long plan. The highly interactive series requires a focus on teamwork, communication, learning styles, expanding perspective taking, and integrating knowledge of leadership content

with their focused real-time action learning. As stated earlier, self assessment at the front end is critical and provides critical information for development of a leading and learning plan that will carry the learning leader through the 3-5 years of graduate school and beyond. Key outcomes include: a more comprehensive self-understanding and awareness of values, learning and leading styles, personality characteristics and social/ethical responsibilities; effective leadership of teams/groups; a demonstrated understanding of global business trends and leadership practices; a defined learning contract for the 3-5 year graduate program that will evolve into a life-long learning and leading plan; demonstrated influential impact in the students' organizations; receiving ongoing feedback from key stakeholders; a defined leadership agenda that maximizes application of all graduate learning in the workplace and in life; and a portfolio demonstrating learning accomplishments throughout the program.

This courses are intentionally staged throughout the graduate program: LLL-I at the onset of the program, LLL-II at mid-point, and LLL-III at the finish. These provide a wrapping for a more intentional and deliberate focus on the learning process itself, stimulating innovation, courage and passion. In turn, this develops critical self-awareness and responsibility for learning and leading while identifying key leadership actions, practices, and applications. Throughout the series, methods to accomplish the objectives include written papers, group presentations, and feedback from others in the students' personal/professional settings, assessment tools and experiential learning methods. Finally, an evaluation process of each of the three courses is intimately linked to the course learning outcomes.

At the end of the series, the student presents a portfolio (electronic or hard copy) that documents the learnings of the series, tied both to program objectives as well as learning outcomes for each of the course the student has taken. These portfolios are ongoing repositories of the students' full array of coursework, their personal assessment of what they have learned, and a final integration of all of the learnings to shape an intention for their leadership focus for the next 5 years after graduation.

At this time, many more students have completed the Leveraging Leadership for a Lifetime (LLL) series of courses. Details of each course can be found in the syllabi on the School of Engineering website[6]. As shown in Figure 1, a total of 330 students have completed the LLL-I course, 208 students the LLL-II course and 158 students the LLL-III course.

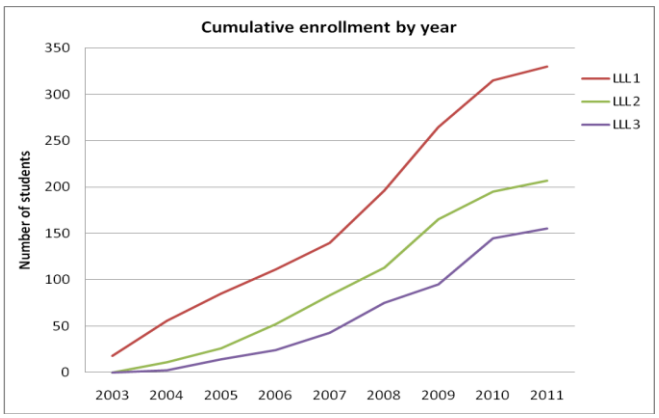

Figure 2. Cumulative enrollment in Leveraging Leadership for a Lifetime courses

Six additional years of results have been observed and documented. Longitudinal research, focusing on interviews with alumni of the program, has been conducted and shows remarkable demonstrated growth in their leadership progress. Accelerated by intentional self reflection and the creation of lifelong learning roadmaps, these alumni are now living their plan and demonstrating their leadership. We had some hunches about overall outcomes, and planned to continue to monitor individual and collective outcomes as the students moved forward in their learning pursuits. We proposed documenting the students' stories of real-time learning and leading to help everyone know just how this process will affect life-long results. We have done just that.

Evidence that the process is working

At the time of the initial post-course survey, students were excited about their learning pursuits, engaging others to support them and beginning to demonstrate their leadership talents as they learned, stretched and grew. They were feeling real strength and power in coming to better understand themselves and taking charge of their own learning outcomes. With an additional six years experience, the power of this approach in releasing the leaders within is becoming much more clear and compelling. Alumni of this program are now convinced that this course has had a profound effect on the way they view the world as an interconnected system, on their role to lead and make a difference, and as a result has changed the way they think.

As a group, the alumni interviewed demonstrated changes in attitude about what is important in their lives. New ways of thinking have inspired them to lead and make a difference. Several noticeable characteristics that are common to all alumni is that they see great value in their teams and give credit to team members for innovation, they are developing the courage to step up and be heard, they have an intensified interest in continuing learning and they are achieving balance in their lives, applying their skills not only to their jobs but to the broader community.

The alumni who have taken the LLL course series have experienced intentional self-reflection and understand the process of learning to become a leader. They realize it is a life-long journey and are prepared to continue to hone their skills, broaden their perspectives, and practice a collaborative leadership style. They are experiencing accelerated learning, and are growing professionally and personally with confidence and conviction. Here are some alumni responses regarding the impact that the LLL course series has made on their lives.

> Ken David has become more self aware of his style, his preferences, his ability to manage himself and his relationships with others. He has grown significantly in his ability to actively listen, to suspend judgment, and to connect with others. He feels the call for 'action combined with leadership' is an urgent call this is at an all-time high and accelerating, and that the LLL course has prepared him to respond.
>
> Keith Kutler used to see leadership as fairly black and white, but has changed radically and now sees all the issues and distinctions about leadership to be all gray. He has learned to leave work issues at work, hold the balance between truth and panic, and that the questions are more valuable to hold than jumping to quick answers.

Ann Jordan is confident, knows herself and practices the advice she gives others: 'engage in continuous learning and get out of the comfort zone, surround yourself with responsibilities and that will help you move forward.'

Olaf Monson's experience changed his mind-set and shifted his life-long learning goals as well as leadership behaviors and intentions. He has learned how to set goals, be intentional with his leadership agenda and has become much more self-aware. He has learned some valuable lessons about the value of reflection and listening to one's inner voice to provide guidance.

Bea Ellison has learned to be a model for others about being authentic, an avid learner, a responsible team player and a leader who embraces change, engagement and wholehearted responsibility. She is thoughtful and careful in her analyses, and willing to take risks to make a difference. Her guiding principle: do the unusual.

It is clear from our research that alumni of the master's programs do think differently now than before they were graduate students. How much of this is through normal maturization is not clear, but virtually all those interviewed claimed that the program, and especially the LLL series, made a large difference in the way their view the world and how they act now to impact that world. Since most of these students had a number of years of industry experience before continuing their education, it may be that these adult students came predisposed to make leadership education 'stick'. However, some of these alumni had fewer years of experience, yet through the LLL series seem to have achieved accelerated learning about their leadership abilities, and have been able to demonstrate that leadership in practice.

Key Observations

We have learned several things about leadership development from our experiences in industry and academia, experiences that have led to our current belief that we need to step up leadership education for engineers and scientists. The lessons are:

- Scientists and engineers have inner skills that need to be nourished and brought out;
- Scientists and engineers have inner leaders that need to be released;
- Scientists and engineers need to develop confidence and courage in their abilities;
- Scientists and engineers need education and training on how to do all of the above; and
- Academia and industry need to demonstrate leadership themselves in creating the cultures that encourage and foster the development of leadership among their scientists and engineers.

The alumni of our program are demonstrating that they are finding their inner leader, developing confidence and courage, doing the right things and demonstrating leadership daily in their jobs, no matter their level in their organizations. They are also demonstrating leadership outside their jobs, in their professional organizations, their communities and beyond. As a group, they share several common characteristics: they practice self reflection; they value all the members of their team and give visible public recognition for the team's work; they take initiative and show

courage; they achieve balance in their lives and make a difference; and they have become life-long learners. They cite that their education has changed the way they think and act and has inspired them to lead from wherever they are.

The Future: A Call to Action

Not all graduate engineer programs have a population with demographics similar to the sample studied, yet those graduate students also need leadership education. Faculty will need to think innovatively to determine how to provide this learning to their students. There is a clear call for leadership education from the EAC of ABET criteria, from results of engineering school surveys and from industry itself. If we as engineering educators really want to serve the needs of our students, we must heed the large number of engineers who move into management, and prepare our graduates to be effective and productive in those leadership positions.

The responses to the survey of engineering deans reinforce the need for leadership education. It is clear from survey data that many schools do not have the space in their curricula to replicate these courses. Despite a packed curriculum, engineering schools need to find ways to integrate leadership educational components into their programs. One way that we know works is by introducing a series of courses that develop those skills. This is one approach, but not the only one. There are other approaches such as integrating leadership concepts into existing courses. There are also opportunities to partner with student counseling departments on campuses to administer various assessment instruments and provide analysis assistance to students. On some campuses, there are opportunities to integrate leadership components into extra-curricular student professional organizations.

To assist those who want flexibility in their approach to leadership education, the theoretical underpinnings and practical applications used in these courses have been documented in recent work by the authors. This work provides a handbook that can be used in conjunction with current curricula and extracurricular activities to assist students in developing leadership skills and attitudes.[8]

Building the capability to offer leadership education for engineers also opens doors to recruiting students, and to serving regional industry in post-graduate professional development seminars and courses. The need for professional development among the professional societies can lead to partnering opportunities with these societies, which in turn will build relationships for future placement of graduates and other mutually supportive opportunities.

We encourage every engineering program to explore ways to build leadership skills in their students and alumni to create the engineering leadership we need to build a sustainable future.

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