AC 2011-134: TRANSFORMING CULTURES IN INDUSTRY: BUILDING LEADERSHIP ATTITUDES AND SKILLS FOR WORKING ADULT GRADUATE STUDENTS

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Transforming Cultures in Industry: Building Leadership Capabilities for Working Adult Graduate Students

Abstract

Creating more effective and productive organizations that expect to increasingly use the leadership talents inherent in their engineering population requires significant culture change. Change of this magnitude requires partnerships between industry and academia, as well as champions in the field; leaders who have the confidence and courage to make a difference, no matter where they are in the organizational structure. The attitudes and skills required to take on this task have been demonstrated by alumni of our graduate program who have developed new ways of thinking and acting through our leadership development process.

Data on Engineers Moving into Management

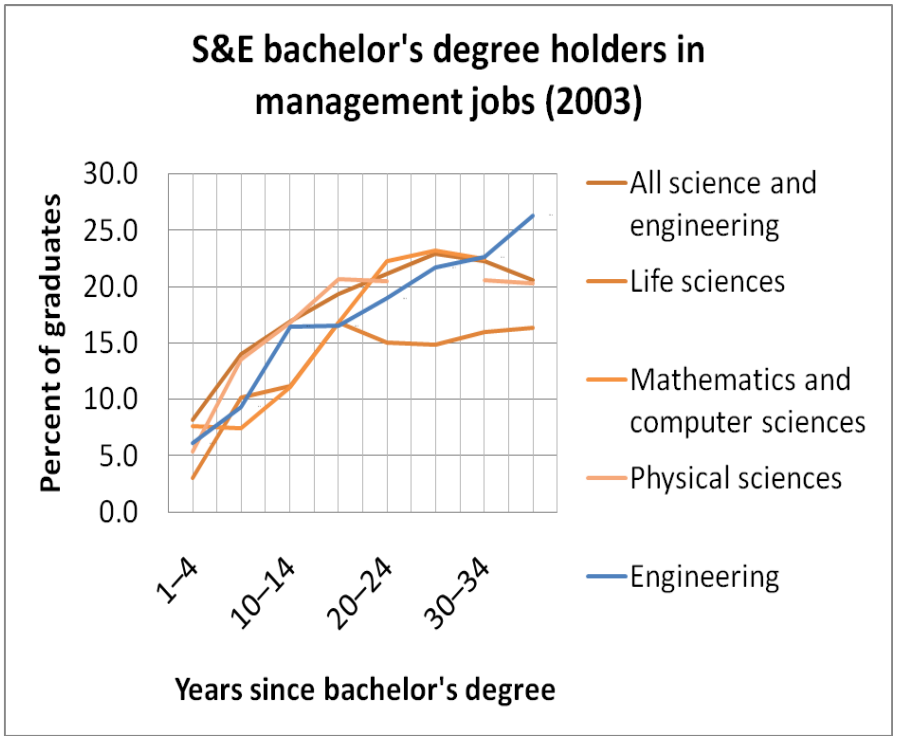

Figure 1. S&E bachelor's degree holders in management jobs by years since degree (NSF 2003)

National Science Foundation SESTAT 2003[1] data (Figure 1) shows that increasing numbers of engineering graduates leave the direct practice of engineering over time and move into management. This NSF report also shows that there is a corresponding fewer number of engineering graduates whose major work activity is R&D as they progress in their careers

(Figure 2). This has implications for the need to build leadership understanding and capabilities for all engineers, and to emphasize continuing leadership education for all.

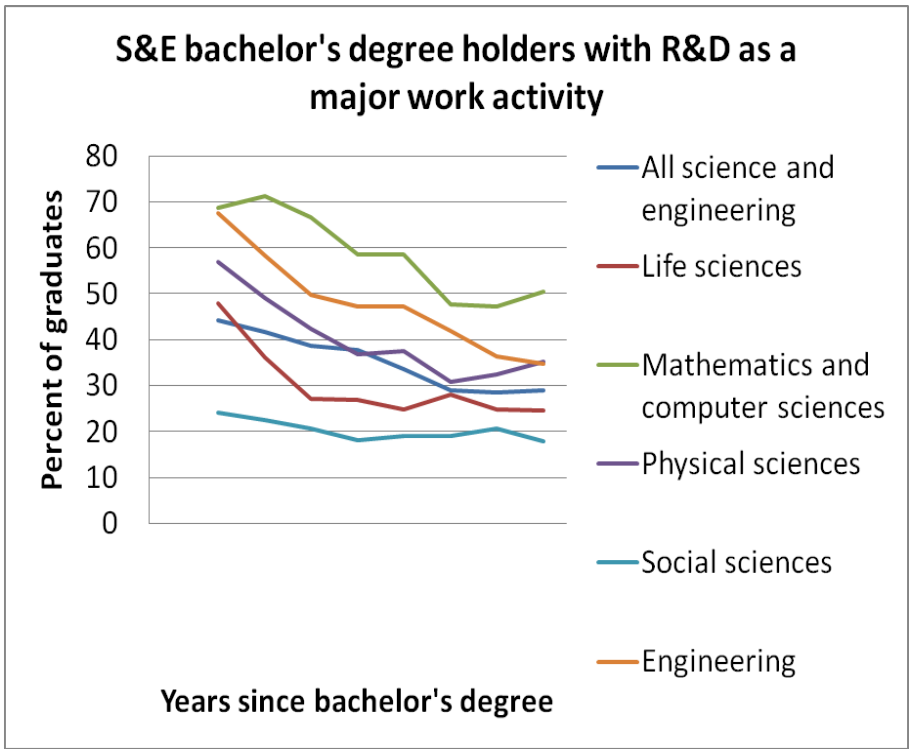

Figure 2. S&E bachelor's degree holders with R&D as a major work activity by years since degree (NSF 2003)

Further research by the National Science Foundation demonstrates what people do after earning a science and engineering bachelor's degree.[2] Data from graduates who received S&E bachelor's degrees before 1994 show that 51% earned no additional degree; 16.5% earned professional degrees in business, law or medicine; 12.6% earned masters or doctorates in the same field; and 5.9% earned masters or doctorates in other fields. Responses showed that 29% of law graduates, 46% of medicine graduates and 51% of business graduates needed science and engineering knowledge in their professions. Even 52% of those employed as artists, editors and writers say their S&E degree was somewhat related to their jobs.

The article concluded by saying the people who have earned an S&E bachelor's degree report science and engineering knowledge is important to their job. S&E knowledge also remained important across a wide set of occupations. Nearly two thirds of S&E bachelor's degree holders in non-S&E occupations reported that their field or degree was related to their job.

The implication is that science and engineering graduates report that their education is important to the practice of their occupation across virtually all fields. Many grow into management roles in their respective occupations with time, where they are increasingly called upon to exercise judgment on many issues, technical and non-technical, and address an increasingly wide array of global complexities. The leadership demands on S&E graduates create great implications for

academia and industry, particularly considering that half of S&E graduates do not pursue advanced degrees. Even at the undergraduate level, leadership education is a critical necessity for engineers and scientists. In the United States, we are educating students to be good engineers and scientists, but are not paying adequate attention to the long-term impact of these graduates in their organizations. While they are promoted in great numbers to be managers and leaders, they are often ill-prepared for the changing duties that lie ahead. Too often the technical expertise that they have demonstrated leads to organizational promotions that require them to lead and mobilize groups of people when they have had no developmental support to learn how to do this effectively.

Culture Change: The Basics

Based on our experience, the authors believe that there is a huge need for industry and academia to partner together in identifying the components of cultural change that must be addressed. This knowledge is needed in order to fully use the talent and the resources within their technical ranks to build a much broader base of leadership that can provide a competitive advantage for their organizations as well as respond to the greater global needs. The world is crying out for solutions to all of the increasingly disturbing problems, such as those identified in the National Academy of Engineering's *Grand Challenges for Engineering*[3] (global climate change, nuclear fusion, environmentally friendly power, new medicines and instruments for saving lives, vulnerability of cyberspace, and the list goes on). Most of those solutions are dependent upon innovative, technological solutions that can only be masterfully led by technological experts who know how to be effective leaders.

There is clearly a call for expanding the development of technical experts to include stepping up to leadership and therefore being able to masterfully mobilize forces to assist in meeting the world's challenges. This call demands that both industry and academia play a role in supporting the changes required for transforming the organizations, the learning institutions and the people who we depend upon for our future.

Some of the basic cultural change components that need to be assessed are:

- Expectations for leadership (technical and otherwise): competencies, attributes, and development processes
- Promotion policies and practices within the organization
- Cross functional team management: functional, global, virtual, and customer oriented
- Partnering across industries in ways that bring about feasible solutions to world needs
- Clarity on how, who, and what needs to be part of the development process for building stronger leadership capacity within the science and engineering ranks

There is precedent for this kind of industry/academia partnering. Industry took a leading role in partnering with academics, helping to establish the EAC of ABET Criterion 3 Program Outcomes, often called the 'a-k' criteria[4]. As was done with these outcomes, industry now needs to clearly let engineering educators know what is important to them specifically in developing engineers who will become leaders, and to focus on developing these leadership skills and attitudes among their employees.

Among the Criterion 3 Program Outcomes, there are six that relate directly to leadership. These 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

Industry needs to articulate the specific competencies it wants in its leaders. Those competencies need to be communicated to academic leaders. Just as important, industry needs to communicate those competencies throughout their own organizations, building understanding and development experiences that help people to acquire those skills. Based on our interviews with alumni[5] who have been promoted into leadership roles, few were given any clear expectations of the changing nature of their jobs when promoted into management. Very few were ever given specific development education for leading and mobilizing people toward common goals. Often they have been left to think through how to do this on their own.

Genesis of the "Leveraging Leadership" Course Series: The Industry Advisory Board

Since the inception of graduate programs in manufacturing and engineering at the University of St. Thomas in 1986, leadership education has been included. Leadership topics were embedded in courses such as *Project/Program Management, Masterful Leaders and Leadership* and the *Capstone class on Global Strategy, Ethics and Leadership*.

The emphasis on leadership was expanded in 2000 when our Industry Advisory Board (IAB) asked how we knew that we were achieving our mission, how could we determine that our students were becoming the leaders we claimed and, further, how would we know what our program was contributing to students' personal growth? There was further discussion among industry representatives, faculty and students on what it meant to be "professional" and a "leader." With further inquiry and data collection in the industry sector that sends graduate students to our programs, we discovered that industry was asking for more focused leadership development of their technical professionals. This resulted in the creation of a three-part leadership course in our Master of Science in Technology Management degree program.

The course series was called Leveraging Leadership for a Lifetime (LLL). The three segments of the course are labeled LLL-I (Focus on Self), LLL-II (Focus on Team & Organizational Change), and LLL-III (Focus on Global Impact & Professional Responsibility). These parts, one each at the beginning, middle and end of the degree program, were designed to assess the students' initial leadership capacities and then engage the student in more self-awareness assessment, planning and creating a learning and leading roadmap. Students were given powerful action learning assignments that required them to more fully engage in their organizations as a leader working with teams to make significant change.

Link to Previous Work

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

We have now documented the students' stories of real-time learning and leading to help everyone know just how this process affects life-long results. Six additional years of results have been observed and recorded. Longitudinal research, focusing on interviews with alumni of the program, has been conducted and shows remarkable demonstrated growth in their leadership progress and the resulting effects in their organizations. Accelerated by intentional self reflection and the creation of lifelong learning and leading roadmaps, these alumni are now living their plan and demonstrating their leadership.

At the time of the initial writing, 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 developmental outcomes. With an additional six years experience, the power of this approach in "releasing the leader 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.

When the original paper was written in 2004, the LLL series had just begun. Thirty-five students had completed the first course, LLL-I, eleven had completed LLL-II and two had completed LLL-III. At that time, the LLL series was required of only the Master of Science in Technology Management students. Six years later, Figure 3 shows that 330 students have completed LLL-I, 208 students LLL-II and 158 students LLL-III. The LLL series is now required of all master's students in the School of Engineering. Details of the courses can be found on the School of Engineering website.[7]

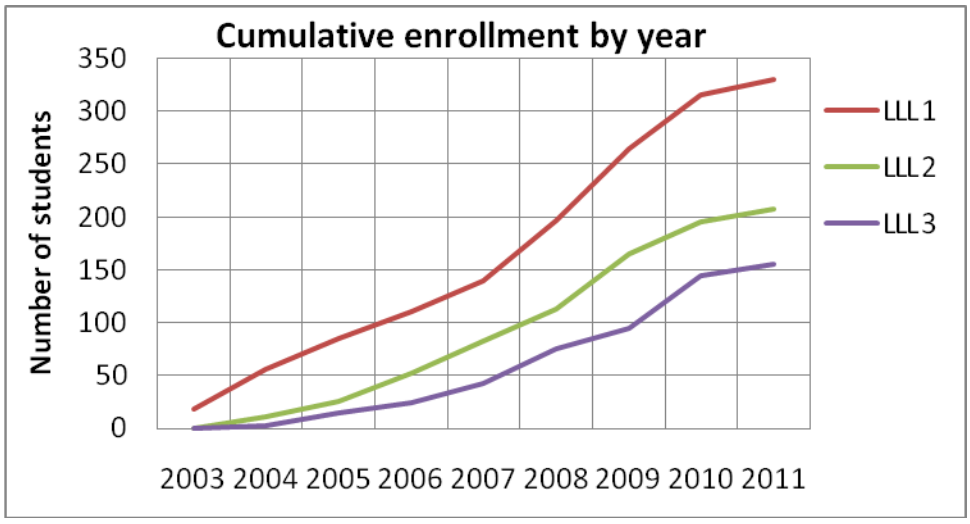

Figure 3. Cumulative enrollment of University of St. Thomas School of Engineering graduate students in Leveraging Leadership for a Lifetime courses

Alumni Leadership Experiences

To provide examples of this growth, we provide here some of the stories from alumni who were interviewed on their experiences with leadership development as a result of the UST program. Each is unique and tells a story that demonstrates their ability to take charge, step into leadership and make a difference for their organization and themselves. Some of these alumni graduated prior to the creation of the Leveraging Leadership for a Lifetime (LLL) course, but had leadership development through the earlier courses mentioned above. We include some of their stories since they have found their inner leader without benefit of the more deliberate LLL approach. Nevertheless, they have become leaders. They did it the hard way, and it took longer. The advantages of those who have had the LLL experience is they are more conscious of the process by which they are finding their inner leader, and are doing so at an accelerated pace. The names of individuals are pseudonyms since interviews were done in accordance with our Institutional Research Board policy. Nevertheless, the stories are factual. Masters graduation dates are indicated in parentheses (graduation year).

Wade Dennison (1994) held a variety of positions in industry, and had advanced to become a vice president of a leading medical device company when he identified a major structural problem in that industry. While working on strategic planning for his company, it became clear that a broader system's view of the biology based medical device industry was needed. Therapies for medical conditions are treated in many ways that include electronic devices, medical procedures and implants, and pharmaceuticals. These therapies are merging, and new gene based methods offer the promise of entirely new approaches in the future. Someone needed to take action on understanding these broader systems issues not only for the sustainability of his company, but for the many interrelated industries and the economy of the state. Wade left the secure industry position to form and organize a statewide partnership among industry, academia and government to tackle this broad issue. This organization has had remarkable success and is flourishing, changing the way that the biology based economic infrastructure is understood, articulated and implemented in the state.

Orrin Matthews (2006), a Project Manager from a major defense contractor, runs a virtual team of 36 people from six different cities. He has learned how to tap the wisdom of this team to come up with creative responses to cost challenges in the recent economic downturn. The team has repeatedly worked collaboratively and creatively to reduce costs while keeping them challenged and motivated. They saved the organization over $500K in a period of three months, by keeping their minds open, their heads up to potential opportunities, and changing the mindset of the whole organization.

As an up-and-coming R&D leader in a manufacturing firm, Jerry Johnson (2008) was given an opportunity to move into Operations, leading a major business unit. Shortly after his promotion, the business experienced a major downturn, and Jerry was laid off. He was shocked at the turn of events, having been seen as a high potential leader in his organization. Jerry immediately started an LLC organization with friends from his former company, working to bring about an innovative product for the military. Beyond this, he decided to do volunteer work helping people in Haiti and in South America, placing hand or foot powered grinders into their communities, helping people start small businesses and improve their life conditions. Jerry is an entrepreneur at heart, and didn't waste time with determining how to further hone his leadership skills through his entrepreneurial ventures, both social and private business. He has built a large network of people who have been helpful in many ways. He built his own confidence and tested himself through this experience. He has since been invited back to his original company to take a leader role in engineering, and has decided not to do that, at least not yet. He feels his recent experience has changed his philosophy in many ways. While he loves fixing problems, he is now dedicated to serving others, making the world a better place. He feels as a leader, you are constantly asked to stretch your comfort zone for taking on new challenges and new learning and he has taken the challenging road to do just that.

As a quality engineer in a major medical device firm, Corrine Anderson (1992) found her first and most meaningful leadership role after attending training on Just In Time (JIT), a new concept at the time. She approached her boss, and suggested forming a grass-roots effort to implement it in her company. He said 'go ahead'. She formed a team of interested colleagues, put a plan together to explain the goals to her team and then they just did it. She was passionate about change. The results were a 50% reduction in cycle time and large inventory reduction as well. For their work, the team won a company award. This initiative built Corrine's confidence and she's been unstoppable ever since.

Betty Jarrett (2007) is a high potential leader at a high technology company where she has had several positions over her 22 years, ranging from supply chain specialist to process improvement specialist to IT leader, with many variations of all of these roles. She is a black belt Six Sigma leader. She has traveled extensively, been put in charge of many challenging projects and moved in her career from one project to another about every 18 months. She is high energy, focused, and full of possibility thinking. She has had many successes at her company, has been the recipient of many awards, developmental opportunities and is extremely confident, "punchy" in her way of asserting herself with others, honest and open in her interactions, not afraid to let others know where her shortcoming are and/or her talents. She is proud to say she is focused on solving problems, knows how to move a project and the team to the best possible outcome. When told to move from A to B, she is very clear on how to get to that

goal, how to move people forward to that goal, and help everyone find a leadership role in achieving it. She is quick to give her team credit. She is authentic, real, and believes in full and responsible participation in doing what needs to be done. She is goal-oriented, believes that one succeeds by doing the best possible job where they are presently, and trusting the rest will come. She admittedly is a people person and believes in developing others to their highest potential. She is big on development. She has taken responsibility for her own development as well, is a high achiever who leaves no stone unturned. Give her any challenge and she will make it happen.

As a manufacturing engineer with a large manufacturing company, Nate Keys (1994) had been successful. He understood the technical people in his group and knew the job. However, when the plant manager position became open, he was approached to apply for the position. His boss' boss communicated his belief in Nate's skill. Nate met with the vice president and general manager to ask whether he thought he should move to manufacturing management. The vice president told him the main issue would be dealing with a wide variety of people and their problems. This was somewhat disconcerting to Nate. He did think some of his skills would match the job, even though he was good at keeping a lot of balls in the air. It was a risk moving outside his comfort zone, yet others felt he had the ability to succeed. He took the plant manager job. This step led to personal growth beyond his wildest expectations.

A Model Reflecting Culture Change

What is needed in industry and academia to identify, articulate and educate for the capabilities and mindset needed to lead? How can this be done? In our interviews with alumni, we witnessed this being done at high levels in some organizations, but more frequently at much lower levels. The more that leadership and culture change is championed by top management the better, but it doesn't need to wait for the 'boss'. One case from our interviews gives a good example.

Dan Jansen (1994) recalls his first significant leadership role in industry. He was a manufacturing engineer in an aerospace engineering company. A major aircraft project on which he was working was experiencing cost and schedule overruns. With that project completed, he was assigned to another project on the next generation product. Dan gathered some of his engineering colleagues together and, using learning from past experiences and from a graduate manufacturing program, he proposed changing the way they did this project. He recommended point of use stores near production, pull vs. push methods, and disposition of nonconforming product on the spot and other modern manufacturing thinking and methods new at the time. He didn't ask permission to do this, he just did it. It was the right thing to do. He sold the approach to those not familiar with these methods and because he had

thought them out well, his colleagues saw the merits and joined him. It made sense. Members of the group saw the benefits from their own perspective. They made sweeping changes that took management aback. The result was dramatic improvement: it took 180 days to get the first components manufactured; by the end of year one, they were producing one unit per day. He did this all without official sanction. The other engineers worked with him to develop a vastly improved process that resulted in on-budget and on-schedule performance. Dan was not asked to do this: he took the initiative to take charge, for the benefit of his company and of their customer.[5]

An instructive model of this significant performance improvement is outlined in the Honeywell Value Creation Model (Figure 4)[8]. This model demonstrates how organizations create value. Motivated employees create innovative processes that result in exciting products which generate repeat business, while at the same time creating lean operations which cut costs. The result is delighted stakeholders. This can only happen on a consistent basis, however, if the organization creates a culture that encourages innovation and supports employees who want to experiment, try new things and take risks.

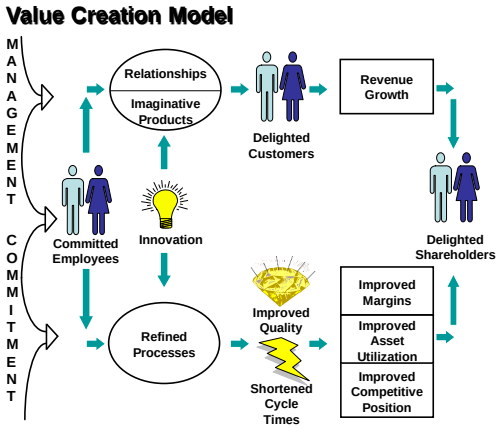

Figure 4. Value Creation Model

New Ways of Thinking

Prospective students usually ask what the University of St. Thomas School of Engineering graduate programs will do for them. Often they are thinking about whether they will get faster promotions or learn some secret of life. We have given this question a lot of thought, and there are a number of specific differences depending on the program. However, the overall major difference is that after going through any of the programs the students will think and act differently. When confronted with a specific situation prior to attending the program they can think of two or three ways of handling it. After completing the program, they will be able to think of 9 or 10 ways to deal with it. Their thinking will have opened up, they will have become more creative and innovative, and their options will become much greater. That is the greatest value our program has to offer. Our program has benefitted from a very close relationship with

industry that has led to this capability. Other programs, in partnership with industry, can do the same.

In the rapidly growing global economic environment, alumni talk about the need to be rapidly responsive, to be more innovative and creative, and to think differently. They need to practice active listening, to understand other cultures and to build on the knowledge of every individual in the organization. They need to empower others, to 'let go' of direct control, to allow others to grow. And yes, at times, to let others fail. As one CEO of a major corporation in Minneapolis told his employees, "I want you to try hard, and to make mistakes. You will learn a lot from them. Just don't make the same mistakes over and over."

Engineering Leaders Need to Change

As shown by the NSF data cited earlier (Figure 1), engineers become more and more engaged in management as their careers progress. However, based on our personal experiences and those of the alumni we interviewed, seldom are these individuals given appropriate education and development experiences to take on their duties as managers. Even fewer are provided training specifically on how to become an effective leader. In order to exercise creative and innovative leadership, they need to understand what leadership is and how to gain the capabilities necessary to release their inner leader. As one of our alumni noted when asked whether his job description included leadership expectations, he noted '*no, the most important things are never in the job description*.'

Industry needs to step up and include leadership development for all managers, particularly those educated in science and engineering, to make their organizations competitive in the future. The expectations required for leadership need to be included in the job descriptions, measured as part of annual performance reviews, and communicated to academia to be included in the curricula.

Survey of Engineering Deans

During the past year the authors have also conducted surveys of engineering school deans to determine their views on the need for leadership education for engineers and on their current capacity to deliver this kind of education. While only 46% of the schools responding said they offered leadership education for their undergraduate students, and an even lower 21% for graduate students, fully 100% felt leadership education for engineers was important.[9]

If leadership is so important to industry and to engineering deans and faculty, why are more programs not including it in their curricula? According to the survey, the major issues are time and space; time to devote to this topic, and space to put it in the already crowded curriculum. Driven by our Industry Advisory Board, we have created space in the graduate curriculum to include the required Leveraging Leadership for a Lifetime sequence. The mode of delivery is important, but can be modified depending on your program. What is critical is the leadership development content.

There are other ways this can be done by building parts of leadership learning into existing courses, part being done by student counseling, part being done through professional associations

and their student chapters, part being done by industry through internships and coop programs. There is an opportunity here for industry to play a major helping roll.

Call to Action: Industry & Academia Working Together

What can industry do to help engineering programs develop the leaders they need? Some ideas were suggested in the section above. Each program will be different, as are the needs of each company. It all begins with a discussion among the champions including industry leaders, deans of engineering schools, faculty, alumni and students. This might be initiated by the dean or chair of the Industry Advisory Board or a leader within a specific organization.

It is important to officially legitimize this partnership. To do so, the team of champions may begin with a formal facilitator to help the group determine its mission, purpose and clear objectives. From this place, it is important to outline roles and responsibilities for all to become actively involved to shape its agenda and plan. After some experience, it might be possible to move to rotational self-leadership of the group, always making clear what outcomes the group wants to promote and achieve.

The following list contains some possible actions you, as a group or an interested champion on your own, might initiate:

- First, gain clarity on the needs within an industry and its associated organizations. Identify the call that the organizations are hearing from their stakeholders, their organizational mission and the future requirements for bringing about real solutions. Recall the University of St. Thomas example of the Industry Advisory Board and their organizational leaders asking for leadership from their employees who are our graduate students.

- Define leadership competencies and requirements necessary today for effective leadership. Communicate those expectations loudly and clearly, helping all organizational members understand that they have the ability to step up to leading the organization to make effective changes.

- Create a talent management plan and process that identifies those potential leaders in your organization who need specific developmental supports to be put in place, ensuring they have a leading and learning plan in place for realizing their leadership ideals.

- Convey your leadership needs to academia, and ask academia to connect these to the EAC of ABET Criterion 3 on Program Outcomes and the schools Criterion 2 Program Educational Objectives. Identify educational program outcomes that will enhance the talent management process, whether designed in-house, or in partnership with a local university.

- If you are not already actively involved, join advisory boards of engineering programs.

- Establish a Professional Development Program for Engineers, resourcing it with appropriate champions, development experts, assessment tools, mentoring program and other resources that ensure the engineering profession is included in serious leadership development

- Offer to help in a personal way:
  - Act as mentor for engineering students within your mentoring program and develop a new mentoring program if there isn't one. Make sure to get appropriate expertise to make it successful.
  - Build leadership development experiences into your internships, coop programs, quality improvement programs and professional development plans.
  - Speak to student professional associations, and to faculty, on the partnerships that are working between academia to industry, or how to transition from one sector to the other and where that has benefited the leadership process.
  - Create an award/scholarship program for leadership achievements, reflecting the accomplishment of organizational and leadership expectations.

- Become an active EAC of ABET program evaluator for your professional association

- Speak at professional association meetings on the need for linking partnerships to meet the world's needs for technical solutions and what it takes.

- Create opportunities for continuing education of all employees to develop leadership capabilities and attitudes with mentors from within and outside your organization.

- Promote the ideas proposed in *The Magic of Mindset: Liberating the Leader Within*, and use workshops for helping organizations learn how to make effective change, starting with their talent management processes, working across the organizations to build effective teaming processes and developing leaders.

The key is to become involved, to share your needs and knowledge. The engineering schools in your area, we know from our survey, are open and willing to seek innovative ways to include leadership in their programs. Help them out, and you'll be helping yourself.

What faculty can do

It is clear that engineering programs are crowded. In addition to basics of science, mathematics and engineering, new technical developments need to be addressed. In many universities there are now additional pressures to reduce the number of credits for a bachelor's degree. How can additional material possible be included?

You may want to review syllabi for the Leveraging Leadership for a Lifetime courses[7] or ideas from recent work[5] for ideas, but as stated earlier, additional courses are not required. What is critical is the leadership development content. There are other ways this can be done by building parts of leadership learning into existing courses, using the EAC of ABET Criterion 3 as a guide; part may be done in partnership with your student counseling office, such as administering assessment tools and analyzing results with students; part being done through professional associations and their student chapters such as SME, ASME, IEEE, IE, etc; and part can done by structuring requirements for internships and coop programs with industry to include leadership components.

Conclusions

Addressing the cultural factors that become barriers for those working adults in science and engineering professions is a complex undertaking; this paper simply scratches the surface. There are societal beliefs and limitations, and organizational and industry beliefs, about who does what and why, and personal belief sets that working adults in these professions think are true about their roles and responsibilities. To address this multiple set of complexities goes far beyond the scope of this paper. However, it is these authors' belief that much can be done through partnerships among academia and industry to recognize some of the simple basics that can begin to create a wave of change for the sake of all.

We have proposed some of the beginnings of change that we have experienced, documented and personally witnessed with a growing population of working adult students. These students have come to realize their full potential and are beginning to make powerful contributions in their organizations that can only serve as ripple effects in their organizations and their industries. They are demonstrating what is possible, working hard to overcome barriers, and clearly having an impact on the cultural change process in their own organizations. Almost anything is possible when we begin to see and experience our own potential.

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