ASEE Engineering Leadership Development Division (LEAD)

Strategic Plan 2016-2020

Version 1.0

Calls for "engineers who are broadly educated, who see themselves as global citizens, who can be leaders in business and public service, and who are ethically grounded."

The Engineer of 2020: Visions of Engineering in the New Century
National Academy of Engineering, p. 5.

Strategic Planning Committee

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HISTORY

The genesis of our LEAD Division dates to 2010, when David Bayless and Ron Bennett formed an ASEE Constituency Committee to explore interest among ASEE membership on the topic of engineering leadership. Dave and Ron engaged about 60 members to form this committee in 2011, a number that grew to 200 by 2013. In June 2014, the Constituency Committee exceeded the 200-member threshold and the new ASEE LEAD division was formed that summer with 280 members. Once the division launched, membership grew rapidly to 724 in 2015 and it was during that summer that we decided to form a committee to craft our first strategic plan. This six-member strategy group began to work on this plan in November 2015 and worked continuously for seven months, completing this version on June 22, 2016. We followed a general methodology outlined in David Norton and Robert Kaplan's book, *The Execution Premium.* A more expansive history is included in the Appendices of this planning document.

MISSION

The ASEE LEAD Division serves as a collaborative consortium of engineering leadership development programs that prepare engineering leaders to realize their full potential to make dramatic contributions to their stakeholders.

VISION

The ASEE LEAD Division will support the creation of engineering leadership educational programs and outcomes, viewed by those who participate in the programs and those who hire the graduating students, as the best in the world.

VALUES

- Being proactive and impactful
- Encouraging each other to continuously improve the education and practice of engineering leadership
- Developing engineering leaders and followers who

  are courageous in the face of adversity,

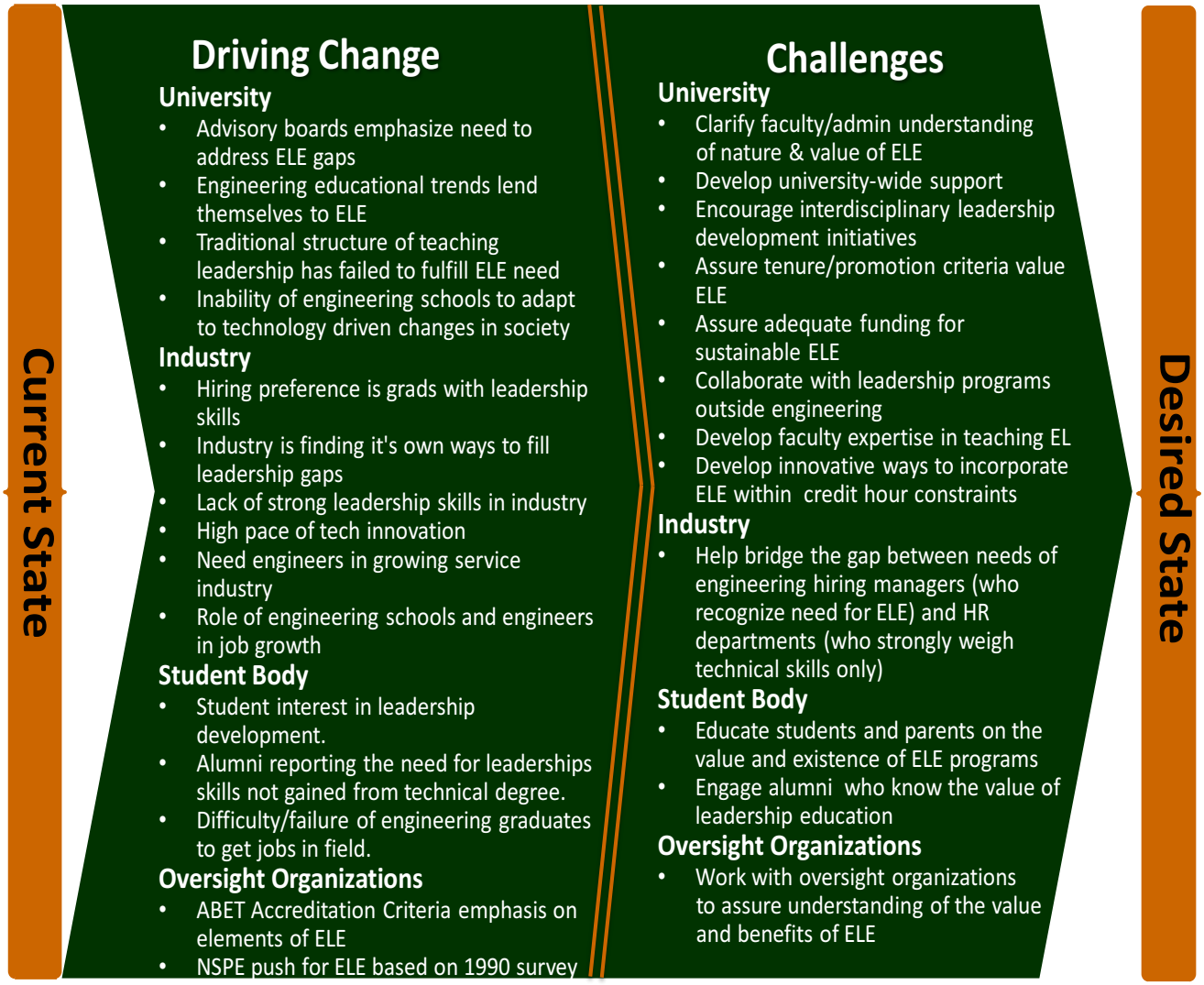
  continuously strive to reach their full potential,

  exhibit ethical and empathic inclusiveness, across cultures and nations,

  create value and deliver benefits to organizations and societies.

ANALYSIS OF CONTEXT: FORCES DRVING CHANGE IN ENGINEERING EDUCATION

The following graphic integrates our understanding of the many complex forces influencing the context of our programs in engineering leadership. The forces on the left illustrate those that we believe are driving the growing interest in educational programming. We believe these explain the "Current State", which today represents about 32 academic programs in engineering leadership across North America. The forces on the right represent the challenges that we face collectively, as engineering schools continue to create and implement new programs in engineering leadership. All of these forces help us understand the strategic context of change; forces that we must consider as we seek to achieve our new division's vision, which is embodied in our "Desired State". A more detailed analysis is provided in the Appendices.



STRATEGIC ISSUES, GOALS, OBJECTIVES AND MEASURES

Strategic Issue	Goals	Objectives	Measures
A. How to assist university administrators and faculty to understand the significant value of this new field in academia and practice	1. We will positively influence Dean's and department chairs so that they see the value of ELE	**1a.** Produce a white paper that outlines the value proposition of ELE (and or Unique Selling Proposition)	Growth in number of supportive deans
Implementation team leader: Simon Pitts	2. We will inform engineering faculty on how we staff our curricular programs	**2a.** Create white paper with a few sample programs of who teaches what and how. Post this to our ASEE website	Clicks or downloads of this white paper
	3. We will share our collective programs, program growth, and collective impact with the ASEE community	**3a.** Publish a PRISM article that summarizes our programs, our growth, and our impact. We have a point of contact and provide a link in this article to our ASEE website	Clicks on our website No. of inquiries to point of contact
B. How to resource ELE programs, such as funds, facilities, and capable faculty and staff	1. We will share how our programs originated, are organized, and how our delivery strategies vary	**1a.** Prepare an integrative summary of our programs and post this to our website	Clicks or downloads of this white paper
Implementation team leader: Kyle Gipson	2. We share how our programs are funded, our facilities footprint, etc.	**2a.** Prepare an integrative summary of funding, facilities, and other relevant information and post this to our website	Clicks or downloads of this information Survey ASEE members to assess impact of information

STRATEGIC ISSUES, GOALS, OBJECTIVES AND MEASURES (CONT.)

Strategic Issue	Goals	Objectives	Measures
C. How to effectively integrate within the curriculum, teach, and assess leadership development in engineering students from undergraduate to graduate to practicing engineers ***Implementation team leader: David Niño***	1. Niño will lead the creation of an edited book that will synthesize and codify what our university initiatives have collectively learned	**1a.** Create a project vision, recruit editors and authors, create and implement project plan	Number of hard/soft copies of book in use
D. How to develop a framework/model that describes the diverse Engineering Leadership needs of companies across industries. ***Implementation team leader: Mike Erdman***	1. We will conduct an industry segmentation process from which to identify unique leadership development needs for each segment. 2. Measure the preparedness of graduates from ELE programs to demonstrate that ELE graduates out perform traditional engineering graduates.	1a. Prepare breakdown by type of industry. Develop and distribute surveys to and conduct interviews with representative companies from each segment. 2a. Survey graduates to determine the self-reported usefulness of the programs. 2b. Survey Industry representatives to determine differences in preparedness of ELE students and traditional students	List of needs from industry segments Study results that show ELE program graduates outperform non-ELE graduates

Appendices

HISTORY OF THE LEAD DIVISION

History of ASEE LEAD Division

By David J. Bayless, Founding Director

ASEE's Leadership Development Division has been the work of many outstanding educators. But the initial formation was a result of the work of Rick Schumann, Ron Bennett and Dave Bayless. After reading Dr. Schuhmann's paper on Engineering Education (Schuhmann, Richard J. Journal of STEM Education: Innovations and Research, vol 11:3/4 (2010), p. 61-69) and Dr. Bennett's book (Leadership for Engineers: The Magic of Mindset, ISBN:978-0073385938), Dave reached out to both men with the idea of starting a division in ASEE focused on teaching leadership development to engineering students.

To make a long story short, we reached out to several colleagues practicing in engineering leadership development and found a great deal of work and interest in the area. Ron's network was extensive, having already surveyed engineering Deans on the topic. Rick was a member of the COMPLETE group, an existing best-practices group in leadership development for engineers and significantly contributed to the paperwork and administration necessary to launch the constituent committee.

With the paperwork filed and accepted by ASEE in October 2011, Ron and Dave met in San Antonio in June 2012 for the first business meeting of the committee. Having secured about 60 names of ASEE members interested in leadership development, we held our first election. Dave was elected Chair and Ron was elected Program Chair by unanimous consent We were off and running.

In 2012, Dr. Ann Saterbak, Chair of PIC II, took our by-laws to the ASEE Board and they were approved. We were officially enabled to hold sessions at the annual convention the next year. We needed 140 additional ASEE members to join the constituent committee before petitioning to become a division. However, we got to 200 members far faster than we had expected.

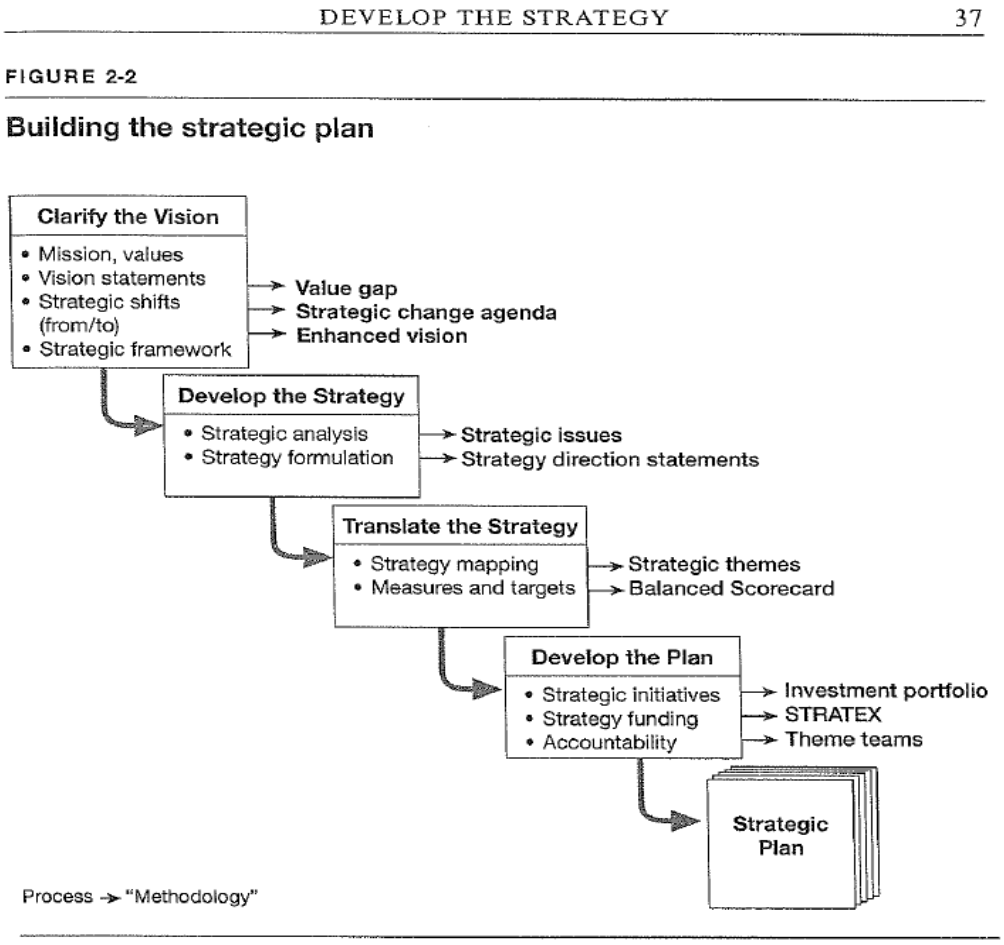
In 2013, Dave Bayless announced that with the members enrolled at the paper session, we now reached over 200 members for the division in just one year. Because of the interest and activity, we petitioned ASEE for final division status. Catherine Skokan, PIC II Chair helped guide us. We were told to expect to be able to explain difference between the goals of the leadership division and engineering management. Ron Bennett and an ad hoc group prepared a draft of the application stating why LEAD was ready to be a division: membership, activity level, and industry support were all key in the application.

During the 2014 ASEE meetings, the constituency committee formally petitioned for division status. Ron Bennett and Dave Bayless prepared the final petition for PIC II Chair to review and forward. We had a good case for division status. 280+ members with 30 more signed up this conference. 78 people attended our technical sessions with ten papers. The posters session was jammed. But the success did not end there. The COMPLETE meeting at Rice University in March

2014, which was a fantastic success, was also a key factor mentioned in the petition. On Wednesday, June 18, 2014, we were officially granted Division status.

STRATEGIC PLANNING METHODOLOGY

The graphic below represents the general framework we adopted to guide our process in crafting our strategic plan. David Niño had experience using this framework in the past and suggested it, in part, because of its strong emphasis on execution and measurement. We did not strictly align our work with its detailed prescriptions, but we were successful in walking through all of the major steps outlined below; Figure 2-2 from page 37 of Robert S. Kaplan and David P. Norton's (2008) *The Execution Premium: Linking Strategy to Operations for Competitive Advantage*, Boston, MA: Harvard Business School Press.



NOTES FROM STRATEGIC GOALS

Notes for Strategic Issue A (How to assist the understanding of ELE value add)

1b - Attached to this white paper will be a summary of the programs that are up and running to show viability and validity of running programs. We could also include letters of support – potentially: President (NU), Ian Waite (MIT), Dean's at RICE and PSU and SMU for example are all extremely positive and proactive (+ Prism article). We also list our configuration of faculty who teach in a few of our programs (MIT, NU, PSU, UTEP, etc…)

2a. A key message here is that we are teaching something that is in a context outside the experience of more conventional engineering topics, it is therefore essential to create the correct team composition of academic and engineering practice skills and experience.

Notes for Strategic Issue B (How to resource ELE programs)

1a. Should review what Penn State and others have already put together in terms of integrative analyses of our programs. We also put together a summary ranging from Grad to undergrad examples of the number of people used …. Also we need to specify the difference between "light touch" (i.e., impacting fewer students with shorter contact time with each) to: this impacts x0 students who are immersed full time and are coached, mentored and taught with a rich student to instructor ratio.

Notes for Strategic Issue D (How to develop an ELE framework/model across industries)

- There is a need for research on this topic of leadership preparedness in general. Prior lit reviews have only unearthed a couple ASEE papers on the topic.
- Would be interesting to look at students that quit the ELE programs (in addition to those that graduated).
- In conducting this research, we need to be able to show that the results of the program isn't due to self-selection of a unique set of students, but that the results are due to the programs themselves.
- Some longitudinal studies along the lines of perceived value of ELE have been started. (Ron at Univ. at St. Thomas for example.)
- Possible place of interest to conduct study would be Brigham Young where all students have to take a leadership course.

PROFILE OF ASEE LEAD MEMBERS (2015-2016 APPROX.)

422 - University Engineering Schools
90 – U.S. Technical Schools
58 – Foreign Engineering Schools
55 – Individual students
26 – Other individuals
19 – Community Colleges
17 – Corporations
12 – Military Academies
9 – High Schools
6 – Consulting Firms
6 – Professional Engineering Societies
3 – National Academies

DETAILED ANALYSIS OF DRIVING FORCES

Forces Driving the Emergence of Engineering Leadership Programs/Centers
Summary by Meagan Kendall
2/25/2016

"We live in a technological age, and if our society is to flourish, many of our leaders should be engineers, and many of our engineers should be leaders."

–Samuel Florman, The Introspective Engineer, 1997

Summary of Major Drivers (Forces Driving Change)

- Student interest in leadership development.
- Alumni are reporting the need for leaderships skills not gained from their technical degree.
- University and Departmental Advisory Boards are emphasizing the need to address the gaps in engineering educational outcomes.
- National Society of Professional Engineers push for integrative thinking, leadership, and teamwork based on 1990 survey.
- ABET Accreditation Criteria emphasis on development of project and professional skills and knowledge of social and global issues.
- Engineering educational trends, such as flipped classrooms and project based learning, etc., lend themselves to helping teach leadership.
- The traditional structure of schools within universities as "Silos" has caused business schools to fail to meet the needs of leadership development within these silos, especially engineering.
- Difficulty and sometimes failure of engineering graduates to get jobs in field.
- Employers are giving hiring preference to recent grads with leadership skills (Hart Research Associates Survey).
- Industry is finding their own ways to fill the gaps after hiring.

- Lack of strong leadership skills in industry (The Cara Group Inc., 2012).
- The inability of engineering schools to keep up with changes in society that are driven by technology and engineering.

DETAILED ANALYSIS OF DRIVING FORCES (CONT.)

- The current pace of technology change is extraordinary and this, by definition, gives rise to a need for greater leadership.
- The service industry is growing. While engineers have been integral in designing and maintaining these systems, they have also had to develop broad knowledge of such systems and have had to develop knowledge of business management and marketing strategies. (Paulson, 2006).
- Engineering and engineering schools play an important role in the growth of U.S. jobs and U.S. leadership in many economic sectors.

Gaps Between Engineering Education and Practice
Implementation Skills

- Delivery to performance, quality, cost & timing requirements
- "Front loading" (Considering downstream needs early and in parallel)
- Engineer for the "real" environment rather than an ideal environment
- Required rigor and robustness
- Program management
- Designing for manufacture
- Designing to avoid failure modes
- Personal Initiative
- Prototyping and Manufacturing Experience

Interpersonal Skills

- Leadership & Followership skills
- Influencing & motivating skills
- Communication skills (visual, verbal, and written)
- Team skills
- Interdisciplinary decision skills
- Organizational & social awareness
- Connecting across cultures
- Willingness to engage with others
- Persistence
- Sales
- Ethics

Breadth of Focus

- Stakeholder focus
- Market & Customer focus
- Competitiveness
- Enterprise understanding
- Business acumen
- Narrow Discipline focus

DETAILED ANALYSIS OF DRIVING FORCES (CONT.)

WHAT ARE THE CHALLENGES TO ENGINEERING LEADERSHIP EDUCATION? (Forces Resisting Change)

University

- Clarify faculty/admin understanding of nature & value of ELE
- Develop university-wide support
- Encourage interdisciplinary leadership development initiatives
- Assure tenure/promotion criteria value ELE
- Assure adequate funding for sustainable ELE
- Collaborate with leadership programs outside engineering
- Develop faculty expertise in teaching EL
- Develop innovative ways to incorporate ELE within credit hour constraints

Industry

- Help bridge the gap between needs of engineering hiring managers (who recognize need for ELE) and HR departments (who strongly weigh technical skills only)

Student Body

- Educate students and parents on the value and existence of ELE programs
- Engage alumni who know the value of leadership education

Oversight Organizations

- Work with oversight organizations to assure understanding of the value and benefits of ELE

Evidence for the Gaps and Drivers for Leadership

Personal Industry Experience of Faculty

- R.J. Bennett – "As a young engineer I proposed an idea to the president of my company. He said, 'Great idea – now go sell it!' I had no idea what he was talking about. It took 13 more years of experience to get it."
- R.J. Bennett – "Later, as an engineering manager, I was disappointed in the engineers' lack of initiative, lack of ability to express themselves clearly, lack of vision of the big picture. I took steps within my organizations to provide additional training, but it was never quite enough."
- R.J. Bennett – "When I eventually became a sales executive selling an intangible knowledge product to engineering groups in companies, I learned about social styles. In eight years I visited 2,000 companies and met with countless engineers and engineering managers. I estimate that fewer than 5% demonstrated leadership and initiative, about the same ratio as those who are early adopters in the general population. The tremendous talent of these engineers was sub-optimized by the lack of leadership skills. What a waste."

1990's NSPE Survey – In the mid 1990s, the National Society of Professional Engineers conducted a survey asking employers what they considered to be the most important characteristics of an engineer, and how well educational programs were doing in preparing engineers with those characteristics. As might be expected, math and science were important, and engineers were judged to be well-prepared. But other characteristics like integrative thinking, leadership, and teamwork were of even higher value, but graduates were judged to not be well prepared, especially in leadership.

Employer Perspectives

- A panel of engineer hiring managers at the ABET Symposium in 2015, referencing the ABET Student Outcomes a-k, was asked what were the three most important characteristics they looked for in new engineer hires. The panel identified 1) putting the team above personal, 2) communications ability and 3) lifelong learning. All leadership related traits.
- This movement may have been a part of what caused ABET to shift their accreditation criteria, in 1996, from a content base to an outcomes base and include learning outcomes that required students to develop project and professional skills (e.g., communication, team management, and ethics) as well as knowledge of social and global issues. However, based on the survey of students and employers in 2004 by Lattuca, Terenzi, and Volkwien (2006), students were feeling better prepared than their counterparts were in 19994. Employer responses were mixed and felt less optimistic about improvements in students.

Lattuca, L. R., Ternzini, P. T., & Volkwien, J. F. (2006). Engineering change: A study of the impact of EC2000. Baltimore: ABET, Inc.

- From January 9 to 13, 2013, [MK1] Hart Research Associates conducted an online survey among 318 employers whose organizations have at least 25 employees and report that 25% or more of their new hires hold either an associate degree from a two year college or a Bachelor's degree from a four-year college. Respondents are executives at private sector and nonprofit organizations, including owners, CEOs, presidents, C-suite level executives, and vice presidents. (https://www.aacu.org/leap/presidentstrust/compact/2013SurveySummary)

Overview

- Innovation is a priority for employers today. Nearly all employers surveyed (95%) say they give hiring preference to college graduates with skills that will enable them to contribute to innovation in the workplace.
- Nearly all those surveyed (93%) agree, "a candidate's demonstrated capacity to think critically, communicate clearly, and solve complex problems is more important than their undergraduate major."

- More than nine in ten (90%) of those surveyed say it is important that those they hire demonstrate ethical judgment and integrity; intercultural skills; and the capacity for continued new learning

The gap described above has also pushed some companies to establish their own programs. IBM for instance created their own Service Science, Management, and Engineering program (SSME). SSME is a "a growing multi-disciplinary research and academic effort that integrates aspects of established fields like computer science, operations research, engineering, management sciences, business strategy, social and cognitive sciences, and legal sciences" (IBM, 2010). SSME attempts to "increase productivity and innovation in services-related industries and tasks by applying scientific means and methods" (Paulson, 2006).

- IBM. (2008) Service Science, Management, and Engineering, IBM Systems Journal, Vol. 47, Iss. 1. http://researchweb.watson.ibm.com/journal/sj47-1.html
- Paulson, L. D. (2006). Service science: A new field for today's economy. Computer, 39(8), 18-21.

IBM also describes what they call "T-shaped" engineer (IBM, 2009, p. 1). A T-shaped engineer has deep knowledge of certain technical skills (the vertical axis of the T). But they also have a "sufficient understanding of a broad range of related disciplines to allow them to see contextual linkages, to constructively participate in interdisciplinary teams, and to continually adapt their visions and their contributions to rapidly changing conditions and needs" (the horizontal axis of the T).

- IBM. (2009). Beyond IT: IBM's role in creating the workforce of the future. Retrieved from 05.ibm.com/de/ibm/engagement/university_relations/pdf/Beyond_IT_report_IBM_Workforce_of_the_Future.pdf

A national survey by The Cara Group Inc. (2012) of Fortune 1000 companies found that 62 percent of respondents identified a leadership skills gap in their organizations, and 84 percent increased their focus on leadership development in the last two to three years. (CARA, 2012, http://www.caracorp.com/news-events/press-releases/2012-press-release-archive/84-of-companies-report-renewed-focus-on-leadership-development-according-to-cara-survey/).

Advisory Boards

- University of St. Thomas - In 2000, the UST Industry Advisory Board required leadership development be included in our new Master of Science in Technology Management degree program, inspiring the development of our Leveraging Leadership for a Lifetime course series.
- UT El Paso – At our first advisory board meeting in Jan. 2016, the E-Lead Advisory Board shared personal stories about their own experiences with the "Gap" between engineering education and practice. They emphasized leadership, communication, business, and hands-on experience.

DETAILED ANALYSIS OF DRIVING FORCES (CONT.)

Rapidly Changing Technology

- The inability of engineering schools to keep up with changes in society that are driven by technology and engineering
- The current pace of technology change is extraordinary and this, by definition, gives rise to a need for greater leadership
- The rapid evolution of biotechnology, nanotechnology, materials science, and computing has placed new sets of demands on graduating engineers in these disciplines to solve problems in new ways (see the "Engineer of 2020" for lots of supporting data)
- Each of the macro problems associated with the NAE's "Grand Challenges" are driving the need for leadership among engineering graduates
- Advances in information and communications technologies have also caused many industries to shift focus from developing products to providing service systems. While engineers have been integral in designing and maintaining these systems, they have also had to develop broad knowledge of such systems and have had to develop knowledge of business management and marketing strategies. In the US, approximately 80 percent of the economy is represented by the service sector (Paulson, 2006).

Needed for Job Growth and Economic Development

- Engineering and engineering schools play an important role in the growth of U.S. jobs and U.S. leadership in many economic sectors (see the Taking Action, Building Confidence Report from the President's Council on Jobs and Competitiveness)
- An aggregate example of the cost of this lack of competitiveness is shown below in terms of the negative US trade balance of Hi-Tech and All Manufactured Products.

Leadership Education Limited for Engineers

- The traditional structure of schools within universities into "silos" has caused business schools to fail to meet the needs of leadership development within these silos, especially engineering

Lack of Leadership in Profession

- As others have pointed out, I think engineering as a profession has experienced strains resulting from a lack of competent leaders and managers. But I'm not yet convinced that engineering is unique in this regard. There are many sources of evidence that managers and leaders in U.S. companies, in general, tend to be incompetent performers in their roles. Here's just one example of a recent poll http://www.gallup.com/businessjournal/167975/why-great-managers-rare.aspx See also many reports and reviews by the Center for Creative Leadership and Hogan Assessments on the subject of "Management Derailment" http://www.hoganassessments.com/_hoganweb/documents/Management_Derailment.pdf All of these studies point to a widespread trend in U.S. society of incompetent (and sometimes toxic) leaders and managers.

DETAILED ANALYSIS OF DRIVING FORCES (CONT.)

Other Publications

Beyond Study Abroad: Preparing Engineers for the New Global Economy

- "To remain competitive in the global workforce, American engineers must develop broader perspectives and new teamwork and entrepreneurial competencies to supplement preparation in the traditional technical subjects . . . The NAE report on Educating the Engineer of 2020 listed 'team, communication, ethical reasoning, and societal and global contextual analysis skills as well as understand work strategies were essential for the American technical workforce of 2020.' In addition to those, the study also identified attributes needed beyond technical competence including 'creativity, ingenuity, professionalism, and leadership.'"
- Miller, R., & Way, O. (2007). Beyond Study Abroad: Preparing Engineers for the New Global Economy. Unpublished paper, Olin College of Engineering, Needham, MA.

Leadership Skills Development for Engineers

In 1994, the Green Report (http://www. asee.org/pubs2/html/green report.htm) recommended that engineering education reform be accelerated to include:

- Team skills, including collaborative, active learning;
- Communication skills;
- Leadership;
- A systems perspective;
- An understanding and appreciation of the diversity of students, faculty, and staff;
- An appreciation of different cultures and business practices, and the understanding that the practice of engineering is now global;
- Integration of knowledge throughout the curriculum;
- A multi-disciplinary perspective;
- A commitment to quality, timeliness, and continuous improvement;
- Undergraduate research and engineering work experience;
- Understanding of the societal, economic and environmental impacts of engineering decisions; and
- Ethics

"Many of these skills have been taught under the guise of senior design while the basic and engineering sciences advocated by the Grinter Report have remained literally unchanged in engineering curricula for over 50 years."

-Farr, J., & Brazil, D. (2009) Leadership Skills Development for Engineers. Engineering Management Journal, Vol. 21, Iss. 1, pgs 3-8

DETAILED ANALYSIS OF DRIVING FORCES (CONT.)

The Engineer of 2020

- Calls for engineers who are "broadly educated, who see themselves as global citizens who can be leaders in business and public service, and who are ethically grounded" (National Academy of Engineering [NAE], 2004, p. 5)
- "At their core they call for us to educate technically proficient engineers who are broadly educated, see themselves as global citizens, can be leaders in business and public service, and who are ethically grounded."
- National Academy of Engineering. (2004). The engineer of 2020: Visions of engineering in the new century. Washington, DC: National Academies Press.

DETAILED ANALYSIS OF STRATEGIC ISSUES

Strategic Issues

1. Rapid growth of Engineering Leadership programs across the country
   - Program diversity
   - Need for common language
2. Legitimacy of Engineering Leadership programs within universities
   - Lack of consistent understanding/credibility with administration, faculty, students, and other stakeholders.
   - Perception of there being a lack of vigor or value in the discipline
   - Has the growth exceeded the demand curve?
   - Issues with getting university stakeholders to both understand and value the need for engineering leadership
3. Curricular capacity to include Engineering Leadership education
4. Lack of a unified message on the need for and framework/definition of Engineering Leadership from (need to develop model for Engineering Leadership development):
   - Industry
   - Across all companies
   - Across different levels within a single company (HR vs. Engineering)
   - Professional Organizations
   - Academic Organizations
   - Educational issue of showing stakeholders where they fit into the framework of Engineering Leadership development
   - The variability of perceived needs in leadership education based on point in their career.

DETAILED ANALYSIS OF STRATEGIC ISSUES (CONT.)

5. How to actually teach and assess leadership development in engineering students. (Once there is a framework for Engineering Leadership) Areas such as:
    - Capabilities
    - Skills
    - Motivations
    - Attitudes
    - Identities
    - Behaviors
6. Resource availability to initiate and sustain Engineering Leadership programs
    - Space
    - Funds
    - Faculty
        - Attract - those with experience in leadership
        - Retain
        - Instruct
        - Develop courses
        - Curriculum
7. How to organize and collaborate amongst the diverse centers (in industry, academia, professional societies, etc.)