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- Minutes -
Engineering College Council Meeting
April 12-13, 2018
Cornell Ithaca Campus

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Members Present: Nadine Aubry, John Balen, Najib Canaan, Lance Collins, Frank DeCosta, Greg Galvin, Rana Glasgal, Ken Goldman, Kevin Johnson, Michele Kaliski, Bill LaFontaine, Aref Lahham, Jonathan Ludwig, Ivan Lustig, Avi Mehrotra, Jim Ricotta, Susie Riley, Tony Satterthwaite, Dan Simpkins, Elissa Sterry, John Swanson, Joe Thanhauser, Molly Tschang, Andy Verhalen, Lisa Walker, Craig Wheeler, Eric Young.

Emeriti Present: Dick Aubrecht, Jim Becker, Jay Carter, Bob Shaw

The meeting presentations and materials can be found at:
https://confluence.cornell.edu/display/ECC/2018+Spring+ECC+Meeting

Welcome and Introductions

Greg Galvin, ECC Chair, welcomed the Council to the Spring '18 ECC Meeting. Lance Collins, Dean of Engineering, announced that the focus of the meeting would be the Engineering College Council Task Force Committee Reports.

College Update
Lance Collins, Joseph Silbert Dean of Engineering

Lance Collins gave an update on the state of the College. Among the topics he discussed were the Radical Collaborations initiatives launched by the University. He noted that this is an ambitious initiative to enhance research in the radically collaborative discipline areas of: nanoscale science and molecular engineering; genome biology; data science; sustainability; the social sciences; infection biology; and the humanities and arts. He emphasized that the University's greatest strength is its ability to collaborate. He pointed out that the thrust areas most impactful to the College are in the areas of: Advanced Materials, Bioengineering, Complex Systems, and Energy. He added that these thrust areas will be in radical collaboration with the University's initiatives in Nano NEXT; Data Science; Genome Biology; Arts and Humanities; Infection Biology; Social Sciences and Sustainability; which he described as follows:

Nano NEXT: "is a multi-year interdisciplinary program at Cornell to push nanoscale science and engineering to the next level of design, function and integration". Lance noted that we're one of the world leaders in nanoscience and are in the process of recruiting 10 faculty leaders.

Data Science: is at the intersection of computer science and operations research and "is concerned with the core methods – computational, mathematical, and statistical – for working with data". Lance pointed out that that University would like to create a Center for Engaged Data Science to unify the current efforts across colleges and campuses and to hire research faculty to

connect theory with practice. The Data Science Center will provide informatics-driven health; security and privacy for data systems; global scale public health, smart transportation and precision medicine.

Genome Biology: is "Understanding the Responsive Genome in Health, Agriculture, and in the Environment. The genome is an organism's complete set of DNA, including all of its genes. Genome biology focuses on the structure, function, evolution, mapping, and editing of genomes." This initiative will be a collaborative effort that will strengthen our ties to Cornell Weill.

Infection Biology: is a new initiative that studies the host's response to microbial pathogens. It represents the basic biology of microbes and the development of drugs and other approaches to combat infection. This initiative seeks to establish two cross-cutting trans-campus centers: the Center for Immunology and Center for Antimicrobial Resistance.

Sustainability: is defined as "satisfying the needs of humans today should not come at the expense of satisfying the needs of future generations. Transformational societal change is required, and is as dependent on changes in attitudes, policies, and institutions as on technological discoveries". The biggest impact on the College are in the research areas of: water, energy, industry, innovation, infrastructure (sustainable cities and communities, in collaboration with the College of Architecture, Art and Planning).

New College Leadership:
Lance announced the following new College leaders: David Erickson, Associate Dean for Research and Graduate Programs; Miranda Swanson, Associate Dean for Student Services; Alyssa Apsel, Director of the School of Electrical and Computer Engineering, starting July 1, 2018; and Kavita Bala, Chair of the Department of Computer Science, starting July 1, 2018. He also announced that Jeff Tester has been named Chief Scientist, Earth Source Heat, and Lynden Archer, Director of the Energy Systems Institute. Lynden was recently elected to the National Academy of Engineering, one of the highest professional distinctions accorded to an engineer, for advances in nanoparticle-polymer hybrid materials and in electrochemical energy storage technologies. He also announced the names of several new faculty including: James Antaki (BME, Lowell and Susan McAdam Professor of Heart Assist Technology; April Gu (AEP) first female senior faculty member hired by a Cornell Engineering dean; and Brenda Dietrich (ORIE, Arthur '59 MIE '61 and Helen Geoffrion Professor of Practice).

Research Highlights:
Lance highlighted several research breakthroughs in the College, including the news that Cornell researchers have become the first to control atomically thin magnets with an electric field (Jie Shan, professor of applied and engineering physics). This discovery provides a blueprint for producing exceptionally powerful and efficient data storage in computer chips, etc. He also noted that there are ongoing collaboration efforts at Cornell to reduce health care disparities through technology. For example, Cornell's Institute for Nutritional Sciences, Global Health and Technology (INSiGHT) is developing point-of-care diagnostic devices such as the Cornell NutriPhone and FeverPhone, which can diagnose infections and other analyses from a drop of

blood in a few minutes using a cell phone device as a computing device (co-founder, David Erickson, professor of mechanical and aerospace engineering).

Diversity in Engineering:
Lance gave an overview of diversity efforts in the College. He announced that the freshman class has more women than men for the first time, at 51%. He also pointed out that the URM percentage in the Freshman class is 19%, and the percentage of African-American students is 5/5%, up from 3.8%. This is the result of important collaborations between Engineering Admissions and Diversity Programs, in addition to the gift from Robert F. Smith, which has increased our visibility. Lance noted that the College received over 13,234 applications for admission for Fall 2018 – a 7.3% increase over last year with 1,198 offers of admission (322 fewer than last year). The overall admit rate dropped from 12.3% to 9.1% (a single-digit admit rate for the first time). The admit rate for women increased from 52.6% to 53.6%, URMs from 25.6% to 31.6% and African Americans from 7.2% to 10.6%. However, he noted that although we received more applications than ever, the yield rates have decreased due to competition from other universities. He also pointed out that the 5-year engineering graduation rate for undergraduate URM's is 88%, compared to 91% graduating from Cornell.

Lance noted that Ph.D. enrollments are decreasing (also a nationwide trend) which is puzzling. He added that in order to grow our faculty, we need more Ph.D.'s. There's an increased number of Ph.D. women and URM's enrolled (the Sloan program has helped with this growth). He also discussed the College's faculty demographics and pointed out that there has been a steady climb in the number of women, with a goal of increasing that number to 20%. The number of URM faculty has remained flat. He added that there continue to be real challenges in hiring.

Giving Day and Philanthropy:
Lance pointed out that Giving Day was a huge success and a great team effort. In terms of dollars, the College came in 6th in the University. We were the top college in individual giving, with an average gift of $2,000. He indicated that the project teams were extraordinarily organized and raised significant funds. The project teams' internal campaign with alumni generated numerous donors. Lance noted that 71% of ECC members have made a contribution to the College in Fiscal Year 2018, and he thanked them for their generous and continued support. He also acknowledged the following ECC members for major contributions: Elissa Sterry for her phenomenal gift to our MEng Program in ORIE; Kevin Johnson contributed to a scholarship at a significant level; and Howard Morgan endowed a high-level professorship in ORIE and for Cornell Tech.

Lance announced that the task force committees would give their task force reports at this meeting, the: New Educational Paradigm Task Force Committee led by Dan Simpkins and Molly Tschang; the Energy, Environment, and Sustainability Task Force Committee led by John Swanson and Elissa Sterry; the Bioengineering Task Force Committee led by Craig Wheeler; and the Capital Infrastructure Task Force, led by Ken Goldman and Lisa Walker.

New Education Paradigm Task Force Committee Report
Dan Simpkins and Molly Tschang
Charge: Provide strategic counsel to enhance, transform, and disrupt traditional approaches to educating undergraduate and graduate students.

Dan Simpkins gave an overview of this task force committee that focused on the classroom and the student, as the customer. He thanked Lance for giving them this exciting opportunity to get involved in this process and educating themselves and Lance on their perspective. The goals of their task force are to "provide recommendations to increase relevancy of engineering education so graduates are trained to solve 21st Century problems, and to explore ways for engineering faculty to partner with ECC/alumni and build better ties with industry". He thanked Molly Tschang, co-chair, for her coaching and direction, the committee members for their involvement, and the faculty who provided their valuable insight. He indicated that they recently held three focus groups, one with six faculty members and two focus groups of students, which changed some of their assumptions.

Dan described the aspirational characteristics of what an engineer should be (dream state) and the group distilled this into six components: technically competent (balance between content and tools); leader; team player with global and cultural agility; problem solver; curious and creative (think out of the box); self-confident and self-aware (soft skills). He indicated that the task force committee members were required to read the textbook, "*Designing the New American University*" by Michael Crow and William Dabars. This caused the committee to consider, "What can be done to rethink the way universities function; in particular, how do these issues relate to Cornell Engineering"? He noted that the core theses of this textbook are that we need to be aware of ingrained methods (tradition, tendency to emulate our peers for prestige or rankings, and can lead to homogeneity); societal demands (global issues are transdisciplinary and cross geo-social boundaries); and collaboration is necessary (partnership between government, academia and industry to solve the toughest global problems). He noted that we "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".

Dan pointed out that after the task force committee distilled their objectives, they decided to divide themselves into two sub-groups: Classroom Sub-group and Experiential Sub-group.

The Classroom Sub-group
Michele Kaliski indicated that this sub-group explored five new learning methods: flipped classrooms, interactive classes, online or pre-programmed content, AI tools for dynamic content, and "soft-skill" programs. She noted that new innovations take time and resources for faculty to implement. The group had numerous conversations with Kathy Dimiduk, Director of the James McCormick Teaching Excellence Institute. She gave them a very clear snapshot of what is currently going on in the College with regard to these new learning methods which have been found to be very valuable to both faculty and students. However, they discovered that there is no consistent methodology for these learning methods.

Dan Simpkins pointed out that some faculty are using multi-media in innovative ways. For example, some faculty are using alumni in their classes (an alumnus presents a specific problem that is relevant to an area of study, then the alumnus creates a problem set that they videotape. After videotaping the problem set, the alumnus turns it over to the faculty member who, in turn, integrates the problem set into their class. The students have been incredibly responsive to this method, which gives students a real sense about a theory they're learning and applying to a real-world problem. Some faculty expressed concerns about the flipped or partially flipped classrooms. You can't fully flip a class without it having a significant impact on the faculty member and student.   The sub-group discovered that it takes a lot of time to prepare a flipped class, and it adds additional burden to the student because now they have to do work outside the classroom, and then come to the lecture and do more work during the lecture (although this method provided a deeper understanding of the work). Students were very frank and indicated that the new learning methods are effective but don't necessarily fit everyone's learning style. They also increased the time commitment and costs for students. Some also expressed concerns over the interface and grading. Since different faculty use different online platforms (i.e. Wiley learning platform), it was often time consuming for students to learn these various platforms. In summary, the "use of new learning methods is widespread and found to be valuable to both faculty and students but not consistent in methodology".

Michelle Kaliski outlined the key challenges of deploying new learning methods: "lack of reliable and useful data regarding successful and unsuccessful integration of new learning methods; 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. In general, the broader modernization process is a piecemeal effort that would benefit from a centralized roadmap built on an overarching strategy for educational innovation". The group indicated that collaborations across the University are key to making these efforts successful.

The group also indicated that there is a clear benefit to integrated leadership training to produce new graduates who are both successful engineers and impactful young leaders. "We need to integrate soft-skills and experiential activities into the existing curriculum and leverage opportunities outside the classroom". The group was surprised to hear from the students that they did not see the value of "soft skills". Students do not inherently understand the value of soft-skills and saw more value when soft-skills were taught and practiced in active learning modules.

Classroom Sub-group Recommendations summary:
This Sub-group recommended implementing: new learning methods that provide teaching relief to faculty to develop more active learning classes; rethink faculty teaching evaluations to encourage the implementation of new learning methods; employ methods to adapt to different learning styles and to optimize out of class assignments. Soft-skills are embedded, but students need to understand the rationale, i.e., explore a pilot program involving ECC members and alumni as mentors. They also suggested using the alumni base to bring real-world problems into the classroom. Consider winter session course platform to help lower-performers (i.e., use the

January term to build transition courses and test new learning method. Establish a measurement and review process to ensure that these changes are meeting the objective of producing the aspirational engineer).

Experiential Sub-group
Molly Tschang explained that this Sub-group focused on experiential learning, which it defined as learning through reflection on doing. This is done by integrating classroom theory with practice in real-life settings and to reflect upon experiences. This also 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. This Sub-group identified the following key opportunities: create shared visibility of what exists; increase student awareness and demand to take advantage; find ways to cross-pollinate across programs and for ECC to add value.

Eric Young discussed the value of experiential learning and the outcomes which included: applied engineering skills (applying tools learned in the classroom to real-world engineering); team leadership and collaboration (people skills in groups); personal growth (individual communication skills, self-confidence, self-awareness); innovation (what do start-up's do, creating something people care about, thriving in change); and real-world, non-engineering considerations. He encouraged more entrepreneurship activity in the College and outlined some of the experiential programs in the College including the: Kessler Fellows, Commercialization Fellows (PhD students), eLab, eHub.

Rana Glasgal discussed additional experiential learning opportunities including: research involvement (in particular at the undergraduate level) and co-op. Frank DeCosta discussed internship opportunities. He agreed with the recommendation to not add additional experiential programs, but enhance those that already exist. Eric Young noted that to improve our marketing of these programs we need to consolidate our messaging and make it more readily available to the student population. We need to help students understand where these programs fit in the course of their education. Rana added that there are 29 project teams with 17-65 members each (1,068 total students). 80% of these students are in 4 facilities, hosted by 9 departments with 15 engineering majors. She noted that it's important to have a life cycle for these teams. Rana discussed the need for higher student engagement, increased awareness, program capacity, funding, and staffing. The sub-group recommended enhancing our current experiential programs rather than adding new ones, and knowing when to phase out some programs. They also indicated that more students need to be engaged in experiential learning.

The future role and next steps of this task force are: to embrace this as a beginning, not an end of their support (they are extremely engaged and eager to support). The ECC is excited about what's happening in engineering – and is eager to help the college rise to the next level (e.g., new classroom methods, student leadership programs (Portfolio), extra-curricula platforms, winter programs, etc.). The end-goal is to better serve our students, stakeholders and society (faculty need the right tools to innovate, create incentives, and mandate). The faculty should be encouraged to explore ECC and alumni collaborations to accelerate our rate of change – they are

here to help! In conclusion, we need to improve our marketing and communications, and get out the message about the importance of experiential learning. Lance has asked Mike Thompson, associate dean for undergraduate programs, to continue to work with the team to identify focus areas.

Energy, Environment, and Sustainability Task Force Committee Report
John Swanson and Elissa Sterry
Charge: Provide strategic counsel on research and education related to existing and emerging energy technologies, carbon sequestration, energy management, and the use of the campus as a "living laboratory".

Elissa Sterry acknowledged the task force team members and thanked Lynden Archer for his contributions to this group. Elissa outlined the process this task force used to address this topic. First they compiled an extensive thought paper under John Swanson's leadership including what the plans might be to achieve a zero carbon environment here. They also discussed different alternatives to achieving those plans, and what energy resources the University might have, as well as potential areas for cooperation with corporations or other third parties. They also engaged with Lynden about his vision for the Energy Institute. After they compiled all of this information, they stepped back and said what is it that we as a council can uniquely do to support this. Then they tried to match this and overlap this with some of Cornell's energy goals, and discovered an overlap in two areas: help bring the private sector to the College and participate in joint projects with students and faculty. Elissa indicated that the council is uniquely positioned to help the College in this effort in four areas of expertise to achieve the goal of being carbon neutral by 2035: Identification of private sponsors, fundraising and joint projects with students and faculty; technical expertise in a broad range of relevant technologies and challenges; business expertise to help with effective development and execution of plans; and support efforts to build the Cornell brand as an energy leader. She added that there are two aspects to consider: there's the shared research aspect and the doing of societal good.

Lance pointed out that most of the top universities have identified the thrust area of energy as their top priority. The College needs to position itself as unique, and also to get credit for doing the good, and being seen as a mover and shaker in the field of energy which will attract funds, students, and faculty. So he posed the question, "How do we build the brand and be different from the other universities"? What can we do that will set us apart from them and make us unique and special? Elissa indicated that the branding of the College's energy efforts needs to be one of our top priorities. Lance indicated that the university is strongly committed to becoming carbon neutral by 2035. In addition to funding, Lance indicated that the College needs the power house of our students, faculty, the financial resources of the private sector, foundations, DOE funding, State funding, as well as the engagement of the ECC members to make this happen.

Elissa described the two major strategies of the University: Build the Energy Systems Institute "brand" by supporting development of new, innovative technology. Lynden Archer indicated that the University is a slightly behind the curve and has embraced this challenge to some

extent. He added that the Energy Institute has crafted a strategic plan that they feel is far reaching and is thinking beyond 2035. The goal is to lower the carbon footprint through innovations and materials, technology and systems design. And the idea is to use this institute as a way of thinking beyond 2035.

Elissa indicated that their task force recommends two University strategies: University, Strategy 1: build the Energy Systems Institute "brand" by supporting the development of new, innovative technology: partner with energy-minded companies for co-op and research opportunities; and work with the University to define a "win-win" framework for cooperative development with the private sector. She emphasized that it is important that we create frameworks that make it easier for companies to engage in business and create partnerships with Cornell. The group brainstormed on several potential research and corporate sponsorship programs, such as: battery recycling studies; North Campus new housing as "ground-up" opportunity; partner with Ag School on carbon sequestration, biogas generation; work with utilities on load balance, pricing/ supply/demand matching and cyber security; Earth-Source Heat funding; student bio-diesel project funding; energy conservation (LED lighting, etc.); and participating in the development of a nationwide HVDC network. She noted that one of the reasons why technology fails in the energy space is not because the technology doesn't work, but because it can't scale or is too expensive. She indicated that the challenge is making these efforts scalable and commercial realities which might prevent good ideas from being implemented.

Elissa pointed out that the Energy Task Force Committee recommended forming a "Build the Brand" sub-committee to define the ECC's role in support of this strategy. The sub-committee members would be comprised of the Energy Systems Institute, select faculty and ECC representation whose role would be to: identify and contact potential sponsors and partners to raise funds; work on cooperative development frameworks; participate in outreach as needed; develop a calendar of public engagements to showcase Cornell's Earth Systems Institute's goals and progress (beyond research); and identify potential pilot and commercial outlets for emerging technologies.

Elissa emphasized that you need to have a big goal and make it known that you're changing the world (branding). She suggested that the current Energy Task Force be disbanded and re-formed in to two subcommittees. One would be a "Build the Brand" subcommittee. This would be a multi-year commitment. She indicated that they'd like to review this subcommittee's charter for the fall meeting. She'd also like to know if AAP should be involved in this effort. Lance noted that our ties with architecture are growing and that we want to make this effort public. He indicated that it's critical that we establish a consortium which will help the Energy Systems Institute now and in the future.

Elissa also outlined University Strategy 2: Cornell as a "Living Laboratory" for world-class energy systems research translated into commercial practice. The objectives are to: support Cornell's objective to reach carbon neutrality by 2035; develop Earth Source Heat as new green technology; use "Big Data" to make the Cornell region a smart region. The ECC brainstormed

about an input plan to reach carbon neutrality by 2035: viability and capacity of geothermal to meet goals; availability of carbon neutral electricity off the grid; opportunity to sell energy to the grid for carbon credits; opportunity to purchase energy off the grid at lower prices and store it as heat or hydrogen; future pricing models and assumptions; smart classrooms; no/low carbon campus transportation systems; encourage energy conservation behaviors by Cornell Community; consider building a Cornell campus micro-grid for research and education. The second subcommittee of the Energy Task Force recommended forming a Cornell as a Living Laboratory subcommittee comprised of ECC members and faculty to oversee plans and milestones in achieving this carbon neutral goal. The next steps for the committee which would be to confirm the priority of the two energy strategies identified: Build Energy Systems Institute "brand" by supporting development of new, innovative technologies; and Cornell as a Living Laboratory for world-class energy systems research translated to commercial practice. They need to solicit interest from the full ECC membership for the Build the Brand subcommittee and the Cornell as Living Laboratory subcommittee. She added that they would like to review these charters and membership at the Fall meeting.

Elissa indicated that the Council could be very helpful with public outreach. There's a lot of expertise on the Council about how to interact with industry and venture capitalists and large corporations that are working on technology development (for example have a presence at companies' technology days which brings in outside people to talk about what their research developments). Also, it is important that identify places where technologies can be tested. Even with early or front end research you have to get at least some demonstration of concept fairly early and Cornell can't build enough facilities to pilot all the technologies they might like to innovate. What are the opportunities to get those technologies tested? Lance indicated that he's in a leaning mode with this effort and the advice and wisdom of this committee would have a huge impact in this effort. Lynden agreed that the Energy Institute would also benefit from this effort.

Elissa noted that we need to make our sustainability efforts widely known (i.e., sustainability report or progress report on how we are doing in this effort). And use this a platform to talk about all the great stuff we're doing (i.e., we just built Upson and it's Leed Platinum and make it very visible and public. You have to have a big goal but it can't look like it's self serving. It has to look like you're changing the world. You need to find a way to bring other people to the party to either emulate what you're doing or contribute to what you're doing to have an impact on changing the world. She recommended that this committee disband and form into these two committees which will probably have a multi-year life since these are long-term objectives. She would like to open up membership on these sub-committees to the greater council to achieve some of the things they discussed. Then review the charters at the Fall meeting. They would like Lynden to be a contact for these sub-committees. Lance will be reaching out to the council for leadership on these two sub-committees. Lance, Living Laboratory is about training students and doing dozens of projects that will advance us, but also educate them, and get them to think about how the earth could be different. With Earth Source Heat, we are trying to demonstrate, at a scale that energy companies will pay attention to, what we think could be a new technology for heat. Lance would like to create a consortium for this effort and is counting on

the council to help with this. In summary, Lance believes that the recommendations made by this task force to re-organize into two sub-committees is sound. He plans to ask two ECC members to serve as leads on the "brand" and "living laboratory" subcommittees, in addition to close partnership with Lynden Archer, Director of the Cornell Energy Systems Institute.

Bioengineering Task Force Committee Report
Craig Wheeler
Charge: Provide strategic counsel about enhancement of bioengineering research, teaching and interdisciplinary engagement across the College, and the University.

Craig Wheeler thanked the bioengineering task force for their hard work and indicated that each committee member would participate in this presentation. He acknowledged that they used as a reference, *"BCG and McKinsey"*, a knowledge management database on future trends. He also acknowledged the support of Bob Langer and Robert Tijan for their expertise and guidance and reaction to some of the materials they prepared; as well as the analytic support of MEng students and MBA students who helped gather materials.

Craig indicated that they, like the other committees, see this as a starting point in this effort. Bioengineering was divided into two teams: Team 1 – Cornell Today; Team 2 – External Trends. He outlined the goals which were divided into three phases. The goals of Phase 1 are: map the current state of bioengineering at Cornell across the involved areas of the university; evaluate macro trends and develop perspectives on how they will impact Bioengineering; apply this lens to the academic approach to the field to determine the implications for Cornell's Bioengineering strategy; identify Cornell's strengths and gaps against our projected future requirements and suggest ideas for Phase 2 to explore ways to extend Cornell's leadership position in the field.

Craig indicated that Cornell is starting from a position of strength in Bioengineering (with 83 faculty across 24 research areas and 7 departments) and that the field of biomedical engineering is growing rapidly. He also summarized the efforts needed by the university, faculty/program and student level efforts needed to enhance Bioengineering at Cornell. At the university level, he noted that there are broad areas across the University but lacking a unified strategy for the field of bioengineering. He suggested that the University create a central place to capture data and metrics to make those choices in its areas of focus then define strategies and investments needed to establish a leadership position. Cornell can then build on its leadership position by defining a broad objective for its bioengineering efforts.

At the field level, Craig pointed out that bioengineering should integrate future requirements from our rapidly changing global ecosystem into their research planning. He emphasized that it's essential that we have a strong and continuously refreshed set of relations with relevant industry, and venture and government players should be established for each area of focus.

At the faculty level, Craig indicated that faculty should be given training and support to help them systematically evaluate the relevancy of their research and the requirements they must

fulfill to successfully drive impact. Subsequently, programs should be evaluated, and then supported, to identify, build toward appropriate funding, and ultimately drive societal use of their discoveries. At the student level, he noted that a limited number of bioengineering companies visit or recruit. We need to build our brand and find better placement opportunities for our students.

Craig noted that the task force developed a set of four recommendations for Phase 2: initiate a University level strategic dialog about priorities and themes for bioengineering; launch an Engineering College level initiative to consider how to properly target efforts in priority areas; establish a set of pilot programs to bring strategic focus in two or three core areas and develop the tools for a broader rollout; implement an administrative project to develop the metrics and tools to map and monitor our progress in bioengineering. He added that this subcommittee is committed to supporting the University in Phase 2, however, this will require significant Cornell resources and attention at senior levels.

Ivan Lustig outlined their preliminary efforts to map the current ecosystem of bioengineering. The task force discovered that it more diffuse than they originally thought. They decided to measure what bioengineering is at Cornell through the lens of faculty and students to try to judge where we are. First they decided to define the field of bioengineering. Assumption 1: The activity must be at the confluence of biology and a complex system approachable with engineering techniques. Assumption 2: Areas of the field (meeting the above criteria) can be found in a broad range of applied research, and can be roughly categorized in three areas: Biomedical Engineering; Biological and Environmental Engineering; Biomolecular Engineering.

Cornell Bioengineering has distributed strength in 24 research focus areas that overlap within several departments, with various levels of government funding. The Task Force reviewed bioengineering funding efforts and noted that this area receives significant federal funding (2/3 of its funding), but industry and foundation funding could be stronger. Coordination across field areas and departments is difficult and it is unclear how focus areas evolve while adapting to constantly changing external needs. Ivan pointed out that intellectual property from Molecular and Cellular Engineering and Materials Synthesis research dominated the bioengineering IP landscape.   The placement rate for BME is commensurate with CBE, but over 15% higher than BEE. About 1 in 4 biomedical engineering Master of Engineering students from the Class 2016 were still seeking employment 12 months after graduation. The majority of biomedical M.Eng. students currently working are employed in industry as compared to academia or government. Also, space is a big issue with the growth of Biomedical Engineering and space is costly. He noted that among the challenges of studying the field of bioengineering is the difficulty of finding data overall (the University doesn't track data on these broad rubrics in the way that they might do in the private sector). There should be better mechanisms for measuring and evaluating Bioengineering as a whole; more connections are needed with Ithaca-based Bioengineering and NYC-based Weill Cornell Medicine and Cornell Tech; and there should be a central site or platform that captured start-ups developed out of Cornell Bioengineering as a whole.

Kevin Johnson discussed the biomedical engineering trends at Cornell. Biomedical Engineering at Cornell is off to a strong start: The investments the College has made in the past decade have created a foundation for a world-class presence in the field. The College has strong and widely recognized faculty, and there's been rapid growth in the number of faculty and students. He noted that we have already chosen cellular imaging and micro/nano biotechnology as areas to drive to number one in status, which is incredibly exciting. He described the biomedical engineering ecosystem which is evolving in the areas of materials, data and tools. He pointed out that most universities' biomedical engineering programs focus exclusively on research, whereas Cornell also focuses on corporate connections, innovation and entrepreneurship which creates incredible opportunities for us. He also noted that healthcare delivery is undergoing a dramatic evolution in how care is delivered based on technology advances, competition, and ability to pay. The economics of healthcare is also evolving with cost effective solutions expected. Global competition is increasing. The changing healthcare delivery sector and increased buying power will result in lower margins for products and we'll also continue to see new "disruptive" competitors from the tech industry which will accelerate market changes. Traditional competitors are going to consolidate and acquire new, innovative companies.

Kevin also discussed some of the trends impacting biomedical engineering. Science priorities are evolving: there's an increased focus on wellness and early intervention; technologies that reduce the cost of healthcare will be prioritized; access to rapidly evolving tool technologies are critical in the areas of nanotechnology and new materials; information sciences and data mining; robotics and 3D printing.

Kevin explained the implications of this for Cornell Biomedical Engineering. At the University level, selecting priority areas for investment will be critical to develop and maintain leading positions in the field. However, this may conflict with academic independence at some levels. There will be a global focus which will be important for the biomedical engineering in the future, particularly, as funding becomes more international. He added that there will be more flexibility around IP and a willingness to work with corporate priorities may be necessary to obtain attractive funding sources, policy will be critical.

Kevin noted that at the field level, biomedical engineering should prioritize areas the areas in which it wishes to lead and identify a road map to attain leadership in each area. Also, it will need a strategy to access critical tools (data mining, materials, fabrication technologies). Evaluation tools should be developed to help faculty understand economic value of their ideas early in research.

Kevin pointed out that at a faculty and program level for each program area, an understanding of the industrial as well as academic space should be developed to inform the research. Cornell should continue to look for the best academic and industrial partners to access adjacent tools and technologies (both inside and outside of Cornell).

Kevin described the key take-aways for Cornell Biomedical Engineering that for all of the key programs, it will be important to factor in the requirement of the changing ecosystem into

research plans and into the future. Funding sources will shift, and Biomedical Engineering should prepare to access corporate investments which will require a global view, and may be from unexpected sources such as tech companies. He added that government funding may become much more focused on cost saving technologies. Biomedical Engineering has some of the most advanced thinking in how they want to focus, may be a good area to pilot new strategies in this area.

Susie Riley discussed trends in Ag-Tech which is a broad category that includes: farm management, sensing, IoT, robotics, and Ag-Biotech. She noted that the key trends driving Ag-tech are: the growing global population – feed 10B by 2050; urbanization – 50% of the world's population live in urban areas; climate change; and consumer preferences – demands for transparency, healthy food, sustainability. This drives yield (there is 30% room for improvement) and reduction of value chain loss (33% on average, as a percentage of initial production); vertical farming; better water management and better seeds; and organic and healthy products, with fewer pesticides.

Susie noted that another area of focus is Bio-Agriculture Engineering, known as Ag-Biotech. She pointed out that there's also the area of Plant Ag-Biotech which involves new approaches to driving top-line value for the grower; small-molecule discovery platforms (i.e., 'shape shifting' boron to produce pesticides to combat pesticide resistant organisms); Biologicals (i.e., engineered microbes that provide 'organic' pesticides); food tech (artificial meat, plant based meat); and Animal Ag-Biotech (with new approaches to alternative therapies for animal health, advanced genetic engineering).

Susie also outlined the evolving market dynamics, noting that there's a lot of turbulence ahead for the big 6 (BASF, Bayer, Dupont, Dow Chemical Company, Monsanto, and Syngenta). She explained that key products in seed and chemistry have come off patents. It's increasingly imperative for the Big 6 to change. Organic disruption is unlikely, so there's been heavy acquisition activity which presents great opportunities for startups to be acquired for big $$s.

Susie described the evolving industry and governmental participation: water and GMO regulations; GMO labeling bill passed in July 2017 - Action on GMO ingredients is in early stages and will likely take 2 years to complete. If not implemented carefully, this could undercut innovation. This will heighten consumer sensitivity. She added that immigration reform will have an effect since undocumented workers make up 16% of the workforce. Consequently, pressures on the workforce will drive innovation in labor (think robots); some governments are investing highly in Ag Biotech (i.e., Dubai sovereign fund made an investment of $205M in Indigo, a biotech startup).

Susie also discussed the implications for Cornell Ag-Biotech Engineering at the University level. Cornell has a unique opportunity to position itself as an institution that can foster innovation in the field due to its unique set of capabilities across several schools (Engineering, Ag School, Biology and Chemistry from the College of Arts and Science). She noted that we could create a perception that we have this unique capability which puts us in a position of expertise and the

ability to leverage these core areas to be a differentiator in the ag-biotech space. Perhaps we could create a 'Cornell Center of Excellence for Ag-Biotech for a Sustainable Future' (CCEABSF) and invite industry and the venture community to participate in it so that they would feel like they have some type of ownership in it as well as funding. It would be a new vehicle through which we can drive and execute on the mission of establishing Cornell as a leader in ag-biotech. She concluded that we need to identify key faculty to spearhead this effort.

Avi Mehrotra discussed the bioenvironmental engineering trends. He described the bioenvironmental competitive landscape at universities. He indicated that many universities have interdisciplinary environmental/sustainability programs, however, few universities have initiatives dedicated to environmental engineering. He added that federal funding contributes heavily to smaller Universities' sustainability programs: Most Fortune 500 corporate partnerships are with larger Universities. Also, some universities focus on sustainability specific to their geographic area: These are typically public universities located in unique climates.

The Bioengineering Task Force Recommendations included: "initiating a strategic dialog at the College and University level to determine critical areas of focus and discuss if we have a need for a Cornell-wide bioengineering vision; launching an initiative to consider how to support and target programmatic efforts without overly interfering with academic freedom; pilot enhanced program support model in two or three key areas to build tools and test concepts; develop a set of metrics and tools to continuously map activities and assess progress against goals across Cornell's bioengineering efforts". The Bioengineering Task Force reiterated their willingness to help, and suggested a smaller discussion with a College and University leadership team to refine a plan for Phase 2. Lance would like to bring the relevant department/school chairs/directors together with Craig Wheeler and Andrea Ippolito to evaluate the task force findings and evaluate how to begin Phase 2 implementation.

Capital Infrastructure Task Force Committee Report
Ken Goldman and Lisa Walker
Charge: Provide counsel, insight, and offer feedback on strategic planning and marketing for major capital infrastructure renovation for the College of Engineering. Ultimate goal is to completely transform the Engineering educational, teaching and research experience at Cornell through reinventing physical spaces.

Ken Goldman acknowledged the support of the Cornell team in putting their presentation together. He noted that in the next three years, the College of Engineering seeks to raise $150M in capital support to transform our buildings into state-of-the-art, 21st century teaching and research facilities. President Pollack and the trustees fully support this campaign as a priority for the University. The task force was charged with providing strategic advice and counsel on increasing our base of prospective donors and encouraging philanthropic support from alumni, parents and friends for this critical priority. He also indicated that the College has a strong base of engaged and generous alumni. However, although it has over 50,000 living graduates, only a small percentage are currently engaged and supporting the college.

Lisa Walker pointed out that each task force stressed the need for increased marketing and branding. Each of them indicated that we're doing great things, but we're not letting others know about them, whether it be our students, alumni, or corporations. We need to take our collective strengths and synthesize them into a universal message. Strategic marketing will be necessary to communicate our message out. Lisa added that we need to discuss how we can get a broader audience. The first thing we should do is segment our market, at least for our alumni. Each member of the task force met with or spoke with members of the development committee and asked them for lists of people we have contacts with, as well as people we don't have contacts with. Another thing they did was recognize that each ECC member is an ambassador in this effort. Many are making significant investments in their engineering facilities. A series of capital-focused events have been planned throughout the coming months to help the College continue to socialize the capital infrastructure plan and need for investment: David Perez will host a kick-off reception in New York City – June 5, 2018; Lisa Walker will host a reception in Chicago – September 26, 2018; Ken Goldman will host a reception in San Francisco – September 27, 2018; Richard Ong will host a reception in Greenwich, CT – Fall 2018.

The capital campaign goal of raising $150 million is a big number to crack; it will not be easy, but it's definitely doable because we have a story to tell. Lisa discussed the fundraising pyramid needed to reach that goal: we need a big gift of $50 million (3 prospects), 1 gift of $25 million (3 prospects), 2 gifts of $10 million (6 prospects), 2 gifts of $5 million (6 prospects), 8 gifts of $1 million (24 prospects), 30 gifts of $500,000 (90 prospects), 48 gifts of $250,000 (144 prospects) and 100 gifts of $100,000 (300 prospects). We have $30 million of fundraising secured to date, $60 million under discussion and $60 million remaining to be identified.

Lisa reiterated that facilities don't define the College, but enable us to attract top-quality faculty and students, and increase our rankings. She played a video showing the renderings of the future Hollister Hall renovation and invited the Council to join Lance on this journey. Lance added that the capital campaign is his, as well as the President's, top priority. He asked for the Council assistance in identifying names to contribute to this campaign.

ECC Feedback on Task Force Reports

Comment: We have an incredible business school and should consider having the proposed task force collaborate with them to leverage their marketing expertise to assist the College with its branding efforts. Carol: we have a list of 5,000 qualified individuals that we know have certain wealth, and we also have a big data project that we're engaged in with AAD and ORIE to try to refine how we do prospect research that is an active project with an MEng student in ORIE. This project will improve our lists of potential donors.

Comment: I've been involved with other universities where they've created clubs for each level of fundraising and receive awards (plaques at the college where their names appeared). They hold a competition by class year each year, which is very effective. This way their donations were not anonymous.

Comment: We might need to create a collaborative center for fundraising. There are people on the Council who could help us further our cause, especially on the operations side.

Comment: Are we thinking about building spaces where interdisciplinary collaborations can take place, rather than by department? Lance: Yes, we're doing that now (5th floor of Upson is CS, ECE and MAE shared space). The Hollister Hall renovation will have space where ECE, MAE, CS, ORIE, CEE and CBE can interact, laboratory space will be flexible.

Comment: The Biotech Building and Duffield Hall are examples where various departments interact with each other. What will happen to Ward Hall? Lance: long term, it will go away. It would be extremely expensive to renovate. In the meantime, we will be using it for many years. Carpenter Hall will eventually go away and the administration will go into the south wing of Hollister Hall. The library will go into the first floor of Hollister. The priority of these renovations to maximize every square inch, especially for wet lab space. The amount of office space is shrinking.

Comment: Will we outgrow this new construction? Gates is already running out of space. Lance: CS enrollment has increased dramatically. If we named the College, that would change things dramatically. The current plan is based on strategic growth of some of the departments. In 2012, we spent 2 years getting to the first plan, and in 2016, we came to where we are today with the current plan.

Comment: Getting the Council engaged was a fantastic change for this meeting. Lance indicated he greatly appreciated the Council's task force committee reports which were very valuable. In summary, with respect to the educational task force, he observed that the College needs to organize its efforts to better serve our students, faculty and society. With respect to the energy task force, he noted that building a consortium is going to be critical. As for the bioengineering task force, he noted their suggestion not to follow in the footsteps of the top tier schools. We also need to think about a leap frog approach to this which is very profound and challenging. With respect to the infrastructure task force, he felt that the need for marketing is clear, and that we should capitalize on the excitement around this topic. He pointed out that at the next meeting, the infrastructure task force committee discuss the second version of their report.

Lance concluded by asking the Council if they thought this meeting with the task force committee members reporting out to them was an effective way of conducting this meeting. The consensus of the members was yes. As a next step, Carol indicated that she will take everything that was discussed at this meeting, will coalesce it, and break it down to what she, Lance and the task force co-chairs and the chairs of the Council and say this is what we heard, and then will get back to the group regarding next steps. The meeting was then adjourned.