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ECC Educational Task Force

Dan Simpkins/Molly Tschang: Co-chairs

ECC Spring 2018 Readout

April 13, 2018

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Presentation Agenda

- ❑ Overview of task force objectives
- ❑ The Cornell Engineer
- ❑ Academic underpinnings – *Designing The New American University*
- ❑ Introduction to Sub-groups
  - Classroom Experience
  - Experiential Experience
- ❑ Recommendations
- ❑ Conclusions and Next Steps

Task Force Participants:

Nadine Aubrey

Jim Becker

Frank DeCosta

Rana Glasgal

Michele Kaliski

Aref Lahham

Bill Shreve

Dan Simpkins: Co-chair

Molly Tschang: Co-chair

Eric Young

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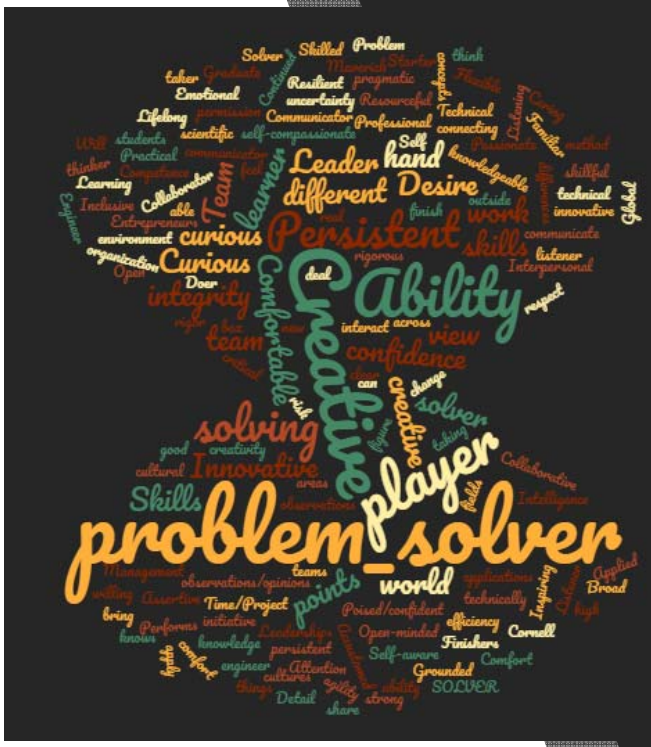
Task Force /Objectives/Goals/Process/

- Mission: Provide strategic counsel to enhance, transform, and disrupt traditional approaches to educating Cornell engineers
- Goal:

  Provide recommendations to increase relevancy of engineering education so graduates are trained to solve 21st century problems
- Process and Partnership:

  Explore ways for engineering faculty to partner with ECC/Alumni and build better ties with industry

Dream State (aspirational) – Cornell Engineers Known As:



- **Technical Competence:** contemporary both in the content and the tools of the relevant fields
- **Leaders:** innovator, thrive in change/adaptive, high integrity, confident, excel in communication, strong work ethic, positivity
- **Team Players with Global & Cultural Agility:** collaborative, work across differences, inclusive, harness diversity
- **Problem Solvers:** doer, persistent, resilient, entrepreneurial
- **Curious & Creative:** life-long learner, think out-of-the-box, apply knowledge from one technical area to new technical areas
- **Self-confident & Self-aware:** listen well, empathetic, strong interpersonal skills

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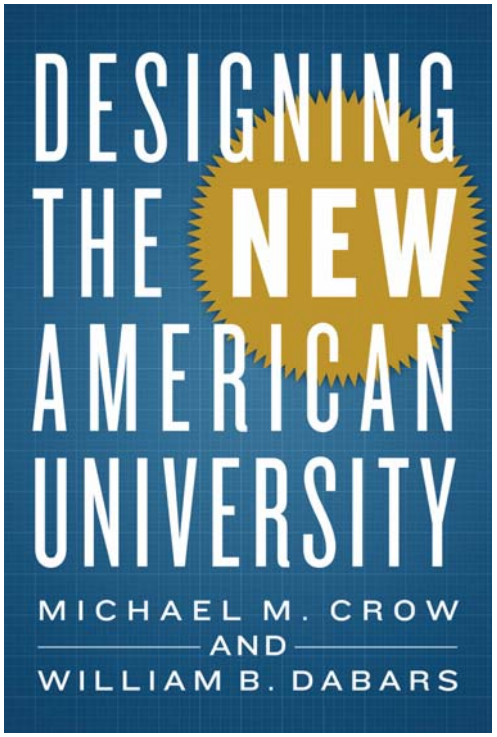
The Text Book



"…nations success more driven by knowledge than natural resources"

- Frank Rhodes
former President Cornell University

"What makes our universities great is that they: "invest in and train young people to be leading scientists and scholars…"

- Jonathan Cole
Sociologist, Columbia University

What can be done to rethink the way universities function; in particular how do these issues relate to Cornell Engineering?

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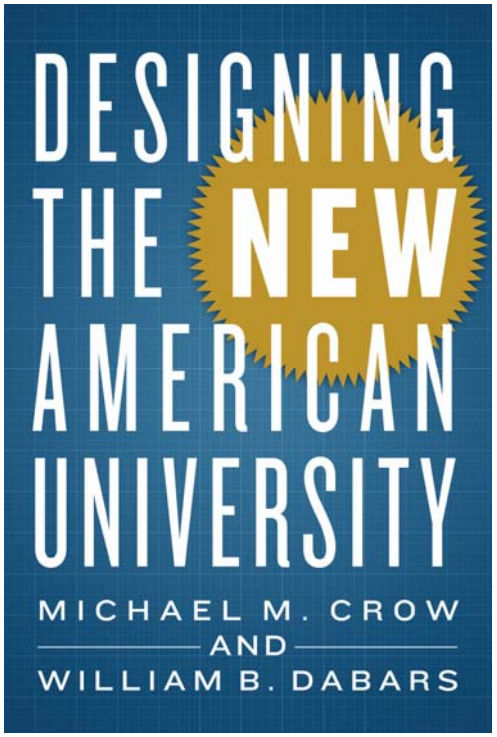
Core Theses in Crow and Dabars' Text



- Ingrained methods:
  - Tradition, constrains the modern university and prevents outside the box thinking
  - "Isomorphism," the tendency to emulate peers stems for a focus on prestige (rankings race)
- Societal demands
  - Global issues transdisciplinary and cross geo-social boundaries
  - Accessibility for higher education
- Collaboration is necessary
  - Partnership between government, academia and industry is required to solve the toughest global problems

Need to bring pragmatism to the educational agenda which changes the way that both disciplines and departments are constructed and the way that students are educated

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CLASSROOM SUB-GROUP DISCUSSION

Classroom Sub-group ECC Members:

Nadine Aubry
Jim Becker
Michele Kaliski
Bill Shreve
Dan Simpkins

Faculty Participation:

Kathy Dimiduk
Mike Thompson

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Classroom Sub-group – Questions We Explored:

- What "new" teaching methods are being used today?
  - Which methods work best and can methods used elsewhere be adopted?
- How can those methods bring attributes such as communications and leadership ("soft-skills") into the existing curriculum?
  - How else can we use technology to improve learning both technical knowledge and soft skills?
- Should changes in the engineering curriculum include proposed changes to core classes taught outside engineering (i.e. math)?

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New Learning Methods (NLM)

1. Flip classes
2. Interactive classes
3. Online or pre-programmed content
4. AI tools for dynamic content
5. “Soft-skill” programs

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New Learning Methods Currently in Use

- 6 of 129 undergrad classes are flipped or partially flipped
- 20% use active learning with “clickers”
- 50% of lecture classes have some type of active learning
- 25% of undergrad tried and/or integrated NLMs
- Broad use of online platforms
- New physical plant
  - Eight new Upson classrooms were created to enable new types of education

Use of NLMs widespread and found to be valuable by both faculty and students but not consistent in methodology

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Faculty and Student Feedback – from Focus Groups

Faculty

- Integration of Multi-Media into classroom
  - Use of video clips for point instructions
  - Use of videos to demonstrate the problem solving process
  - Use of iPads (or equivalent instead of black or white boards)
- Flip or partially flipped teaching adds value to both the teaching and learning experience
- Innovation takes time and resources

Students

- Different NLMs are effective for different learning styles and in the right setting are very valuable
- NLMs increase the overall time commitment for students; increased time must equal increased benefit
- Online interactive platforms are expensive, not robust, and are not standardized resulting in student frustration
  - Rubrics inconsistent

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Challenges of Effective Deployment of NLMs

- Lack of reliable and useful data regarding successful and unsuccessful integration of NLMs
- Faculty teaching evaluations are linked to compensation and tenure
- Limited time available to re-design existing classes
- Faculty would like to see more resources (class, lab, time) dedicated to innovative methods

The broader modernization process is a piecemeal effort; would benefit from a centralized roadmap built on an overarching strategy for educational innovation

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Clear Benefit to Integrated Leadership Training

- Cornell Engineering seeks to produce new graduates who are both successful engineers and impactful young leaders
  - Soft-skills are of critical importance; students don't recognize their importance; and they must be scaffolded to be effective
  - Skill development that is divorced from students engineering practice is not "valued as highly"

We need to integrate soft-skills and experiential activities into the existing curriculum and leverage opportunities outside of the classroom

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Recommendations

- New Learning Methods
  - Provide teaching relief to faculty to develop more active learning classes
  - Rethink faculty teaching evaluations to encourage the implementation of NLMs
  - Employ methods to adapt to different learning styles and to optimize out of class assignments
- Soft-skills are embedded but students need to understand rationale
  - Explore a pilot portfolio program with ECC/Alumni involved as mentors
- Use Alumni base to bring real-world problems into the classroom
- Consider winter session course platform to help lower-performers
  - Use the January term to build transition courses and test NLM
- Establish a measurement and review process to ensure that these changes are meeting the objective of producing the aspirational engineer
  - “If you can’t measure it you can’t manage it.” – Bill Hewlett

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EXPERIENTIAL SUB-GROUP DISCUSSION

Classroom Sub-group ECC Members:

Frank DeCosta
Rana Glasgal
Aref Lahham
Molly Tschang
Eric Young

Faculty Participation:

Tracey Brant
Erica Dawson
Mike Thompson

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Agenda

- Set Context
- Overview: Current Experiential Learning
- Insights, Recommendations, Ways ECC can help
- Discussion
- Appendix

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Experiential Learning "Defined"

- Learning through reflection on doing (wikipedia)
- Integrating classroom theory w/ practice in real-life setting and to reflect upon experiences
- Supplements engineering coursework to help students strengthen their sense of self and capability to skillfully navigate the relational dimensions of working with and leading others to achieve desired outcomes

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Key Opportunities We Identified

1. Create shared visibility of what exists
2. Increase student awareness + demand to take advantage of above
3. Ways to cross-pollinate across programs and for ECC to add value

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Outcomes of Experiential Learning

1. Applied Engineering Skills
   Applying tools learned in classroom to real-world engineering
2. Team Leadership & Collaboration
   People skills in groups
3. Personal Growth
   Individual communication skills, self-confidence, self-awareness (emboldens/enables managing own career development)
4. Innovation
   What do start-up's do, creating something people care about, thriving in change
5. Real-world, Non-engineering Considerations

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Experiential Programs

Program Name	Aopx # Students Per Year	Applied Eng. Skills	Team Leadership & Collaboration	Personal Growth	Innovation	Real-World, Non-Eng. Considerations
Kessler Fellows	12 - 15	★		★★	★★	★★
Commercialization Fellows (PhD)	6	★	★	★★	★★	★★
eLab*	30 - 50		★	★	★	
eHub*	Facility		★★		★	
Research Involvement	300	★★	★		★	
Coop	60	★★		★★		★★
Internship (via on-campus recruiting)**		★		★		★
Eng. Leadership Program (certificate)	25	★	★★	★★		★
Eng. Learning Initiative (ELI)			★	★		
Labs/project (assoc w/ courses; CU-wide)	23%	★★	★			
Project Teams	1,100	★	★★	★	★	★★
Portfolio (targeted Fall '19)	TBD			☆		

* Owned/supported by Entrepreneurship at Cornell & Student Agencies. **100s employers, open to all students, thousands of interviews

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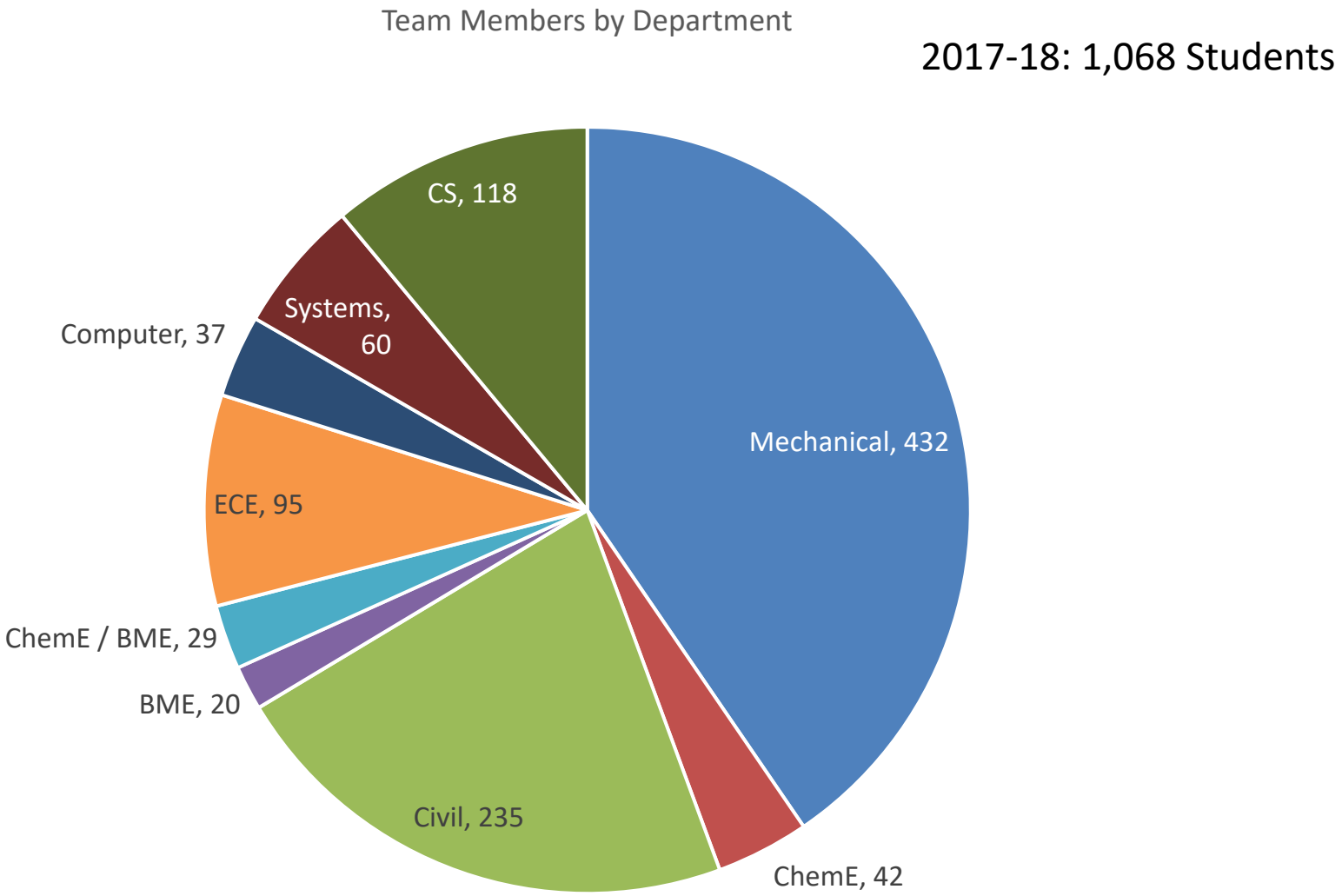
Project Teams: Students Hosted by Department



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Insights: Gaps/Opportunities

- Driving higher student engagement
  - Lack of awareness
  - Lack of program capacity, e.g., $, staffing
- Focused effort/ownership for consolidated view of experiential offerings
- Awareness of unconscious bias/barriers to cross-college collaboration

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Recommendations

- Student engagement
  - "Be in students' shoes" & communicate options when they can best hear; leverage ECC members to convey benefits
  - Excellent "marketing communications" of concise, compelling offering that distinguishes various programs & benefits
  - Unpack demand/capacity issues (ECC as resource)
- Engineering College "leads the charge" in embracing non-engineering owned programs
  - Opportunity to increase benefit to engineering student body w/ more comprehensive experiential learning offerings

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Future Role of Task Force / Next Steps

- We embrace this as a beginning, not an end of our support
  - Task force extraordinarily engaged and eager to support
- ECC excited about what's happening in engineering – keen to help the college rise to the next level
  - e.g., new classroom methods, student leadership programs (Portfolio), extra-curricula platforms, winter programs…
- End-goal: better serve our students, stakeholders and society
  - We have a great product – let's give faculty the right tools to innovate, incentives, and mandate
- Suggest faculty explore ECC and alumni collaboration to accelerate our rate of change – we are here to help!

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Appendix

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Appendix A - Classroom

ECC Spring 2018 Readout

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Clear Benefit to Integrated Leadership Training

Cornell Engineering seeks to produce new graduates who are both successful engineers and impactful young leaders

- Requirements for professional success have changed; new graduates need to demonstrate both technical and "soft-skills"
- Northeastern University (SAIL) and MIT (DSL Life Learning) are two examples of institutions that have recognized these changes and the need to incorporate these skills

Cornell Engineering would benefit from a to shift from traditional education practices to a holistic educational approach that integrates both academic rigor and soft-skills

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Portfolio (approved ’17; target for Fall ’19)

Educational Priorities

- Communication
- Leadership
- Ethics
- Experiential Learning (Engr Practice)
  - Project teams
  - Internships / COOP experience
  - Research engagement
  - Teaching engagement
  - Entrepreneurial activities
- Team-based engagement
- Diversity and internationalization
  - Study abroad
- Lifelong learning

Other Components

- Socially responsible engineering
- Design projects
- Career development
- Engineering / business interface
- Community engagement
  - Within Cornell
  - Beyond Cornell
  - International
- Engaging with media

Course Redesign Initiative (Flip/Partial Flip)

- Goal: Each engineering discipline should have at least one Sophomore/Junior course redesign and more desirable would be 2 to 3 classes per discipline
  - Ideal to do this at a rate of 2 – 3 courses/semester but 1/ semester would establish a good example
- Two engineering classes are successfully partially flipped
  - Sophomore Thermodynamics: Quantum Mechanics 2 (Frank Wise)
  - Lab Course (Kirstin Peterson)

Faculty Observations on NLM

- Integration of Multi-Media into classroom
  - Use of video clips for point instructions
  - Use of videos to demonstrate the problem solving process
  - Use of iPads (or equivalent instead of black or white boards)
- Flip or partially flipped teaching adds value to both the teaching and learning experience
- Application of book knowledge to real-world problem solving (e.g. real world problems with the people confronted by the problem) by leveraging alumni professionals
- Classrooms and labs are designed for NLM
  - Current spaces are best for small classes but more are needed (including large spaces)
- Integrated team assignments are valuable
  - Added activities to enhance learning other soft-skills (e.g. build website)
- Currently integrating more advanced undergrads and grads into teaching environment (e.g. letting them develop some of the homework assignments and taking credit)

Summary of the current state of NLMs

- Willing to take risks trying new methods; enthusiastically engaged in the process
  - Engagement across experience level, discipline, and type of class
- Challenges
  - Not consistent methods
  - Physical plant limitations (not just chairs on wheels but size of room and available equipment)
  - Time to create class material and more time to teach material
- Keys to Success
  - Collaboration across faculty who are using these methods
  - Directory of faculty using methods and available material
  - Identify and leverage existing video content both inside and outside of Cornell
  - Using video effectively – today there are several methods
  - Using interactive tools like clickers
- Need quantitative proof of value

Student Feedback on NLMs

- Variety of video types are being deployed
  - In some cases the videos and lectures create too much repetition
  - In cases where there are videos only, students struggle without written documentation to reference
- Different NLMs are effective for different learning styles and in the right setting are very valuable
- NLMs increase the overall time commitment for students; increased time must equal increased benefit
- Online interactive platforms are expensive, not robust, and are not standardized resulting in student frustration
  - Rubrics inconsistent
- Strong students become obligated to act as educators in group settings and weak students are intimidated and may withdraw
- Students do not inherently understand the value of soft-skills
  - Saw more value when soft-skills were taught and practiced in active learning modules

Designing The New American University

- The Text sets the stage for the redesign of an American Research University and concludes with an explanation of how the foundations led to the reimplementation of Arizona State University beginning in 2002
- It is written by Michael Crow, formerly Executive Vice Provost of Columbia and William Dabars, a senior research fellow and professor at Arizona State University
- The following 18 slides contain various quotes, statistics and passages that are of interest from the text; the text itself presents a theoretical framework demonstrating the need for innovations in higher education in the US

Clayton Christianson and Higher Education

- Christianson has recently applied his theories of disruptive innovations to higher education
  - "disruptive innovation revealed patterns of displacement of dominant business models and markets through the application of new and sometimes unexpected – albeit often inferior but cheaper – technologies has more recently applied this perspective to higher education"
  - He and his collaborator Henry Eyring contend that tweaks to the same old model represent merely sustaining innovations
  - Institutions that emulate Harvard and strive to climb the "Carnegie ladder" are doing just as conventional business logic dictate – trying to give customers what they want
- Higher ed, however, in the traditional model is flawed because there are "multiple value propositions" of "knowledge creation (research), knowledge proliferation and learning (teaching), and preparation for life and careers"
- These are a conflation of "solution shops, value-adding process businesses and facilitated user networks"
  - This is "like merging McKinsey consulting, Whirlpool manufacturing and Northwestern Mutual insurance" in one organization
- "Todays 'multiversities' are limited by historical entrenchment in obsolete institutional design, lack of scalability and residual elitism

Threats to the Old Model – Frank Rhodes

- "The learning industry is about to face the same wrenching restructuring that health care, manufacturing, and other industries, as well as welfare and public service have already undergone"
- "mergers and acquisitions and strategic alliances are likely to become unwelcome additions to the academic vocabulary; so are the terms downsizing and outsourcing.
- He described more fundamental concerns: "Today's university has no acknowledged center. It is all periphery, a circle of disciplinary and professional strongholds, jostling for position, and surrounding a vacant center."
- Absent is a "coherent vision" for the purpose of the academic institution

The New Model

- "The New American University combines accessibility to an academic platform underpinned by discovery and a pedagogical foundation of knowledge production, inclusiveness to a broad demographic representative of the socioeconomic diversity of the region and nation, and, through its breadth of functionality, maximization of societal impact commensurate with the scale of enrollment demand and the needs of the nation"
- "The New American University thus represents a reconceptualization of the American research university as a complex and adaptive comprehensive knowledge enterprise committed to discovery, creativity, and innovation, an institution accessible to the broadest possible demographic spectrum, representative of the socioeconomic and intellectual diversity of our nation."

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Access to Higher Education vs Need

- Unable or unwilling to accommodate enrollment demand from … qualified students …universities define status through exclusion"
- Over the past 25 years, enrollment … has grown from under 13 million to more than 21 million
- ¾ of High School students now enroll in some from of college…
- Total Ivy + Top 50 Liberal Colleges: ~150,000
- Anthony Carnevale, of Georgetown University states "the undersupply of postsecondary-educated workers has led to two distinct problems: a problem of efficiency and a problem of equity"
- "to correct our undersupply and meet our efficiency and equity goals for the economy and for our society, we will need to add an additional 20 million postsecondary-educated workers to the economy by 2025"
- According to Sociologists McNamee and Miller "presumably being made of the right stuff and having the right attitude should ensure success;" but this is a myth of meritocracy
  - "It takes money to make money (inheritance), its not what you know but whom you know (connections); what matters is being in the right place at the right time (luck); the playing field isn't level (discrimination) and …"
- Sadly, income determines school choice more than other factors

Why Do We Need to Teach More Than The Academics

Charles M Vest, former president of MIT

- "If they are going to help us expand our knowledge and solve our problems they are going to have to know how to research, to analyze, to synthesize and to communicate. They must learn how to gather data, to develop hypotheses, to test and refine them or throw out when necessary and start over."

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Goals/Aspirations of ASU (New American Univ.) Redesign

- Four Goals:
  - Leadership in academic excellence and accessibility
  - National standing in academic quality (in every field)
  - Global center for interdisciplinary research, discovery and development
  - Enhance local impact and social embeddedness
- 8 Design Aspirations
  - Respond to its cultural, socioeconomic and physical setting
  - Become a force for societal transformation
  - Pursue a culture of academic enterprise and knowledge entrepreneurship
  - Conduct use-inspired research
  - Focus on the individual within milieu of intellectual/cultural diversity
  - Transcend disciplinary limitations
  - Embed the university socially and advance global engagement

"Oxbridge" versus German Models

- Cardinal Newman articulated a "set of beliefs" about knowledge worth having and the kind of person education should seek to develop," thus underscoring the role of a broad general education.
  - He further stated that "it is the diffusion and extension of knowledge rather than advancement" that defines the essence of the university
- German model characterized by Humboldt underscores the unity of research and teaching
  - "breadth of basic scholarship whose different parts together illuminated a coherent universality of thought and learning to be expanded and pursued for their own sake at the highest intellectual level" – this is the ideal of Wissenchaft (pure learning – the idea of knowledge for its own sake)
  - Schelling and Fichte extended with ideas of Bildung, referring broadly to the "cultivation" of the individual
  - Humboldt believed that "Bildung through Wissenschaft was the cornerstone of the university"

Land Grant Colleges Universities

- Stipulated a more practical role than either the British or German models
- "The legacy of the utilitarian and egalitarian tenets specified in the Morrill Act epitomized by curricula in the "useful arts" – identified by historian Thelin as agriculture, mechanics, mining and military instruction."

Constraints to Change

- Filiopietism: Excessive veneration of tradition (from filial and piety)
  - "We succumb to filiopietism when we assume we have no choice but to accept the status quo because that is just the way things have always been done"
- Here is a paradox: "Academics are trained to question the status quo but tend to assume that our colleges and universities are optimally designed to facilitate knowledge creation and dissemination"

Regression Toward the Mean

- Filiopietism can contribute to "isomorphism" – the "paradoxical tendency for organizations and institutions to emulate one another and become increasingly homogeneous"
- This isn't out of the norm for human behavior; if Harvard is a great university then everyone wants to make their university like Harvard
  - This can cause lower performing organizations to become "obsessed with prestige"

Liberal Arts – A Tradition Worth Defending

- Not all traditional forms of education should be shunned – the current emphasis on STEM is causing a backlash against liberal arts
- Liberal Arts: In antiquity, liberal arts were termed "liberal" because they were worthy of a "free man"
- Seven Liberal Arts – make up Trivium and Quadrivium
  - Logic, grammar, rhetoric
  - Arithmetic, music, geometry, astronomy

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University as Home To Liberal Arts and Research

- This was Humboldt's vision – to do both
- In US in 2013, Universities received $41 b out of a total of $128 b (~32%) in federal R&D budget
- Academia spends $66.6 b out of total of $424 b in total research dollars in US (~16%)
- Universities are excellent resources to stimulate local economies and Cornell should accelerate this obligation
- "Because a post-industrial economy doesn't require industries to settle in strategic locations – near natural resources, for example, companies and knowledge workers increasingly locate "not where they must, but where they will,"…, wherever intelligence cluster, be it small town, or big city, wealth will accumulate." – Kotkin and DeVol
- Focus on knowledge workers will stimulate the creation of a "creative class" that at this point might make up as much as 30% of the workforce and is comprised of artists, musicians, designers, architects, engineers, scientists, etc. – Richard Florida

Proper Design Required to Achieve Interdisciplinarity

- "The implementation of institutional policies conducive to interdisciplinarity are critical for two reasons: academic careers have historically been forged within strictly demarcated disciplinary delimitations , and disciplinary affiliation defines the social organization of American higher education to such an extent that recipients of interdisciplinary training or practitioners of interdisciplinary scholarship often find recognition among peers and advancement difficult. Such policies must moreover advance recognition of interdisciplinary research by professional associations, business and industry, and most important, within federal agencies, which in the estimation of this report, remain resistant to interdisciplinary categorization."

Interdisciplinary vs. Transdisciplinary

- These can be interchanged – but a better usage for The New American University would be defined by Robert Frodeman who observed:
  - "More accurate usage would have 'interdisciplinary' denote changes needed within the academy, 'transdisciplinary' to efforts to move beyond university walls toward the co-production of knowledge between academic and non-academic actors."

The Role of Pragmatism

- "Pragmatism" is characterized by the emphasis on knowledge creation that is geared toward a practical use that knowledge
- The New American University should advocate use-inspired research with a "societal impact."
- Louis Menard – "knowing and doing are indivisible aspects of the same process."
- Therefore, research should be attempting to answer questions of productive relevance

Sustainable Development

- Neither the American Constitution nor the Wealth of Nations contemplated a time when a meaningful awareness of the limitations of our natural world would govern our decisions; today, ignoring these concerns would be both irresponsible and immoral
- **1987 Climate Change report by David Victor argued that "boosting the economy, protecting natural resources, and ensuring social justice are not conflicting but interwoven and complementary goals**
- "At the same time that the average life span of those living in the industrialized nations has doubled, agricultural productivity increased by 5X, the US economy increased several hundred fold and the amount of retrievable information increased by incalculable orders of magnitude. 20% of the planets bird species have been driven to extinction, 50% of all freshwater runoff has been consumed, 70k synthetic chemicals have been introduced into the environment, the sediment load of rivers has increased 5x and more than 2/3 of the major marine fisheries have been fully exploited or depleted!"

Overwhelming problems?

- It is easy for science to create 70k new chemicals and so many other advances but do we have the tools to figure out the impact of those advances on the world. What about all the other man-made changes? And, do we have a political system that is capable of leading us toward sustainable policies?
- "Through a remarkable manipulation of limited knowledge, brute force and an overwhelming arrogance humans have shaped a world that in all likelihood cannot sustain the standard of living and quality of life that we have come to take for granted!"

It is Possible to Design a University to Evolve

- Successful Example is Arizona State University reconstituted as prototype of New American University
  - It is "an institutional model predicated on the pursuit of discovery and knowledge production, inclusiveness to a broad demographic representative of the socio-economic diversity of the region (and the nation) and through its breadth of functionality, maximization of societal impact."
  - Others could do the same if able to overcome lack of scale, fiscal constraints, filiopietism, isomorphism, the pursuit of prestige, etc.
- Dr. M.L. King in 1947: "we must remember that intelligence is not enough. Intelligence plus character – that is the goal of true education."

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Appendix B – Experiential Programs

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Dream State: Cornell Engineers known as

- **Leaders:** innovator, thrive in change/adaptive, high integrity, confident, excels in communication, strong work ethic, positivity
- **Team Players with Global & Cultural Agility:** collaborative, works across differences, inclusive, harness diversity
- **Problem Solvers:** doer, persistent, resilient, entrepreneurial*
- **Curious & Creative:** life-long learner, think out-of-the-box, apply knowledge from one technical area to new technical areas
- **Self-confident & Self-aware:** listen well, empathetic, strong interpersonal skills

*not “doing a start-up” per se; rather, the ethos of identifying opportunity, taking initiative and pursuing it w/o being held back by resources currently at hand

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Kessler Fellows

- Conscientious dive into a summer startup work experience for those curious about entrepreneurship
- One calendar year program exclusively for undergrad engineers
- 10 years in operation, 12-15 students per cohort (of 60 applicants/year)
- Participation specifically Spring junior year/summer/ Fall senior year
- Intent is to find the “right” startup opportunity for the summer, then reflect & share the lessons learned with the other Fellows
- Designed to coach students into “driving their own bus” with confidence
- Substantial 1:1 coaching/mentoring from the program Director
- One required class in Spring (2 credits); weekly Fall symposia mandatory (no credit)
- Program pays student stipend and expenses during summer internship
- Program operating expense funded by alumnus gift

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Commercialization Fellows

- Focused, specific assessment of the commercial value and options available for a given Cornell-developed technology
- Program primarily for 4th year PhD students – Engineering & CS only
- Each Fellow leads the overall effort on their technology of choice
- Cohort size of 6 students; program runs over 6 months time frame
- 2 Cohorts completed thus far: just starting 3rd cohort process
- Fellows take hiatus from lab research for the 6-month period
- Designed to be an outward facing, real world exercise, with substantial mentoring by industry experts and collaboration with MBA students
- Not biased toward licensing vs. startup: all options considered
- Primarily a learning exercise for students
- Also believed to benefit commercialization success of Cornell-developed technologies
- No specific credit toward graduation, but students are strongly encouraged to finish their PhD work after Fellowship concludes
- Program concludes with specific business plan recommendations; further pursuit is optional but encouraged if appropriate
- Program pays Fellow stipend and travel expense during Fellowship period
- Alumni, funded thus far with College assistance

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eLab

- An accelerator for real-world startup business plans
- Open to ALL students (undergrad and grad)
- Team-based participation only: 2-4 students per team
- Program spans the academic year; 8 years running (56 teams)
- Cohorts range from 10-16 teams/year; have increased over time: admission is very competitive now
- Funded by Entrepreneurship at Cornell & Student Agencies, taught by a COB team of instructors (capacity limited)
- Required to take 2 COB courses (4.5 credits); encouraged to take an additional speaker series (1 credit)
- Provided with $5K of non-dilutive funding; substantial access to development and mentoring resources in the Ithaca area
- Ample opportunity to “pitch” to multiple audiences to test their hypothesis and assumptions

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eHub

- Facilities, not a program: 15K ft^2 in 2 locations
- Open to all students, faculty, local community
- Intended specifically for collaborative team work on entrepreneurial projects
- Sites available for hosting events, pitches, bootcamps, hackathons, EIR office hours, etc.
- Renovated/opened in 2016 (alumni-funded)
- Owned & operated by Entrepreneurship at Cornell and Student Agencies
- Annual operating costs covered by most College Deans (including Engineering) and Entrepreneurship at Cornell

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Engineering Co-op

- ~60 students per year participate in Co-op
- Controlled and funded by Engineering
- Co-op is an educational experience combining academic and career interests with industry experience, offering opportunity to clarify academic focus and test career interests/goals. It helps students apply classroom knowledge to work situations, converting theory into practice, while learning information and skills to enhance future coursework
- Learning outcomes include:
  - Practical experience in their field of engineering and the chance to apply classroom knowledge to work situations.
  - Learn to work in teams, communicate effectively, solve problems, develop their professional network, and understand what it means to be a working engineer.
- Participation in co-op is declining

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Undergraduate Research Involvement

- ~300 students per year participate; exact number not known with precision
- UG research is driven at the university level
- Though the exact experience varies, it is typically a highly individualized interaction with faculty research programs. Freshman and sophomores are generally assistants to senior undergraduates or graduate students, undertaking relatively routine analysis or design work. At junior and senior level, students often take on their own projects with labs, leading in many cases to scientific publications. These experiences are also often linked to senior thesis work in the research intensive majors.
- Learning outcomes include hands-on knowledge in a research field, experience with experimental design and interpretation of results, development of critical thinking skills, contact with potential mentors, potential authorship, and the confirmation (or not) of career decisions
- There appears to be an increasing need for research opportunities, particularly for student considering a graduate degree

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Corporate Internships (via on-campus recruiting)

- Mission: "Cornell Engineering Career Center serves students in the College of Engineering by providing resources for ***career exploration, development, and planning***. Our ***mission*** is to ***inspire and empower*** Cornell Engineers to create ***lifelong career success***. Our ***vision*** is that every Cornell Engineer experiences ***career satisfaction***."
- Opportunities include internships, co-op assignments, and full-time positions
- Hundreds of employers, thousands of interviews
- Career fairs, info sessions, Handshake (online)
- To be eligible to participate in OCR, students must complete an online tutorial

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Internships Through Engineering Career Center

- Resource for ***career exploration, development, planning***. ***Mission*****:** to ***inspire & empower*** Cornell Engineers to create ***lifelong career success***. ***Vision:*** every CU Engineer experiences ***career satisfaction***.
- Each year, ***100's of employers*** visit Ithaca to connect w/ ***technical students*** as part of campus recruiting program. To fill internship, co-op, and full-time positions, employers participate in ***career fairs***, host ***info sessions,*** and conduct ***1000's of interviews***. Employers interested in ***recruiting CU engineers*** also post their jobs in the university's ***Handshake*** database.
- Assist students seeking research positions, offer academic support services, encourage students to approach learning + teaching in new and innovative ways, help students find organizations that match their interests, and provide extensive academic advising services.

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Internships Through Engineering Career Center

- Employers interested in ***hiring Cornell talent*** post internships, co-ops + full-time opportunities in ***Handshake***. New/returning employers post throughout academic year, but ***begin adding positions in August***, so start searching early!
- Job postings tied to interview schedule indicate employer will interview on campus as part of OCR program; some employers participate in OCR, but choose to interview via phone/video
- To be ***eligible*** to participate in OCR, students must complete **online tutorial** (~20 minutes; includes quiz at the end); allow 2 business days after completion for update ***eligibility status;*** (***not be notified*** of change; will see ***"ocr eligible"*** label on Handshake profile, indicating ability to view/***apply for positions*** attached to interview schedules

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Engineering Leadership Program: Mission

1. Grow Powerful Leaders with knowledge, skill insight, courage
2. Achieve this through classes and seminars, supplemental instruction in design courses, the engineering leadership certificate Program and other means???

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The Engineering Leadership Certificate

- Highly Selective One-Year Program; covers competencies in self-management, teamwork, leadership and professional skills
- Graduates earn designation on their transcript recognizing demonstrated excellence in engineering leadership
- 2 required classes for Certification Program: ENGRG 3900 (2 credits spring), ENGRG 3910 (3 credits fall)
- Beyond coursework, students work in small groups to design/implement a Leadership Project related to their skills/interests; teams form in March; target completion November; work continues independently thru summer
- Most Certification competencies covered in the 2 required classes; a few can be mastered in optional seminars or other classes already taken
- APPLICATION:
  - To be offered in even years beginning in 2018 (more staff needed)
  - Applications for 2020 cohort (18-24; 25% acceptance rate) available Sept, 2019

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ENGRG 3900 – Foundations of Engineering Leadership

- 1st of 2 required classes in Eng. Leadership Certification Program
- Focus is on the “self” and “team” competencies covered in the certification program. Students gain knowledge about their own strengths, values, purpose, goals, and derailers
- Additional topics include: project management basics, presentation skills, communication and team dynamics
- With this foundation, students propose and form teams to enact a Leadership Project that has meaning and impact
- 2 weekend retreats required, in addition to regularly scheduled class: one first week of January classes; other in April

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ENGRG 3910 – Engineering Leadership Lab

- Weekly experiential learning re different aspects of leadership and teamwork; fun and engaging exercises, may take students outside of the lab to experiment with different “people skills”
- Topics include communication, decision-making for leaders, managing conflict, emotional regulation and personality, brainstorming, ethics, networking, influence and persuasion, organizational culture, and others
- Required course for Leadership Certification students, who enroll for 3 credits; open to all others as well (enroll for 2 credits) Certification students given class time to work on Leadership Projects established in ENGRG 3900

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NGRG 4900 – Project Team Leadership

- Fall. 1 credit. Letter grades only. Instructor permission required
- Enrolment limited to: current/future Eng. Project Team leaders or sub-team leaders
- “Project Team Leadership Independent study” offers instruction in management and leadership skills of greatest immediate use to team leaders
- The seminar builds community of team leaders as sources of support/knowledge for one another; topics include coordinating work teams, managing conflict, basic communication skills, giving/receiving feedback, and motivating team members

Course Projects/Labs/Undergraduate Research

- Research can enhance the undergraduate experience by allowing students to take the skills and knowledge learned in the classroom and apply them to real situations
- It affords students the opportunity to interact closely with faculty and, in many instances, to develop valuable industry connections; when involved in research, students will also find themselves working with peers who share their passion for learning

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On Campus Undergraduate Research Stats

- **> 4,000 Cornell students** earned credit for their research efforts in 2016-2017 (undergraduate)
- **23% of undergraduates** earned credit for participating in research during the course of their study at Cornell during the 2011-2012 academic year
- Typical senior science major spends **15-20 hours/week in the lab** while participating in a faculty-led research project
- In 2017, **97** students graduated with **distinction in research** from the College of Agriculture and Life Sciences
- Humanities majors working on research read an average of 3-5 books each week of the semester

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Project Teams: 2017-'18 Stats (1,068 students)

- 29 teams with 17 – 65 members
- Facilities: 80% (of students) in 4 facilities
  - 50% ELL
  - 28% ELL/GM lab + Hollister + Gates
  - 22% 6 other facilities
- Host Department (9):
  - 40% Mechanical
  - 22% Civil
- Majors (15 Engineering majors):
  - 25% undeclared (freshman/sophomore)
  - 16% CS
  - 13% Mechanical / Aerospace
  - 6% Electrical / Computer
  - 6% Non-eng (Physics, Bio, Other)

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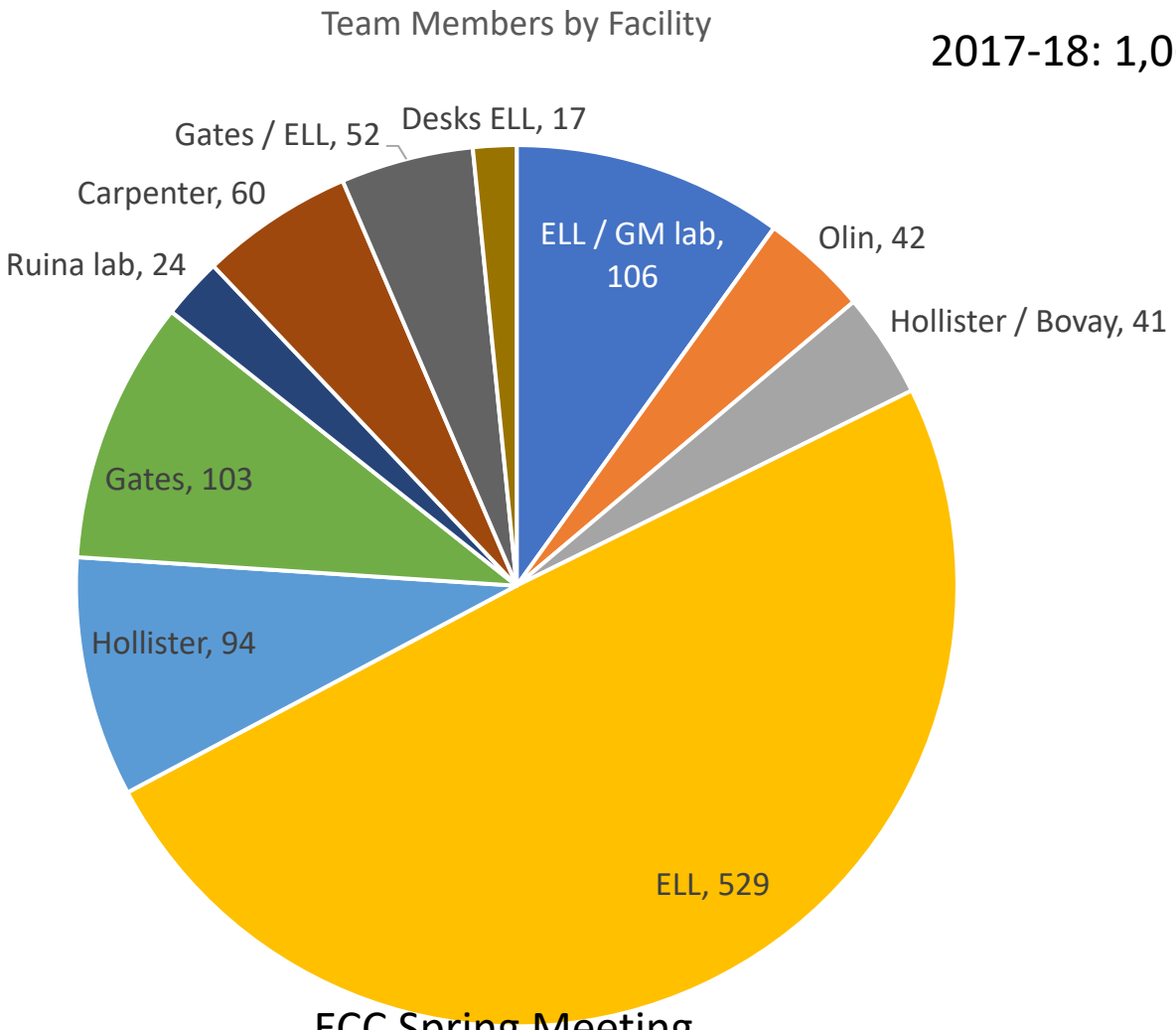
Project Teams: Students by Facility

2017-18: 1,068 Students



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29 Project Teams

Team Name (Short Name)	Primary build location	Type of team	Host Dept	Faculty Advisor	Team Size (2017/18)
AguaClara	Hollister	Social Impact	Civil	Monroe Weber-Shirk	65
CUAir	ELL	Competition	Mechanical	Tom Avedisian	64
Cornell Cup	Carpenter	Self-define	Systems	David Schneider	60
Formula SAE (FSAE)	ELL / GM lab	Competition	Mechanical	John Callister	55
Design and Tech Initiative (DTI)	Gates / ELL	Self-define	CS		52
Baja SAE (Baja)	ELL / GM lab	Competition	Mechanical	Meredith Silberstein	51
Mars Rover	ELL	Competition	ECE	Carl Poitras	48
CUAUV	ELL	Competition	Mechanical	Rob Shepherd	47
Engineers for a Sustainable World (ESW)	ELL	Social Impact	Civil	Francis Vanek	44
ChemE Car	Olin	Competition	ChemE	Abe Strook	42
Concrete Canoe	Hollister / Bovay	Competition	Civil	Ken Hover	41
Hyperloop	ELL	Competition	Mechanical	Rick Geddes	40
Rocketry Team (Rocketry)	ELL	Competition	Mechanical	Daniel Selva	39
Engineers Without Borders (EWB)	ELL	Social Impact	Civil	Peter Hess	38
AppDev	Gates	Self-define	Computer	Walker White	37
DataScience	Gates	Self-define	CS	Thorsten Joechins	35
ACM Programming	Gates	Competition	CS	Walker White	31
Design Build Fly	ELL	Competition	Mechanical	Gregory Bewley	31
iGEM	ELL	Competition	ChemE / BME	Lammerding	29
Steel Bridge	Hollister	Competition	Civil	Ken Hover	29
Resistance Racing	ELL	Competition	ECE	Joe Skovira	26
Autonomous Bicycle	Ruina lab	Self-define	Mechanical	Andy Ruina	24
Engineering World Health (EWH)	ELL	Social Impact	Mechanical	David Erickson	24
Solar Boat	ELL	Competition	Mechanical	Max Zhang	22
Microgravity	ELL	Competition	ECE	Ana Diaz Artiles	21
Design by Biomedical UG Teams (DEBUT)	ELL	Competition	BME	James Antaki	20
CUSail	ELL	Competition	Mechanical	Andy Ruina	18
EERI Seismic Design (Seismic Design)	ELL	Competition	Civil	Gregory McLaskey	18
Bridges to Prosperity (B2P)	Desks ELL	Social Impact	Mechanical	Hadas Ritz	17
					1068

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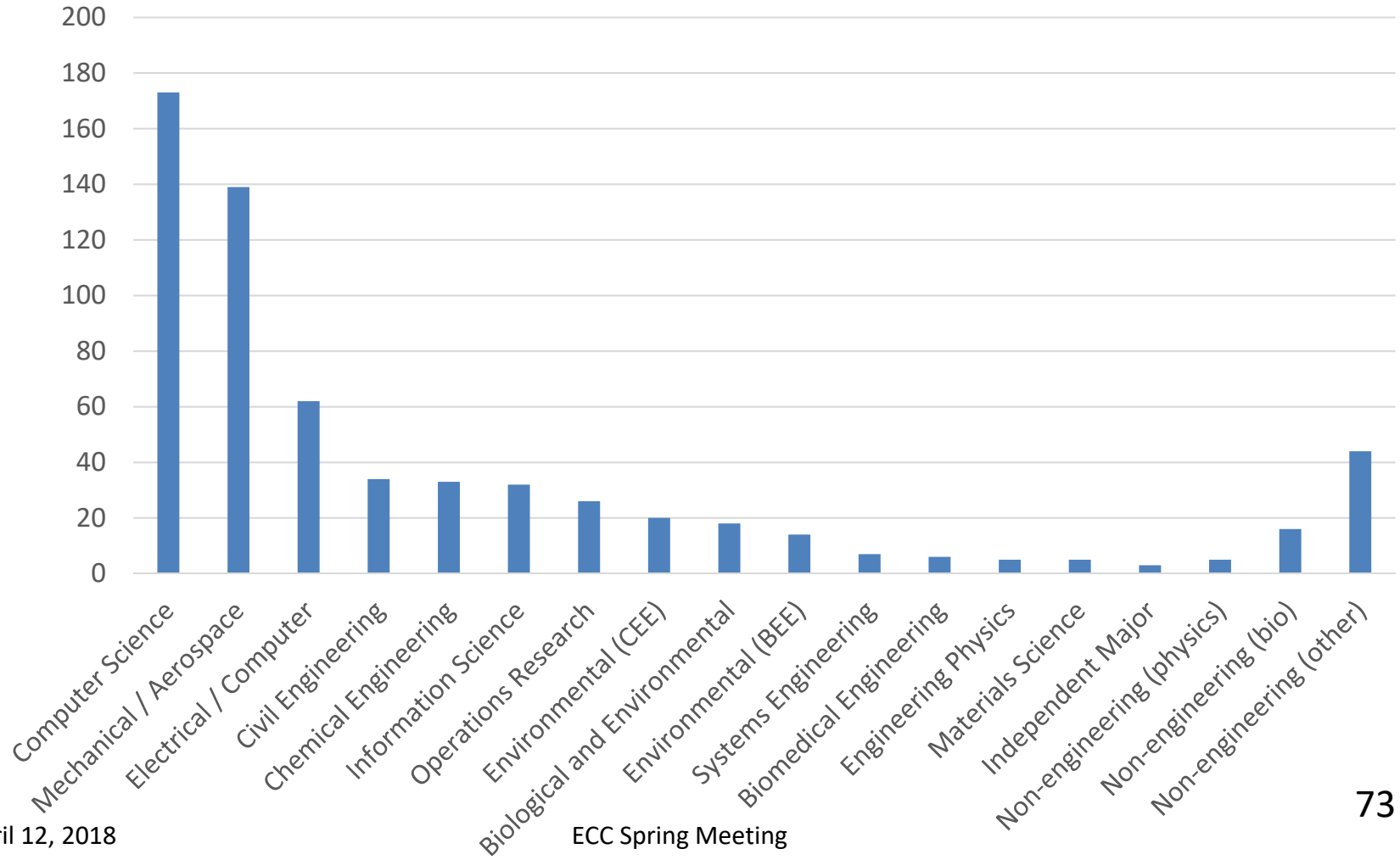
Project Teams: By Major Affiliation

2017-18: 1,068 Students



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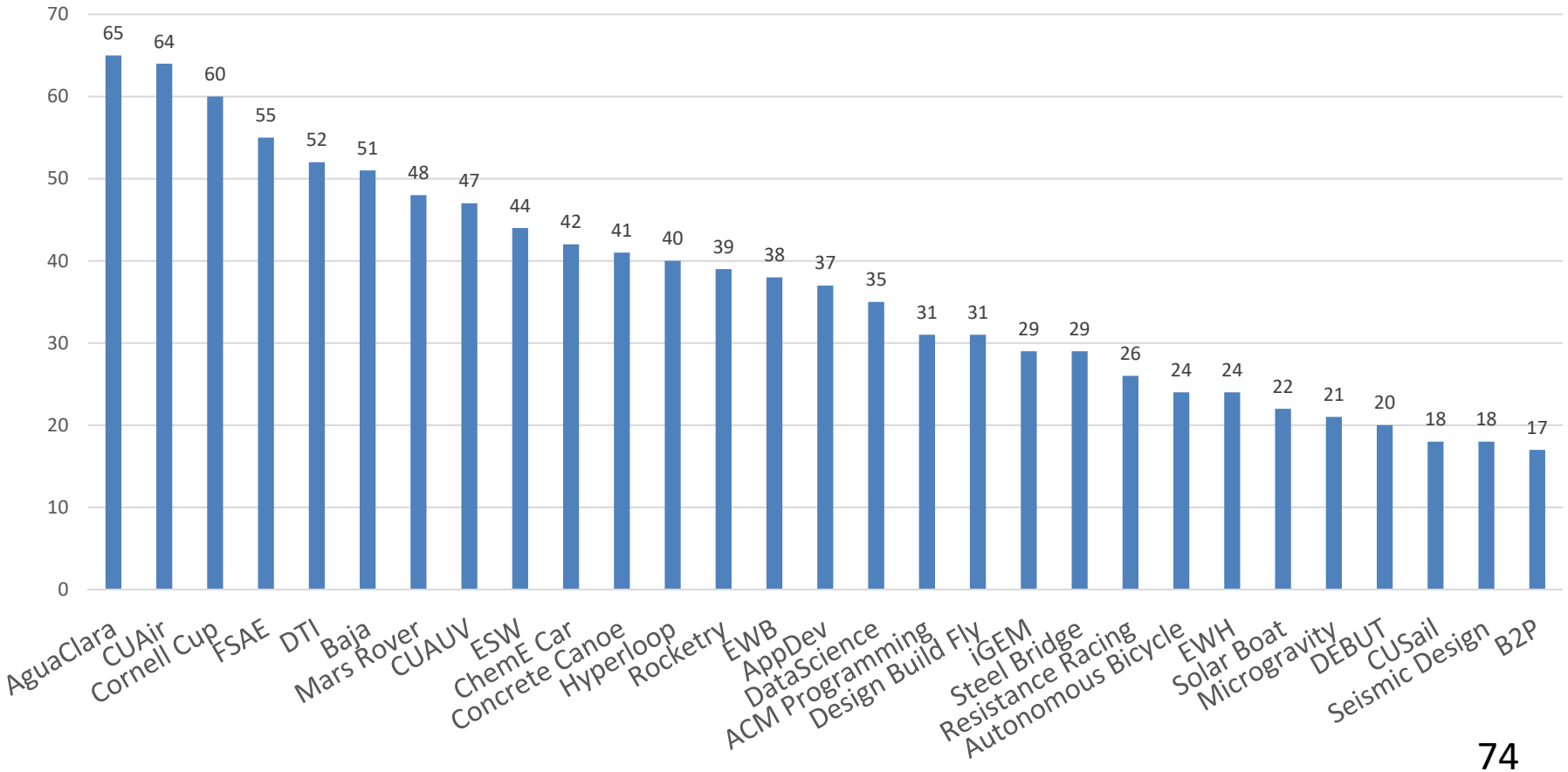
Project Teams: By Team Size (17-65

2017-18: 1,068 Students



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Project Teams: Key "Limiters"

- Space for Physical Projects
  - Upson ELL (Experiential Learning Lab) space is great resource; could accommodate few more "small footprint" teams, or teams w/ interleaving schedules (fall build coupled with a spring build). Many data science teams have relatively small footprints; still need general mtg / desk space for continuity and community.
- Availability of Effective Faculty Mentoring
  - Desire to improve team leader / faculty advisor interactions, which is dependent on engaged, interested, and available faculty
- Team Funding
  - Always a priority. Welcome additional resources to be more competitive. Also value in efforts to raise funding from both donors and corporate sponsors, and to prioritize resources within realistic funding constraints (real engineering)
  - Opportunity: "startup" funds for either new activities (significant non-recurring capital costs) or major redirections of existing teams (FSAE considering moving from gas-powered vehicle competition to electric powered race cars).

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Project Teams: Programmatic Challenges/Opportunities

- Developing Team "Life-cycle"
  - New teams readily added; few teams "sunset. Need sustainable model for flow of teams in and out. Potentially not disbanding completely, but migrating to a 'Project Club" status w/ reduced space/financial support. Challenge is to responsibly phase-down teams to protect existing students
- Idea/Opportunity: "model" to formalize a range of activities:
  - "Club": Students self-organize along interests; not necessarily w/ obvious goal yet
  - "Project Club" Gain faculty academic advisor to continue to organize
  - "Project Team" Ramp up to most robust level
- Note: re: "organic nature" of current project team structure
  - Current structure grew out of CU culture. Teams grow and die based on student interest (and occasionally on an advisor's interest). Different model is where the college picks and develops teams, but ultimately we develop leaders by forcing them to grow into the role.

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Project Teams: Programmatic Challenges/Opportunities (1/2)

- "Student-led team": Another potential model
  - Create parallel structure with teams organized around faculty-defined projects with shorter time-frames and more specific engineering deliverables.
  - If led from faculty, then alternate criteria for team composition becomes more viable … selecting members based as much on "what students would gain from the project" as "what would the project gain from the student".
  - Significant shift of concept and would appeal to a different cohort of students – particularly those who would like to participate in this type of activity but either cannot or do not wish to commit multiple years (as many teams currently desire).

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Project Teams: Recruiting Challenges/Opportunities (2/2)

- Re: unmet demand: no "hard #'s", but teams generally have 3:1 to 10:1 applicant to accept ratios; may suggest many don't get "desired" team, or unable to join any team (*anecdotal student input, "If one really wants to join a team, they're able to – may be as a sophomore or junior."*)
- Encountering issues w/ broad "diversity," as teams manage recruiting & selection independently. Not unexpectedly, there's team bias to recruit immediately on arrival at Cornell for those demonstrating the needed "skills." From the team's perspective, this is the optimal solution
- College interested to provide opportunities to broadest range of students. Mechanisms to provide for some "turnover" may be needed to increase these opportunities for upper-level students. One idea is to mandate x% turnover to be a "project team" – which the college could require to have access to the project team resources (space & money).

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Project Teams: Opportunity – Social Impact Teams

- E.g., Engineers without Borders or Aqua Clara
- Offer ability to enhance “globalization” of our students
- While limited number can travel internationally, their experiences are leveraged through interaction with team members. A more formal structure could be developed to manage the risks of international projects while embracing the opportunities.

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Project Teams: Opportunity – Curriculum Impact

Unique Learning Experience!

- **The professional engineering skills developed in the project teams cannot be underestimated; leaders, in particular, gain management experience that cannot be gained in the classroom.**

Questions We Might Consider:

- How to leverage this experience within general technical curriculum?
- How might student project team experiences "encourage" students toward more formal training in those same skills (leadership, group dynamics, project management, communication).
  - Students currently get credit for project team activities (likely remains)
  - Possibility to provide carrot for students to take a more intentional approach to these skill developments, resulting in a course that has more effective value in their curriculum (e.g., satisfying a technical elective or replacing a liberal elective).

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ECC Educational Task Force

Dan Simpkins/Molly Tschang: Co-chairs

ECC Spring 2018 Readout

April 13, 2018