

ENGINEERING LEADERSHIP AND INNOVATION PROGRAM



KANSAS STATE
UNIVERSITY

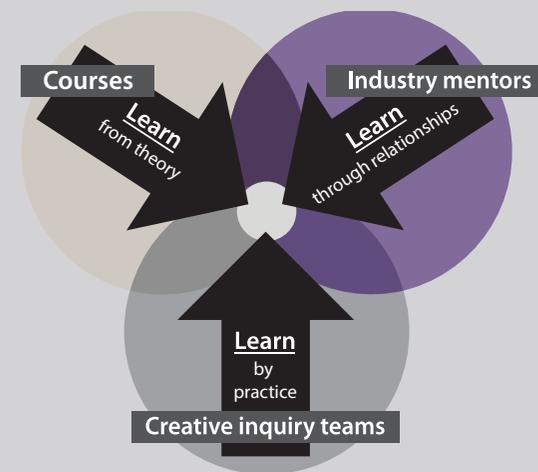
Carl R. Ice
College of Engineering

THE ELI PROGRAM AT A GLANCE



The Kansas State University Carl R. Ice College of Engineering program, Engineering Leadership and Innovation, or ELI, was developed in response to alumni feedback, corporate discussions, government initiatives and opinions of professional societies that a need exists for technical leaders with a broad understanding of how engineering is practiced in a rapidly changing business environment. The complexity of problems facing today's industries requires leaders with both technical and team management skills to solve complex problems that require careful assembly of the social, cultural, ethical, political, economic, business and engineering pieces.

The ELI program will prepare engineering students for potential leadership roles in these types of dynamic environments. Participants enter the four-semester program in their junior year, and will receive a scholarship to take leadership and business courses, learn from an industry mentor, meet with industry leaders and practice hands-on leadership within a creative inquiry team or student organization. The program draws on the unique Staley School of Leadership program, the reputation of the College



of Business Administration, the success of student-led engineering creative inquiry teams in national competitions and our strong connections with our corporate partners. Approximately 20 junior-level students will enter the program each spring, which will yield a total of 40 student participants per year.

Vision

The Engineering Leadership and Innovation (ELI) program will prepare exceptional engineering students for leadership roles in diverse and inclusive organizations that flourish in a dynamic business environment operating under complex social, cultural, ethical, political, economic, business and engineering factors.

Mission

The ELI program will —

- equip students with the skills and confidence needed to lead real-world engineering projects;
- strengthen students' classroom learning through a leadership practicum on a creative inquiry team or student professional organization;
- help students build a realistic career plan directed toward engineering management;
- build students' appreciation of nontechnical factors that affect technical decisions; and
- exemplify an inclusive culture where multiple perspectives are valued as key to engineering solutions.

Approach

Participants learn business and leadership theory through coursework, and define a personal leadership development path through engagement with mentors. Participants will then create and implement innovative solutions on creative inquiry teams. They will document their leadership journey using standard measurement tools interpreted in collaboration with the mentors.

TRAINING LEADERS FOR TOMORROW



In the National Association of Colleges and Employers' Job Outlook 2015 survey, when asked which attributes they look for on a candidate's resume, the largest group of respondents — 77.8% — chose both "leadership" and "ability to work in a team."

There is a need to provide leadership training.

The engineering curricula in the eight different departments and 13 degree programs ensure that we graduate practitioners of leading-edge technology. Our engineering programs are accredited through the national organization ABET, which defines broad-based engineering competencies; and the K-State 8 program, which helps students widen their perspectives, explore relationships among subjects, and build critical and analytical thinking skills. We know we are training highly qualified engineers as our graduates are highly respected and sought after in the job market; still, based on our discussions with alumni and other business leaders, there is an opportunity for our students to further customize and specialize their education with leadership and innovation skills training.

There is rationale for training leaders.

About one-third of CEOs leading S&P 500 corporations hold undergraduate degrees in engineering. K-State engineering alumni are on the forefront of this trend of engineers as leaders. The college has a rich history of producing engineers who move to the top of management structures to lead companies and public sector organizations. We seek to leverage and build upon our strengths to continue this tradition. Research has shown that leaders are "mostly made" — about one-third natural talent and two-thirds environmental influence. The fact that leadership is mostly made means that leaders can indeed be developed through appropriate training.

Mentors are needed to complement the training students already obtain in their technical programs.

Mentors can provide undergraduates information about poorly documented career knowledge such as engineering career options and job expectations, as well as help them to acquire skills for lifelong learning and professional success. Mentoring is often about the qualitative and subjective parts of an engineering career — dealing with frustration, giving constructive criticism, handling disappointment, and behaving with humility and compassion.

Industry mentors must be involved in student training to harmonize expectations between employers and students.

One goal of engineering education is to provide skills and instill attitudes that prepare students for an engineering career. To this end, activities and attitudes of the students must match employer expectations. A recent survey of employers and students by the Association of American Colleges and Universities, or AACU, revealed a wide gap between how students perceived their skills and how employers perceived those same skills. The survey shows a

close agreement between college students and employers on the importance of both field-specific knowledge and skills, and a broad range of skills and knowledge that apply to a variety of fields. However, students are out of sync with employers in their perception of their possession of these skills. Students express much greater confidence in their preparedness than employers indicate they see demonstrated. Employers give college graduates low scores for preparedness across learning outcomes; students think they are better prepared.

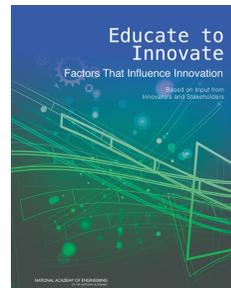
TRAINING INNOVATORS FOR TOMORROW



Innovation skills and attributes must be purposefully added.

A recent National Academy of Engineering, or NAE, report opens by stating that robust innovation in the United States is key to a strong and competitive industry and workforce. To remain a leader in the global marketplace, the United States must significantly enhance its innovation capacities and abilities among both individuals and organizations.

Innovators have a deep understanding of the basic principles of their field, including experiential and/or technical knowledge. Robert Fischell, past NAE chairman and president, said, “You must begin with a comprehensive knowledge of science and engineering.” Thus, K-State engineering is already meeting the first requirement of building innovators through our technical training. However, there is a need to teach our students to be innovators.



Innovation is an “improved product, process, or service that benefits society in a timely and, sometimes, transformational manner” and “is a team activity at the intersection of different fields, bringing together diverse ideas, abilities, and/or methods to result in the creation of value.”

— National Academy of Engineering Report “Educate to Innovate”

Environments and experiences must be created for innovation training; creative inquiry teams are a ready platform.

The NAE committee describes a new “framework for factors that contribute to the success of innovators” that includes three major components: environments, experiences and skills. Some of the experiences cited as contributing to innovative abilities are interdisciplinary collaborations, industrial experience, mentorship, role models, and identification and solution of open problems. The ELI training must therefore provide the proper experiences. Environments are closely linked to experiences and can be described as “an immersive experience, which is appropriate to the cultivation of an innovative mindset.” Finally, several skills needed for innovation, beyond expertise in the field, are described and include creativity, willingness to take risks and to fail, passion, the ability to work at the interfaces of disciplines and the ability to sell an idea. An innovation program must enhance all three criteria — environments, experiences and skills.

Each year, hundreds of students participate on more than 20 creative inquiry teams. K-State’s creative inquiry teams, a highly successful blend of undergraduate research and practice, compete in regional, national and international events, which are sponsored by technical societies and professional organizations, on topics ranging from wind power to unmanned aircraft. Participation on a creative inquiry team by default means students are participating at the “intersection of different fields, bringing together diverse ideas, abilities and/or methods to result in the creation of value.” Such an experience can provide the environment and experience described in the NAE innovation training model, as well as help foster technical and nontechnical skills.

PROGRAM ELEMENTS

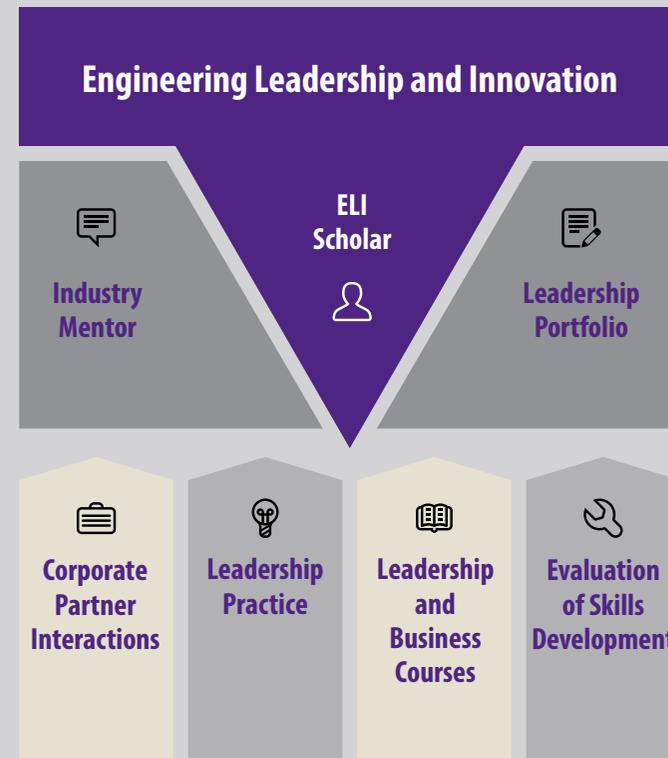


TIMELINE



Primary program elements are as follows:

- » Coursework in leadership and business
- » Leadership practice
- » Engagement with an industry mentor
 - On-campus corporate events
 - On-site facility tours
- » Leadership portfolio
 - Leadership development plan
 - Leadership essay (senior year)
 - Reflections, photos and plans
- » Evaluation of skills development
- » Scholarship of \$3,000 per year



Participants will enter the ELI program in their junior year and follow it for four semesters. The leadership program augments participants' technical work starting with foundational training through courses in the Staley School of Leadership and the College of Business Administration. ELI participants will then work with an industry mentor to apply, through practice, the principles of effective leadership. The leadership practice will take place on a creative inquiry team as the participant works within the team to complete an engineering challenge.

Prerequisites		ELI Program	
Freshman	Sophomore	Junior	Senior
Creative inquiry team or student organization (two semesters participation)		Creative inquiry team or student organization (three semesters participation)	
LEAD 212		Coursework in business and/or leadership studies (select two of the seven courses offered)	
Application		Leadership development plan Corporate partner interactions	Leadership development plan Leadership essay Corporate partner interactions
		Self-evaluation	Self-evaluation 360° evaluation
		Scholarship (\$3,000 per year)	

COURSEWORK



LEADERSHIP PRACTICE



Before entering the program, applicants must have taken LEAD 212 - Introduction to Leadership Concepts, which is organized to provide students with a broad overview of leadership theories, an introduction to ethical decision making, identification of personal leadership styles and current societal issues for leaders. Participants can then tailor their coursework by selecting two of the following five courses:

Leadership Studies Courses

LEAD 350 - Culture and Context in Leadership is organized to provide students with an opportunity to integrate the course and leadership experiences in light of contemporary issues in the study of leadership behavior across cultures and contexts. The course is based on the current research and writing that introduce and discuss the impact of culture and context on the concept of leadership and development of individuals as interculturally competent leaders.

LEAD 405 - Leadership in Practice provides an opportunity to engage in a leadership practicum to understand the process of facilitating change in self, others and systems. The course is designed to develop the capacity to exercise leadership to make progress on personal and community issues.

Business Courses

ACCTG 231 - Accounting for Business Operations is an introduction to the operating activities of businesses, and the roles that accounting information plays in planning, evaluating and recording those activities. An introduction to financial statements is included.

ENTRP 340 - Introduction to Entrepreneurship examines the entrepreneurial process. We will focus on business start-up but will also address organizational entrepreneurship or "intrapreneurship." We will address the process of creativity and innovation and its impact on the success of business start-up. Specific topics covered include new venture planning, marketing, financing, and management. This course will serve as a strong foundation for those aspiring to own and operate their own businesses as well as a real-world heads-up course for students who acknowledge that their future in businesses could very well benefit from examining projects in an entrepreneurial way. (Prerequisite: none)

ENTRP 350 - Technology and Innovation Management aims to equip students with an understanding of the main issues in the management of innovation and an appreciation of the relevant skills needed to manage innovation at both strategic and operational levels. The course focuses on four themes: (1) the source, discovery, and evaluation of innovation and opportunities; (2) the provisions of innovation (products and services) that satisfy the needs of customers; (3) the development of mechanisms to appropriate the returns from the exploitation of the innovation; and (4) the organization of efforts to innovate. (Prerequisites: ENTRP 340)

MANGT 420 - Management Concepts introduces managing organizations through fundamental processes of developing plans, structuring work relationships, coordinating effort and activities, directing and motivating subordinates, and controlling. It also includes managerial roles and responsibilities, effective decision making, productivity improvement, and models and theories of human behavior.

MKTG 400 - Introduction to Marketing is a general study of marketing principles which lead to development of marketing strategy. It includes a review of environmental influences and key analytical tools used in formulating marketing plans, as well as product or service design, distribution, pricing and promotional programs.

A key element of the program is for participants to execute and then evaluate the effectiveness of leadership techniques. Creative inquiry teams are student-led with support from a faculty adviser. Creative inquiry teams at K-State are designed to develop cutting-edge research ideas into a competition solution. Professional organizations pose challenging problems they expect from first-hand experience are difficult to solve and will test skills needed in industrial practice after graduation. The competition organizers know the winning solutions will require innovative ideas that can be shaped to meet realistic constraints such as safety, cost or time limits, the way real-world research and development is done. These are daunting challenges that require strong leadership to solve. Thus, the ELI program will promote participation and leadership on a creative inquiry team or student organization.

The teams will be strengthened by having trained leaders. ELI program participants will learn from attempting to apply leadership theory to motivate their fellow students. ELI program participants should be a member of a creative inquiry team for at least three semesters while in the program. It is generally expected the participant will work with the same creative inquiry team or student organization and ultimately seek a leadership position (e.g., president or treasurer). The creative inquiry team or student organization



will provide an environment where participants can practice leadership skills learned in their coursework and apply knowledge gained from their mentor.

LEADERSHIP PORTFOLIO



The two-year ELI program is an individualized leadership journey. Each participant will create an electronic portfolio comprising plans, major activities in the program and reflection on progress towards goals. The leadership portfolio will have feedback from program leaders, mentors and other participants.

Major components include —

- » Leadership development plan, developed with a mentor, including timeline and goals.
- » Record of scores of the three Student Leadership Practices Inventory surveys.
- » Files to document leadership experiences and activities throughout the ELI program. Examples include resumes, photos, notes and quotes.



MENTORING



Participants will be assigned to a mentor group comprised of an industry mentor from one of the college's corporate partners and ELI participants. The group will serve as the connection point of mentors and mentees. The goal of this component of the program is to help ELI participants learn the tacit aspects of engineering practice. Qualified mentors will have leadership/management experience and will be willing to devote six hours per semester to interacting with the mentees in their mentor group via email, phone, video chat or face-to-face meetings.

Each mentor will guide and organize his or her mentor group. Primary responsibilities are as follows:

- » Organize regular contact with the group, at least monthly.
- » Guide leadership exploration exercises. The mentor will use this as the opportunity to tell the mentees about his or her own leadership journey.
- » Coach mentees as they respond to the leadership assessment reports. The role of the mentor will be to help mentees face candid evaluation while challenging them to undertake constructive personal reflection.

ASSIGNMENTS



Participants will complete two assignments over the course of the program that will help them reflect on and document their individual leadership journeys. They will work with their mentor group to analyze how good leaders behave, develop a plan for their own leadership development in the ELI program, establish career goals and analyze their experiences in the ELI program in preparing them for leadership. The two assignments are —

Leadership development plan — ELI participants will document their career goals and plan leadership activities in the ELI program. Upon entering the program, participants will meet with their mentor group to prepare a set of goals and planned activities. At the start of each subsequent semester, participants will highlight successes and respond to challenges during the previous semester. Participants' leadership development plans will then be updated for the coming semester.

A leadership essay will be the culmination of the ELI program. Participants will work with their mentor groups to summarize and interpret leadership activities on creative inquiry teams or student organizations into a five-page essay.

Participants will visit and meet with industry executives to take part in tours at corporate partner facilities. The corporate partner tours will allow participants to gain knowledge on employer expectations, which will help participants prepare for an engineering career. Throughout the program, ELI participants will meet with representatives from our corporate partners while they are on campus for company spotlight events.

EVALUATION



From the Student Leadership Practices Inventory, or Student LPI, a commercial tool marketed under the Leadership Challenge brand: "Applying the proven principles of Kouzes and Posner's acclaimed Five Practices of Exemplary Leadership® model, the LPI enables individuals and organizations to measure their leadership competencies and act on their discoveries. Leaders will gain deep insight into how they see themselves as leaders, how others view them, and what actions they can take to improve their effectiveness." This helps students determine actions that will improve their leadership skills.

Measurement is made against the Five Practices leadership model, which says leaders will —

- Model the way.
- Inspire a shared vision.
- Challenge the process.
- Enable others to act.
- Encourage the heart.



Participants will use both versions of the Student LPI —

- Self-assessment** in which the ELI participant answers a set of questions about her or his own interests and attitudes.
- 360° assessment** in which the ELI participant answers a set of questions about his or her own interests and attitudes, and can select team members, mentors and instructors to answer the same questions.

¹The Five Practices of Exemplary Leadership. 9/28/15. <http://www.studentleadershipchallenge.com/About/Five-practices.aspx>



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