State of the School - Fall 2015

Thank you very much. And good afternoon!

This Fall we are celebrating 110 years of engineering at USC! This is 11 decades since 1905, where engineering just started flexing its muscles as the discipline that will come to be the dominant and most empowering one of our times … Also 11 years ago, in 2004, we celebrated the Viterbi naming of the school. Which is now, synonymous with the excellence of our namesake and his late wife Erna. And this Semester will mark the beginning of my 11th year as dean of the school… (number 11 again, just a coincidence?…) I can assure everyone though that when we celebrate 12 decades of engineering at USC, in 2025, I will certainly not be starting my 21st year!

Emeritus professor George Bekey, a robotics pioneer, worked in the last couple of years to highlight the great and wonderful role that USC engineering has played in the life of USC, Los Angeles and Southern California- but also to document its remarkable ascent. His just published book: A remarkable trajectory- From humble beginnings to global prominence is an account of the second part of the history of USC engineering- since 1960, namely a span of 55 years (or 5 times 11). You can order the book at amazon.com!

So, as we review today the State of the School it is with the perspective of its long history and its remarkable trajectory, that we should view it. Now, before I proceed I
would like to acknowledge the presence of our friends from organization Base 11 (of course, what other number would we have today…) which is partnering with our Department of Astronautics (founded 11 years ago!) and the Rocket Propulsion Group, to enhance the attraction to engineering and other STEM disciplines of talented students from underrepresented groups in community colleges. Welcome Landon, Michelle, and Cindy! In the same spirit, I cannot also avoid the temptation to say that Dan Erwin, the current chair of Astronautics, joined USC in 1982, a mere (3 times 11) years ago. Not only that, I just learned yesterday that Dan was elected as Associate Fellow of the American Institute of Aeronautics and Astronautics. Congratulations Dan!

If we were to summarize in a couple of words what is different about engineering – even ten years ago, let alone 1905- and in our own school of engineering today are the notions of Engineering+ (conceived here at this very school) and the Changing of the Conversation. They encapsulate What engineers do, Who they are, and What they look like.

Chuck Vest, the late President of the National Academy of Engineering, said at a meeting at USC five years ago: “We live in the most exciting era for science and engineering in human history.” His words have never been truer. “We live in the most exciting era for science and engineering in human history.” And the main reason for this is the exponential growth of technology- that is revolutionizing our world and has made engineering the empowering discipline of our times. A discipline that empowers all other disciplines, from the natural sciences, to medicine, to social sciences, to the arts. This discipline has now become Engineering+.

To capture best what we do, I tend to use a simple, but I think powerful, statement:
Technology (and engineering) is leveraging phenomena for useful purposes

What are useful purposes? They address important questions on sustainability, security, health and how to further enrich life. They are societally relevant—e.g. the elimination of extreme poverty, even of poverty itself. And the rising of living standards across the globe. But useful purposes also include helping discover new phenomena on the boundary with the sciences, that will accelerate technology with goals to solve these fundamental challenges and improve the human condition for the better.

Now, in the past we engineers typically used phenomena of mechanical and electrical origin (that was certainly the case in 1905), namely phenomena of mostly physical nature, to enable useful purposes. (And I will come to “useful” shortly.) But engineering and technology have come to address progressively more complex phenomena: in order of such increasing complexity, we can identify physical, then chemical, then geological, and now biological phenomena (including single organisms or species). These have all spawned tremendous technologies of chemical, earth and space, and biochemical/biomedical application—leading for example to the accelerating convergence of medicine with engineering. And then, in increasing complexity come social phenomena, which I believe will be the next important area where engineers and computer scientists will come to play an important new role—in the convergence of engineering with social sciences. (Now I have this theory that social phenomena are very similar to chemical reactions—but I will leave this topic for another 5-hour lecture…). This exponential growth in technology has spawned engineering+, from the discovery of fundamentals in nanotechnology and materials to bioengineering and data sciences, and is
positioning this new engineering at the center of today’s world- technological, economic, business, leadership.

So, I submit that Engineering+ is what we do now and will be doing in the near future as engineers. And this narrative must be the first and most important ingredient in “Changing the Conversation” about engineering. It is also the reason why we already see the beginning of a real change in the demographics of those we study and practice “engineering”. In multiple ways, engineering+ is becoming as important part of education as liberal arts.

Indeed, at the end of the day, engineering and technology (and I will use these two terms interchangeably) are at the core of all new innovation; the ways to solve emerging challenges at global scales; and to create new exciting possibilities for the benefit of humankind. Because engineers do not only solve problems- they also provide opportunities to enrich life. And that is another part of the narrative that must change. Engineers not only solve problems- they also create boundless opportunities. Few professions turn so many ideas into so many realities. Few have such a direct and positive effect on people’s everyday lives. It is engineers and their imaginations that will help us meet the needs of the 21st century. No profession unleashes the spirit of innovation like engineering. And USC Viterbi is at the forefront of this movement.

Allow me also to open a parenthesis- and to remark that in the above definition, what is useful to someone may not be so to another. Indeed, technology offers choices and decision-making alternatives. Ethical, legal and moral decision-making is therefore, inexorably tied to our discipline. It is in this spirit, therefore, that in the inexorable drive of technology, decisions and ethics are essential elements of the use
of technology—of useful purposes. And in such decision making the fundamental underlying lever is our values. It is in this context that we announced recently the formation of a new Center on Decisions and Ethics, headed by Professor Ali Abbas, to explore further these connections.

But there is a second, equally important part in “changing the conversation” about engineers: Who they are and what they look like. We are all familiar with the engineering stereotypes, which are as hard as those for lawyers. OK, I don’t disagree much about the lawyers… (Just a joke— all my family have been lawyers, and I just barely escaped that destination myself…) But, it is about time that we change, nay, dismantle these negative, Dilbert-like stereotypes about engineers and to just simply declare that engineers literally change the world — and they must come from all segments of our society.

It is with effort in mind, that during the last several months, we have supported and helped launch a number of national initiatives with goal to “change the conversation” about engineering. Perhaps you read or heard about them in the Los Angeles Times, Fortune, The Chronicle of Higher Ed or NPR. I will take a second (or eleven) to remind you of a couple of these initiatives.

Last February, in partnership with the National Academy of Engineering and MacGyver creator Lee Zlotoff, we started a worldwide contest, “The Next MacGyver”, aimed at producing a script for a new TV show starring a female engineer. More than nearly 2,000 entrants, worldwide, submitted ideas, which in June were distilled down to 12 finalists. In late July this summer, the 12 winners pitched their idea to a panel of judges. The competition came to an end with the selection of five talented writers — some of them engineers (imagine that!) Each
finalist took home a $5,000 prize and was paired with a distinguished Hollywood mentor, including Anthony Zuiker of the CSI franchise, actress–producer America Ferrera of Ugly Betty, and Star Trek and Scorpion writer and producer Roberto Orci. Just as CSI led to a surge of interest in forensics, we hope that one or more of our finalists’ visions for a strong female engineer lead will eventually make it to the TV screen, galvanizing girls everywhere to become the new face of engineering.

I should remark that USC Viterbi has been transformed in the past few years in the makeup of its undergraduate class- as well as its faculty. The Fall 2015 freshman class this year was 38 percent women, while the percentage of Viterbi undergraduates who are women is about 35%. Unfortunately, the national picture remains mostly unchanged. It has stagnated at about 19 percent for several years. And this must change- hopefully the Next MacGyver will do just that.

But the changing the conversation must also address other currently underrepresented in engineering segments of our population, Hispanic and African American. This is not simply a moral or societal issue. Given the changing demographics of our nation it is also a deep economic issue- I would dare say, even one of national security; and also an issue of diversity of ideas, that can come from the diversity of cultural backgrounds. In his book “the beginning of infinity” David Deutsch asks: How is knowledge created? He answers: by the diversity of ideas, the majority of which will be poor and simply wither away, but a few of which will grow, will pass repeated tests and finally become new knowledge. Therefore, we view diversity not as a bow to political correctness- rather as the arch that extends and strengthens our entire field for our collective benefit and advancement. Happily, a growing number of engineering schools around the nation share our view.
As part of the ASEE Engineering Deans Council Executive Committee, I recently drafted a pledge letter for engineering schools to take concrete steps to address these vexing issues. I am very pleased to tell you that in only about three months since its inception, more than 148 engineering deans have signed this commitment letter. Among the pledge, included are actions to reaching out to K-12 to change conversation about engineering in that important milieu, and to non-research, four-year-only engineering programs and community colleges. The President of the United States celebrated these commitments at the White House Demo Day for inclusive entrepreneurship on August 4, 2015, an event that I attended on behalf of my fellow engineering deans.

We are indeed entering a new phase of engineering- with new faces of engineering. The final and decisive chapter in “changing the conversation” will be written by how we educate our new engineering students- how we incorporate Engineering+ in our curriculum and their education to produce the engineers of tomorrow. The World Economic Forum recently articulated the key ingredients of the successful workforce of the new century: In addition to literacy and numeracy, important new skills are collaboration, innovation and creativity, and strength of character- such as leadership, and determination (what some people call grit). So we believe that the new engineers will be those with superb technical competence, but who are also interdisciplinary, entrepreneurial, and innovative, understand the global context, and with a strong sense of societal responsibility. This is where enters the Grand Challenges Scholars Program.

This program was jointly conceived with our (former USC) colleagues at Duke University and Olin College and announced in 2009 at the first National Summit on the NAE Grand Challenges, and in response to the announcement of the NAE Grand
Challenges in 2008. I am very pleased to tell you that six years later, it is being implemented in more than 100 engineering schools nationwide and spreading globally as a model of the next engineer. I am very proud that USC Viterbi was one of the three institutions that conceived it and championed it.

Participating schools have committed to graduate more than 2,000 GCS engineers annually starting in the next couple of years, with an ambitious goal of graduating 20,000 in the next decade. The White House warmly welcomed and supported this initiative and its three founding schools, USC Viterbi among them, along with the NAE, at the Science Fair last March. I believe that this program will be the blueprint of the education of the new engineer. And I am committed for USC Viterbi to not only graduate 20 scholars every year—but to aspire that all our graduates will have these characteristics upon graduation (ABET willing…)

As you know, as part of our efforts to change the conversation about what an engineer does we have long promoted the NAE Grand Challenges – first, by hosting a national conference at USC in 2010; next, by organizing the 2013 Global Summit in London, in partnership with the Royal Academy of Engineering and the Chinese Academy of Engineering. And a week ago by helping organize the second Global Grand Challenges Summit in Beijing.

But the Grand Challenges, and any grand challenges of the future will be solved by the next generation. It is for this reason that for a year now I helped organize the first-ever global student business plan competition on the Grand Challenges at the Global Grand Challenges Summit in Beijing. Fifteen teams, five each from the US, China and UK, competed in a pitch competition very similar to our own MEPC. I
am proud to tell you that USC Viterbi’s very own Stasis Labs took home the Silver Medal (and the highest placement among the US teams), under the guidance of Ashish Soni of our own Viterbi Student Innovation Institute. Earlier this year, *Inc. Magazine* named this fledgling startup – which develops cost-effective technology that allows doctors to easily and inexpensively monitors patients’ vital signs – as one of 16 “Coolest College Startups of 2015.”

And I am very pleased to let you know that as a result of a wonderful gift from one of our BoC members, we will announce in two weeks a new plan competition, similar to MEPC, only with a goal of societal entrepreneurship. Of course, those of you who follow me on Twitter know about all these already! Those who don’t, it’s never too late: Follow me @DeanYortsos!

So, 110 years since its founding, USC Engineering is redefining what engineers do, who they are, what they look like. And as we take stock of where USC Viterbi is and where it is going, I would like to remind you of our four pillars, which essentially guide our strategy:

1. **Attract top talent, whether students, faculty or staff, from anywhere in the world; and create the environment for them to flourish.** TALENT

2. **Continuously add value in the curriculum, programs, and infrastructure.** VALUE

3. **Lead globally to solve world challenges and enrich life, from sustainability, to health, to security to the elevation of the world’s standard of living.** THOUGHT LEADERSHIP
4. **Be the catalyst for the innovations (exponential, digital, combinatorial) that will fuel the economic growth of Los Angeles, Southern California, and the world. IMPACT**

I will give you a very brief glimpse of where we stand in these four pillars this moment:

Just like last year, our freshman class is the best in its history. In fact, this year was our most selective year since I have been at USC.

38% of the entering class was named university scholars; 13% are National Merit Scholars. The average SAT at USC Viterbi has increased 77 points (seven x 11) in the last nine years. I can say that we have the best freshman class in our history! (Of course, I said the same last year, and the year before, etc…. and I think I will say the same next year too…).

Our students come from 29 different countries; 41 different states; 10% are First-Generation students (the first in their family to go to college); having incredibly diverse backgrounds and interests.

Developing skills outside the curriculum is a key and important part of the student’s experience. One of our undergraduate students, senior Brian Kim, recently completed a prestigious Kleiner, Perkins, Caufield & Byers fellowship in Silicon Valley- Kim, a computer engineering and computer science major, was one of only 82 KPCB fellows chosen from 2,500 applicants from more than 200 universities nationwide. Previously, he helped found HackSC, our now thriving hackathon.
Five talented USC Viterbi undergraduates recently built an optical projection tomography (OPT) microscope as part of the course ENGR 499 Microscope Design and Construction. The instrument produces three-dimensional images of pea-sized biological samples, such as organs and embryos, providing a valuable tool for scientists to study how organs develop, maintain and repair themselves.

At the graduate level we had a record 13,400 new applicants to all our M.S. programs, a new school record, and more than 2000 applicants for the PhD program. Doctoral student Moshref Javadi was recently named a Google Ph.D. Fellow – USC Viterbi’s second in the last three years – one of 15 nationwide and the only one in computer networking.

In the past faculty recruitment cycle, we hired 9 new tenure-track, of whom three are women, and 12 non-tenure track faculty. The TT pool was 1,800 total applicants. Among our new faculty I will name a few: Phebe Vayanos, assistant professor in ISE, comes to us from MIT having earned her Ph.D. at Imperial College London; Xuehai Qian, in EES, joins us from the University of Illinois at Urbana-Champaign. Qiming Wang, assistant professor in civil and environmental engineering, earned his Ph.D. at Duke University and was recruited from MIT. Birendra Jha, an assistant professor in the Petroleum Engineering area of our Mork Family Department is joining us, also from MIT, where he earned the “Best Doctoral Thesis Award” from the Department of Civil and Environmental Engineering at MIT; Ilias Diakonikolas, assistant professor in computer science and Columbia University Ph.D. is joining us from the University of Edinburgh; Alejandra Uranga, an assistant professor in AME, also an MIT Ph.D. has interests in novel aircraft design and integrated propulsion systems; and S.K. Gupta, a senior faculty member and
former director of the NSF Robotics Initiative is joining us from the University of Maryland to lead efforts in Advanced Manufacturing.

Other accomplished senior faculty joining us includes Neil Seigel, Northrop Grumman VP and chief technology officer in the company’s Information Systems sector. David Ashley, former president at UNLV and Founding Executive Vice Chancellor and Provost of UC Merced and former Dean of Engineering at The Ohio State University, will join us the Astani Department. Thanasis Fokas Caltech PhD and also an MD, will join us with a joint appointment between EE and the Department of Applied Mathematics at the University of Cambridge. Thanasis is world leading applied mathematician with strong interests in medical imaging.

I would like now to mention some of the important awards our faculty have received in recent months. Maryam Shanechi, Ketan Savla, Paul Bogdan and Minlan Yu have each won NSF Career Awards. A total of 4 NSF Career awards! Not too bad.

Popular Science recently named Maryam Shanechi and Bhaskar Krishnamachari to the “Brilliant 10” list. Two of ten were Viterbi faculty!

John Carlsson received the Air Force Office of Scientific Research Young Investigator, one of only 42 in the country; Shang-Hua Teng won the Godel Prize for a second unprecedented time; the ASCE awarded Costas Sioutas the John G. Moffatt-Frank E. Nichol Harbor and Coastal Engineering Award; John Slaughter received the NSF Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring plus the HENAAC Chairman Award; Steven Lu won the IFEES Duncan Fraser Award; Kirk Shung won the IEEE Biomedical Engineering Award; Maja Matarić and Urbashi Mitra received the 2015 Insight Into Diversity Inspiring Women in STEM Award; Computer Scientist Nora Ayanian was named a
“Mic 50” that honors the next generation of breakthrough innovators, leaders and cultural influencers; Mark Thompson received the IEEE Photonics Award; Viktor Prasanna won the IEEE Computer Society W. Wallace McDowell Award; and Petros Ioannou the IEEE Transportation Technologies; and Najm Meshkati will be awarded the Arnold M. Small President's Distinguished Service Award from the Society on Human Factors. Wow!

Curriculum and program innovations continue at a rapid pace, with new classes and master’s degrees, including an MS in spatial informatics, launched in cooperation with Dornsife; and an MS in Communication Informatics in cooperation with Annenberg. And as you know, we have ABET coming to town next Monday- be ready!

The Information Technology Program continues to offer new minors that have generated much interest among non-Viterbi students. The popular program has grown substantially in recent years. I am very proud of the program and its faculty, and the strong leadership provided by its director Mike Crowley!

Construction continues on the USC Michelson Center for Convergent Bioscience. The center, which is expected to be completed in 2017, will bring together engineers and scientists to tackle grand challenges in health-related fields, also including bioengineering and materials science. We look forward to its grand opening- of the largest and biggest science and engineering building on the USC campus.

And speaking of infrastructure, we have completed a feasibility study for the conversion of the Engineering and Science Library to a Maker Space, to house all our outside-the-curriculum activities, from the student groups, such as the RPL, to K-12 outreach to innovation and entrepreneurship space. Mary Ann and her team are
actively fundraising for this very important project.

This Fall we will be celebrating the 10th anniversary of the naming of the Mork Family Department (MFD) of Chemical Engineering and Materials Science, following a seminal $15M gift in the fall of 2005 by Viterbi alumnus and Chairman of the USC Board of Trustees John Mork and his family. That momentous occasion unified the closely allied areas of chemical engineering, materials science and petroleum engineering under the Mork name.

On the research front, there so many interesting activities going on that it will take another long talk to enumerate them. Under Prem Natarajan’s leadership, ISI is winning multiple, multimillion dollars awards- including a just today announced award on Cybersecurity from DHS. Carl Kesselman, director of the Informatics Division at ISI, Scott Fraser, director of the USC Dornsife and Viterbi Translation Imaging Center, and Dornsife’s Don Arnold are collaborating to image synapses in living zebrafish – the first direct study of living synapses in the intact brain, to gain a better understanding of the brain. The National Institutes of Health is underwriting this research with a five-year, $9.7 million Transformative Research Grant. Priya Vashishta and his team won the inaugural DoE grant on the Material Genome, a spectacular win for this emerging field. Congratulations Priya!

Last year, as you know, USC became the home to a new hub of innovation (one of only seven in the nation) aimed at helping high-tech startups succeed. A three-year, $3.5-million grant from the National Science Foundation will help create an I-Corps Node at USC, to unite USC Viterbi and USC Marshall with our partners at UCLA
and the California Institute of Technology, placing USC at the center of the emerging technology ecosystem in Southern California.

In this sphere, the USC Viterbi Startup Garage, the nation’s only engineering student/alum-led business incubator, has incubated 10 promising companies in its first three years of its operation.

Along with all other entrepreneurial and innovation activities, including MEPC, we are positioning USC Viterbi as a leader in tech innovation and entrepreneurship. Indeed, according to a recent study on engineering salaries and start-ups, Riviera Partners singled out USC as #2 ahead of Stanford as the school producing the most in-demand candidates. We want to be the leader in the advancement of the innovation and entrepreneurial ecosystem known as Silicon Beach. It is our hope that USC Viterbi’s young budding-business builders will one day launch the next Apple, Amazon or Google right here in Silicon Beach.

Finally, our budget this year is strong, thanks in part to the innovation in our programs and the quality of our faculty and the support of our friends.

So, as you can see from this short, OK, relatively short, review, the State of the School is strong. However, our ambition exceeds our ability to pay for it, as President Nikias often says.

To help us reach there, we have embarked on one of the most ambitious fundraising campaigns ever undertaken by an engineering school. Legendary aerospace engineer and mathematician Theodore von Kármán said, several decades ago: “Scientists
discover the world that exists; engineers create the world that never was.” Creating the world that never was is the theme of our campaign.

We aim to raise $500 million to elevate USC Viterbi to greater heights. In the broadest sense, we will invest our donors’ gifts to support the four pillars by attracting world-class professors and students; endowing chairs; creating new programs; naming and endowing departments and programs; and building best-in-class facilities to advance research and our commitment to innovation and entrepreneurship.

To-date, we have raised almost $300M- about 60% on the way to our goal. Almost 11,000 unique donors have given so far in this campaign, that is led by Mary Ann Schwartz, our senior associate dean of advancement, and her Advancement team. When I started as a Dean I articulated the following vision: To be

- First at USC
- A leader in the nation
- Constantly rising quality
- Excellence in all our endeavors

So that we can all say: I am fortunate to be part of the Viterbi School. This vision remains as strong as then.

Thanks to you, the school has scaled unprecedented heights in teaching, research and innovation and now attracts the best and brightest talent from anywhere.

Each and every one of you has played an important role helping to transform USC Viterbi into one of nation’s finest and most dynamic schools of engineering. I am most grateful for your dedication and commitment.
As I close, I am reminded of the book “The Beginning of Infinity”, by Oxford quantum physicist David Deutsch. He states,

1) Problems (I prefer to say, challenges) are inevitable.
2) But all problems are soluble.

Indeed, there will always be problems, because they represent collisions of ideas and because as you move ahead, the challenges become greater. But I absolutely share in the belief that all problems are soluble. I invite you to share this mindset.

Thank you and fight on!