

Cornell Engineering: “Division of Engineering Practice”

ENGINEERING COLLEGE COUNCIL

OCT. 21, 2016



Need for Professional Skills Broadly Recognized

ABET, organization that accredits many Cornell Engineering Programs, enumerates 11 “student outcomes”

- a) Fundamental knowledge
- b) Conduct experiments
- c) Design systems
- d) Multidisciplinary teamwork
- e) Solve engineering problems
- f) Understanding of professional ethics
- g) Communicate effectively
- h) Broad education to understand impact of engineering in society
- i) Desire for life-long learning
- j) Knowledge of contemporary issues
- k) Use of modern engineering tools

Need for Professional Skills Broadly Recognized

ABET, organization that accredits many Cornell Engineering Programs, enumerates 11 “student outcomes”

Many of these coincide with the larger professional practices

- a) Fundamental knowledge
- b) Conduct experiments
- c) Design systems
- d) **Multidisciplinary teamwork**
- e) Solve engineering problems
- f) **Understanding of professional ethics**
- g) **Communicate effectively**
- h) Broad education to understand impact of engineering in society
- i) **Desire for life-long learning**
- j) Knowledge of contemporary issues
- k) Use of modern engineering tools

ABET requires continuous review of curriculum ... an opportunity???

So what are we already doing

...

Cornell is already at the forefront
of experiential learning

Engineering in the 21st Century



Create, Lead, Disrupt, Invent

CornellEngineering



Cornell's Experiential Programs

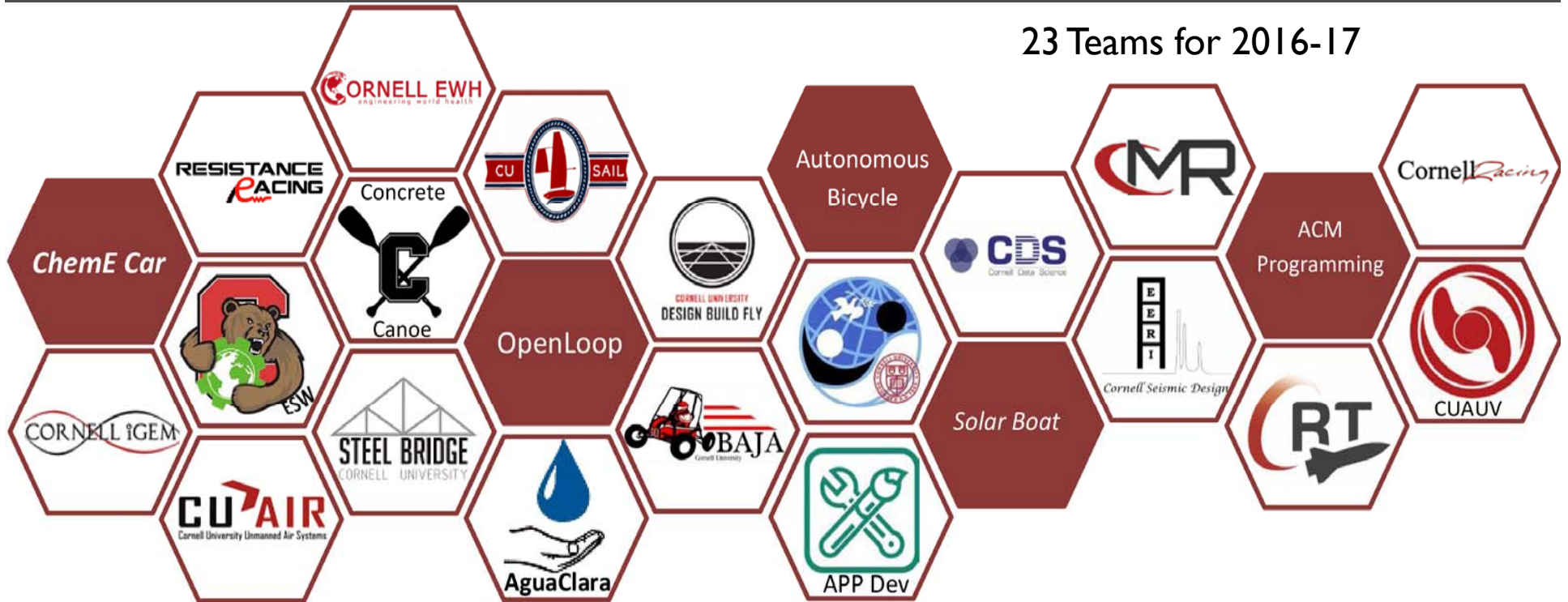
Learning By Doing

- Coop program
- Business Minor with the Dyson School
- Entrepreneurial Minor
- **Project Teams (Swanson endowment)**
- eLab/PopShop and eHub Expansion
- Kessler Fellows
- Engineering Leadership Program
- Product Design and Manufacturing Institute



2016-2017 Project Teams

23 Teams for 2016-17



- One of largest program of its kind in the country with over 1,000 student participants
- Over \$1 million dollars of funding for 2015-2016
- Multidisciplinary collaboration across 14 Engineering majors and 7 undergraduate colleges/schools

eHub Incubator



15,000 sq ft

Joint with Student Agencies

5 Colleges (CALs, CoE, COB: Johnson, SHA, ILR)

Courses and mentoring

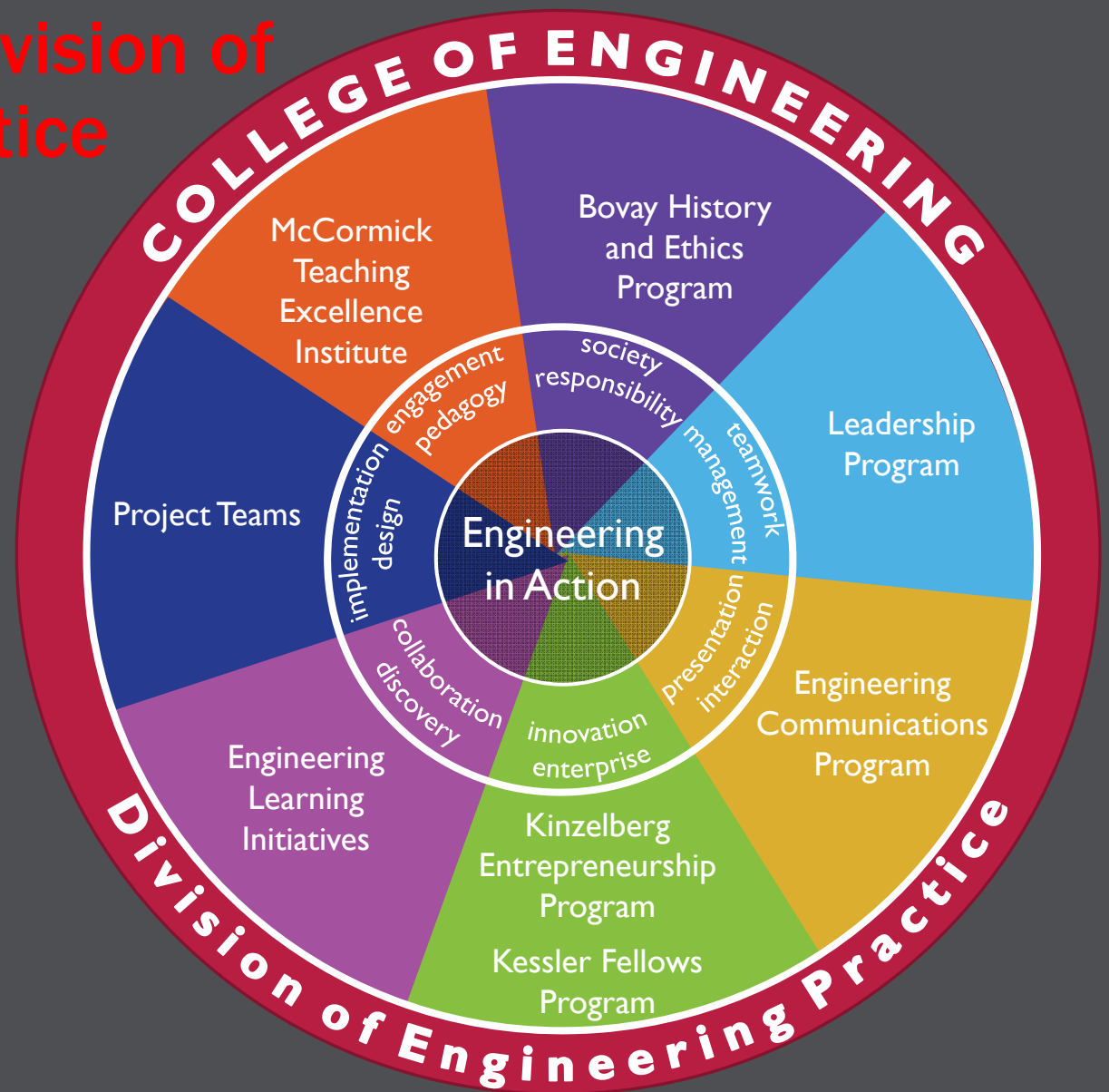
How can we better support these teams

...

and how can we bring this experience into the curriculum to support all of our undergraduates

Bring Together: Division of Professional Practice and Development

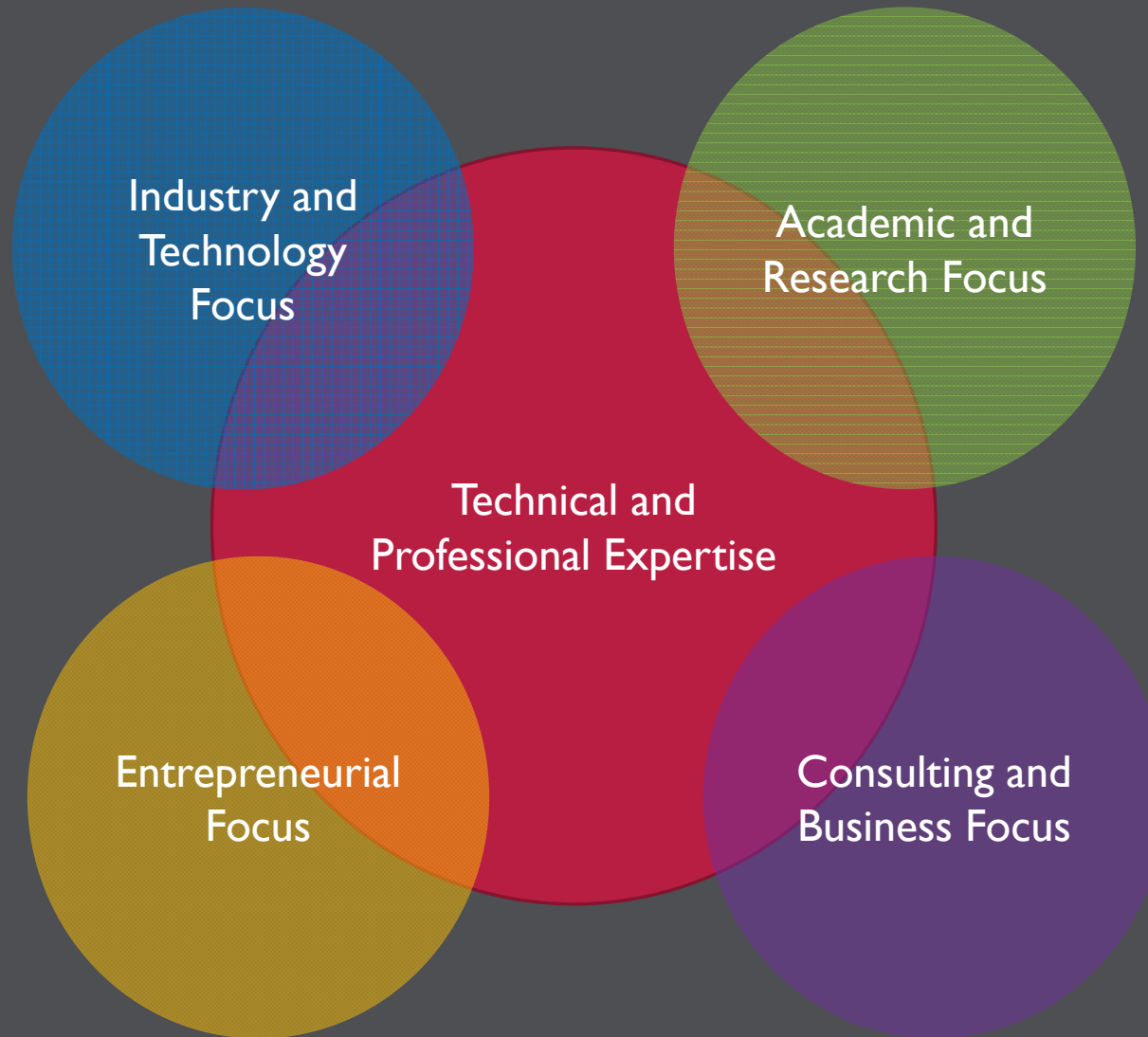
- Combine existing programs to leverage synergies in professional development
- Span broad aspects of the professional engineer's life



Involvement with students across a range of skills

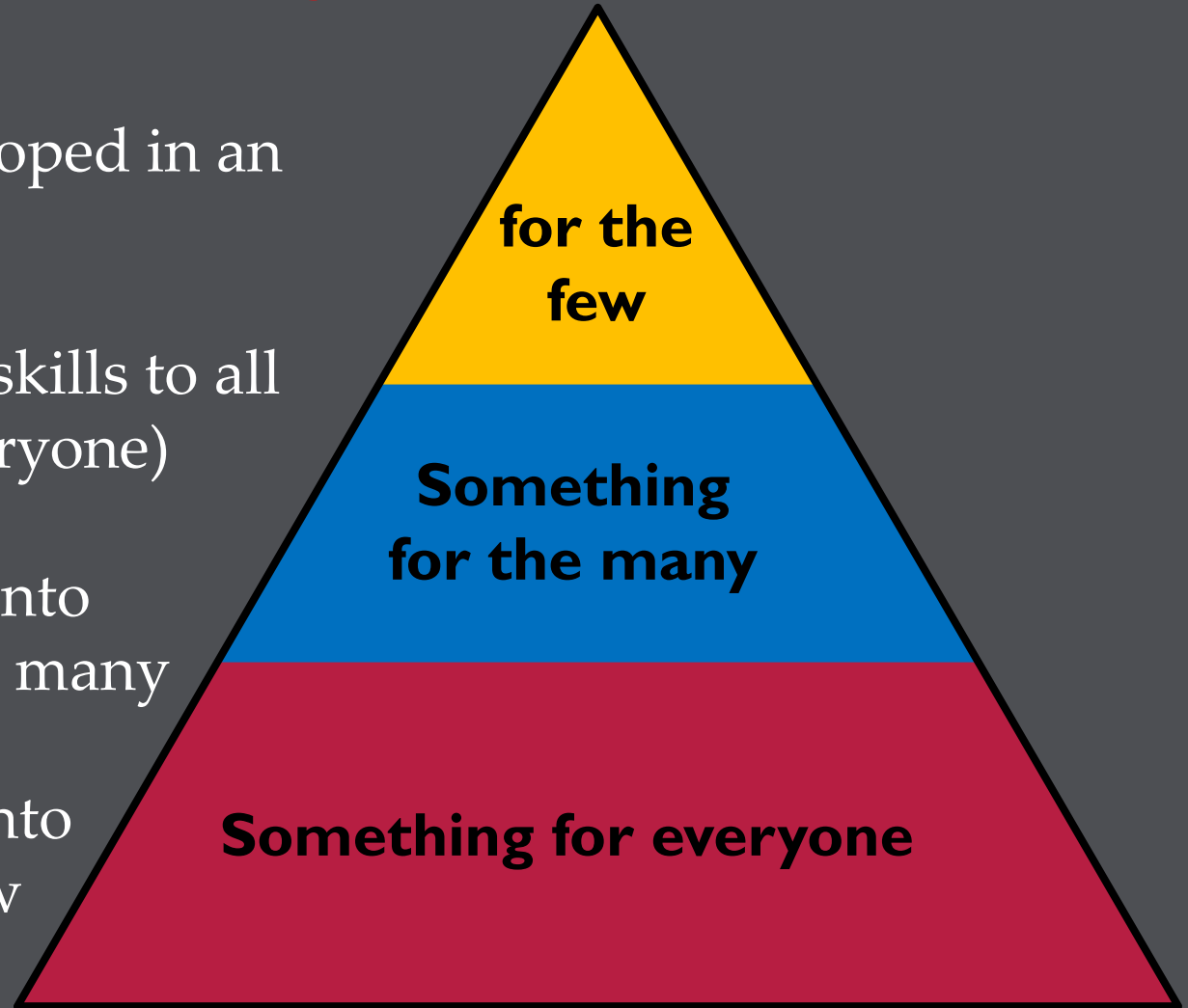
- Communications
 - Today in the broadest sense
 - Written, oral, and increasing visual
 - Range of formats from technical papers/presentations to elevator pitches
- Ethics
 - Individual and societal responsibility
 - Unique engineering role as stewards
- Leadership
 - Vision, team management, communication, project management
 - Group dynamics
- Project Teams
 - Design, implementation, leadership, team management
- Entrepreneurial programs
 - Kessler Fellows
 - Networking, self awareness
- Learning initiatives
 - Research involvement
 - Collaborative learning
- McCormick Teaching Excellence
 - Pedagogy / assessment

Involvement with students across a range of interests



Challenge and Opportunity

- Skills must be developed in an appropriate context
- Needs to introduce skills to all of our students (everyone)
- Challenge of going into depth – emphasis to many
- Opportunity to go into great depth for a few



Philosophy from Erica Dawson - Leadership

Engineering Communications

Objective: enable undergraduate engineering students to develop strategies for learning to learn how to act effectively and efficiently as communicators

- Communications Courses –
 - ENGRC 3500 – Engineering Communications
 - ENGRC 3350 – Communication for Engineering Managers
 - ENGRC 3340 – Independent Study in Eng. Communications
- Writing Intensive Engineering Courses –
 - instruction in a specific discipline
- Writing Intensive Co-op and Internships
- Embedding with existing courses

Evans, Richard
Robert N. Noyce Director
of Communications

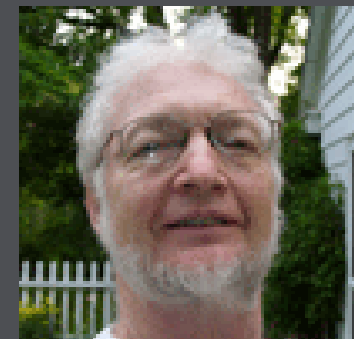
Bovay Program for Ethics in Engineering

Objective: Be a catalyst for consideration of social and ethical issues in the Cornell Engineering College

- Braudy Workshop and Bovay Seminar Series
- Direct impact courses
 - ENGRG/ECE/STS/HIST 2501 Technology in Society
 - ENGRG 3600/STS 3601 Ethics in Engineering Practice
 - INFO 2921/HIST 2920/AMST/ECE 2980 Inventing an Information Society Communications
- Embedding in curriculum courses
 - ENGRG 3910 - Engineering Leadership Lab
 - MAE 4300 - Professional Practice in Mechanical Engineering
 - ECE 4210 - Art Support Analysis and Algorithms
 - ECE 5010 - Professional Seminar for M. Eng Students
 - BME 4400 - Science Policy Bootcamp: From Concept to Conclusion



Prof. Ronald Kline
Sue G. and Harry E. Bovay
Jr. Professor in the History
and Ethics of Professional
Engineering

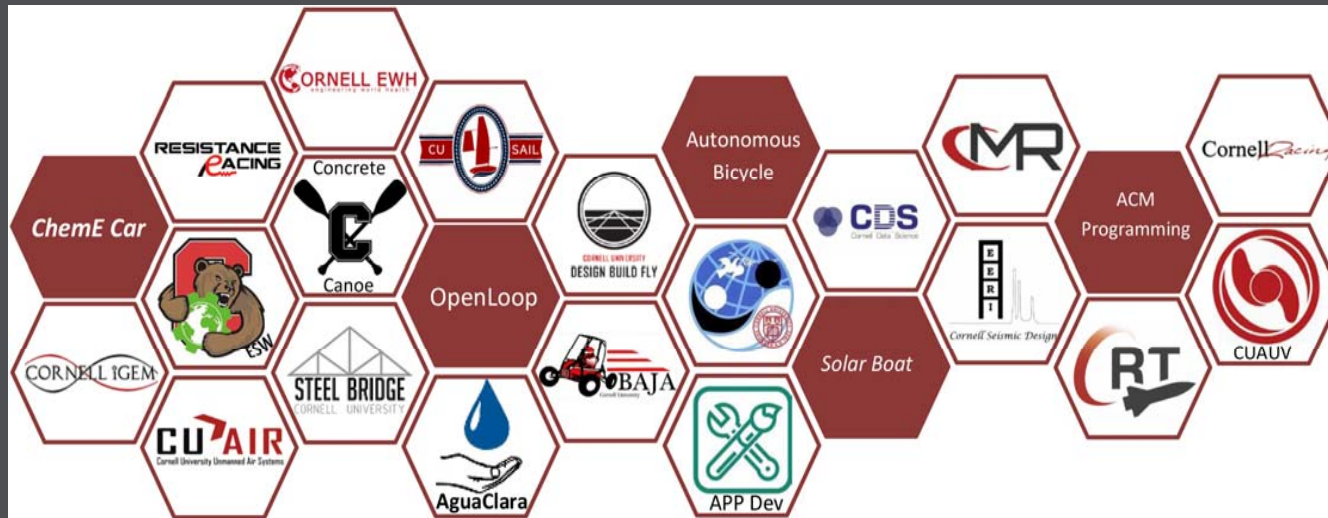


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Project Teams Program

- Coordinate and manage the team and team projects
- Develop training programs to support team dynamics
 - Leadership and team building
 - Conflict management
 - Corporate relations

Rebecca Macdonald
Swanson Director of
the Engineering
Student Projects



Engineering Leadership Program

- Develop and support programs to foster leadership and team management skills
 - Creating a vision
 - Project management
 - Communication
 - Budget and finance
 - Professional ethics
 - Building inclusive teams
 - Self awareness
- Workshops, short courses
- Goal: Over time integrate into curriculum

Erica Dawson
Director of the
Engineering
Leadership Program



Leadership Program – implement in curriculum

- Everyone
 - Presentations in the ENGRG 1050 course to 100% of the freshman students
 - Introduce concepts of teamwork and leadership
- Many
 - Work with faculty in courses across the college to include leadership development within curriculum
 - Specific leadership courses
 - ENGRG 4900, 3010
- Few
 - Engineering Leadership Certification Program (~25/year cohorts)
 - Direct assistance to project teams



Entrepreneurial Activities

- Entreneurship@cornell.edu
- **Kessler Fellows**
 - Exposure to the startup culture
 - Spring course – Essentials of Entrepreneurism
 - Summer placement in start-up
 - Specialized advising
 - Fall symposium to present experience and impact
- **New Entrepreneurial Minor**
 - ENGRG 2070 – Introduction to Entrepreneurship for Engineers
 - Ethics course
 - Ideation and Design Thinking
 - Capstone Entrepreneurship



2016 Kessler Fellows

- **Dyson Business Minor**
 - Increasing interest across all engineering majors

Engineering Learning Initiatives

- Enhance learning environment in the College of Engineering by providing students with opportunities to engage in
 - collaborative learning
 - undergraduate research
 - peer tutoring.
- UG Research
 - Engagement in faculty-mentored research (~120 students per year)
- Academic Excellence Workshops (AEWs)
 - Collaborative learning workshops - 70 undergraduate facilitators
- Engineering Graduate TA Development Program
 - 2-day training for ENG TAs – 230 per year
- Engineering Undergraduate TA Training
 - Half-day training for 105 UG TAs
- Engineering Math Workshops
- Tutors-on-Call

Lisa Schneider-Bentley
Director



Anne Poduska
Associate Director

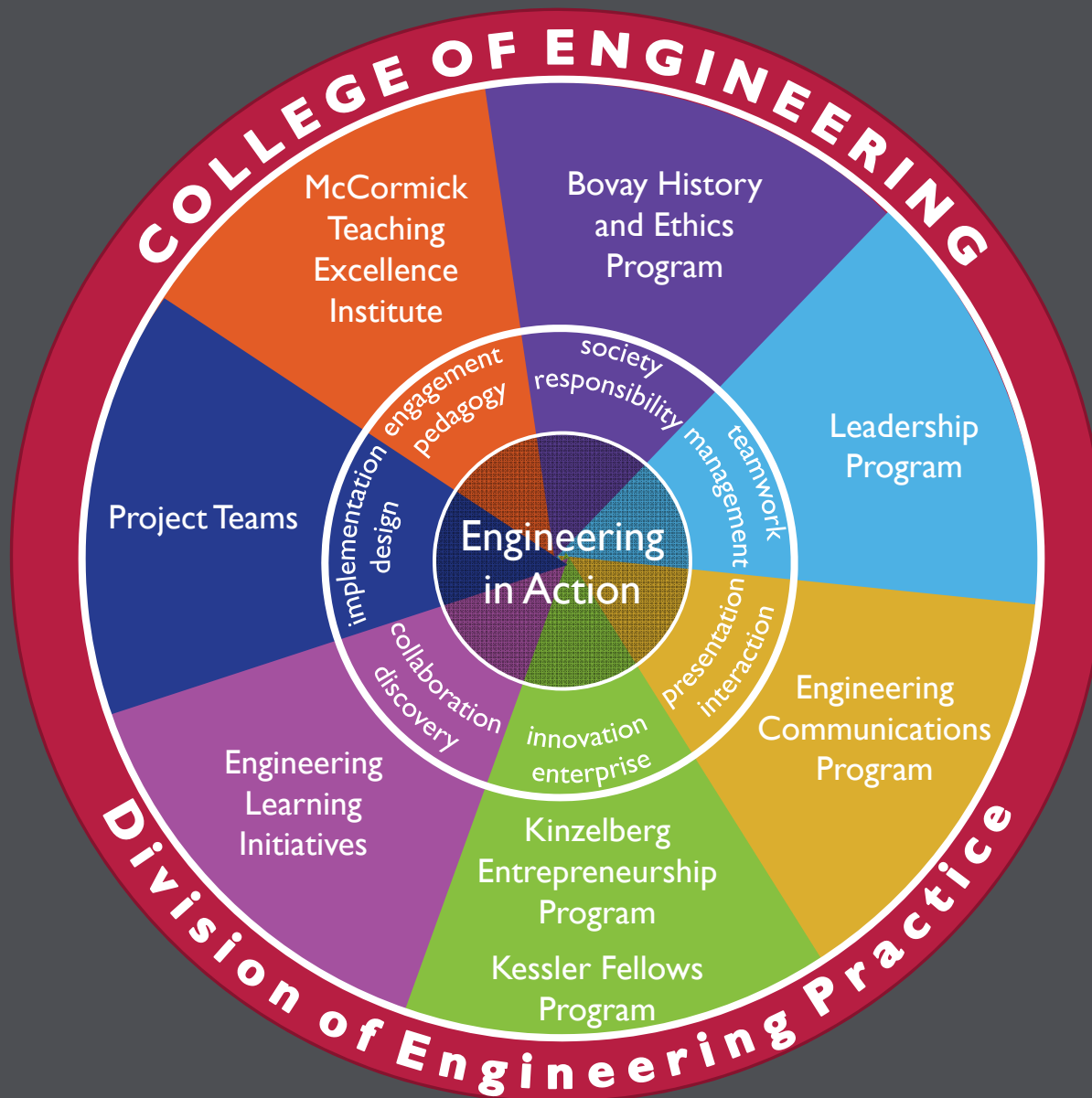


McCormick Teaching Institute

Kathy Dimiduk
Director



- Assessment and Course improvement
 - Support of existing curriculum
 - Critical for continuous improvement
- Activities
 - Individual Consultations
 - Classroom Observations
 - New Faculty Assistance
 - Teaching Research Assistance
 - Teaching Tips and Resources
 - Workshops and Seminars
 - Books and Articles on College Teaching
- Encouragement for new teaching styles
 - Movement to flipped course models
- Critical to implement changes in this new paradigm



Potential Topics for Group Discussion

- What attributes are critical for an engineer in the 21st century possess?
 - How have these changed over the past 25 years?
- Beyond the professional practice efforts currently being developed, are there other areas that we should be exploring or considering?
- Should we prioritize the various elements of professional practice, and how?
 - If yes, should it depend on the career path of students (e.g. industry, academia, entrepreneurship)?
- How can these skills be integrated into the more traditional curriculum that marks Cornell's engineering?
- How do we balance the need for technical depth with the need for these broader professional skills?