

State of the School Address

September 19, 2017

Good afternoon to everyone and a warm welcome to the 2017 State of the School Address!

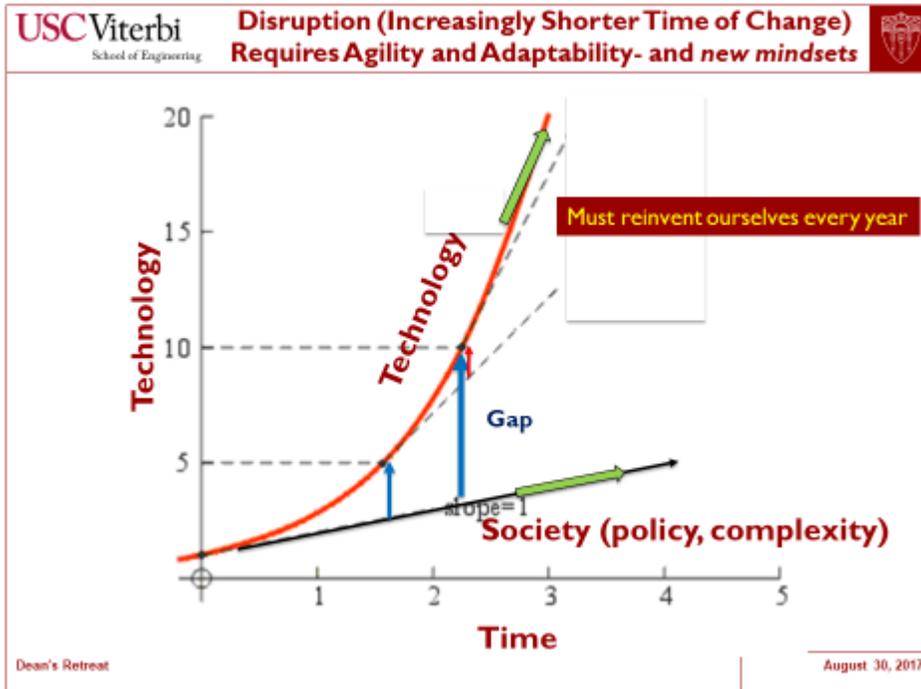
Before I proceed, I would also like to add my own encouragement to all of you to consider contributing to the GNC. I am proud that last year, Viterbi again led the university in total amount raised. The partnership with our surrounding community is integral to what we do as a university. Serving our constituencies is key to our mission- and our surrounding community is an important constituency; we are already serving many of its components, through K-12 outreach, service learning, and other student and faculty led activities. The development of a strong and vibrant ecosystem in our own neighborhood empowers us all. Our neighborhood stepped up in unanimous endorsement of the USC Village plans- now a spectacular reality. Let's keep up the GNC Viterbi leadership- and consider contributing again, whether or not you have done so during the last year.



As you might have noticed already in your tables, this year's State of the School address comes with a Show and Tell. No, this is not a clever attempt to insert a ppt presentation. But I wanted you to have useful aides to help interpret my wild gesticulations about to come.

Some of you may remember the USC Grand Challenges Summit (the second one nationally) in Fall 2010. Then, the NAE late President Chuck Vest remarked: "We live in the most exciting time for science and engineering in human history". I am sure that all of you would agree that this statement could have be repeated every year since then (and could probably having been said several years before as well). In fact, I myself have quoted his statement repeatedly, ever since- not to mention that we have put it on banners on Bloom Walk! And I am convinced that it will continue being valid and ever stronger every year in the foreseeable future.

The fundamental reason behind it is simple: We live in times of exponential growth, driven by technology, which as the chart on your table shows, every year becomes higher and more empowering than the previous year. It looks roughly like this!



Now, the most important lesson one learns from this simple curve is that there are no longer what we call “steady states”. (Such would arise when the curve in the schematic is relatively flat.) In fact, the very rate of change is not constant either. The tangent to the curve in your handout (what I have denoted as “society”) shows how things would have evolved assuming a constant rate of change. To the present time, our organizations, our endeavors have historically been based on the assumption of a steady state- or in most enlightened organizations- on a constant rate of change. Consider politics (not exactly an enlightened field) where change has a time constant of say

four years or even longer. It is not hard to see that in an exponentially changing world, the typical assumed rate of change of politics and policy results into an increasingly deeper chasm- also shown in the graph- one that we vividly experience today in the world. Such disruption is prevalent and surrounding us. The constant change brings up tremendous opportunities- but also the possibility of being left behind fast.

This is our challenge- and our opportunity- and it will be here every year! In order to shape and lead, in order to not be left behind we have no option other than to reinvent ourselves- every year. We must “hug the exponential”. All of our pillars (which, by now, you all know, I am sure- talent, educational programs, research and innovation), all our supporting functions (from staff to communication and to fundraising) must constantly strive to stay on the exponential curve, to hug the exponential. Or, as I have mentioned to my team before, borrowing from the game of soccer: We must play as if the score is 0-0. (Regardless of how far ahead we might be.)

Which brings me to growth mindsets! No, I am not going new-agey on you. On your table you will also find the

book by Stanford University psychologist Carol Dweck “Mindset: The New Psychology of Success”. In this engaging book, Dweck argues that people have either “fixed” or “growth” mindsets.

I have taken the liberty to “translate” it using the graph attached.

Those with fixed mindsets believe that talents and abilities are fixed traits (let’s say that such mindsets are the tangent to the curve). In his wonderful book, “The contrarian view of leadership”, former USC President Steven B. Sample has a chapter that distinguishes between “Being President vs. Doing President”. The fixed mindset is that of “being”.

On the other hand, those with growth mindsets believe in constant growth and change. In hugging the exponential. This is the mindset of “doing”- of “becoming”, of President Sample. The growth mindset is purposeful, with perseverance and resilience, devoid of debilitating stereotypes, it is about growth and passion. It drives innovation and renewal- and those with such mindset are the world’s change agents.

USC Viterbi has always been in the business of “doing” and “becoming”. When I started as dean of the school, waaaay back, I encapsulated our ambitions as “first at USC”, “a leader in the nation”, with “constantly rising quality” and “excellence in all our endeavors”. This growth mindset continues driving the school in all that we do. But the imperative of a growth mindset is even more relevant today in our exponentially changing world. And it is a mindset we must cultivate not only in ourselves, but importantly in our students. Today’s times can’t wait for anything else.

So, as I go over the State of the School, I would like us to keep in mind how we do in *hugging the exponential*, in possessing a growth mindset, in our *becoming* rather than *being*.

If I were to single out the most important part of the State of the School is our continuing leadership in changing the rapidly conversation about how engineering, what it is who we are as engineers and what we look like. You have heard me say quite often that in today’s world, engineering is *leveraging phenomena for useful purposes*. And these are phenomena of all kinds: Physical, chemical

and biological; but also behavioral and increasingly social. While at the same time strengthening the disciplinary foundations and enriching them with the new tools and skillsets of today. This articulation for some time now of what we call Engineering + is also termed today as the Era of Convergence, what the World Economic Forum calls the 4th Industrial Revolution. Indeed, in our exponential world, engineering is the most enabling discipline to all disciplines, the sciences, and the arts.

We have practiced this convergence for some time now. In fact, USC is the ideal university for convergence. Last time I counted there were 19 USC deans- easily the largest for any university I am familiar with! The real significance of this is that there are 19 distinct disciplines presenting a unique opportunity (a great fortune) for Viterbi students and faculty to establish unique convergence relationships with 18 (or more) disciplines. And this is we have done in what we call Engineering + (drumroll....) X. Consider:

The Center for Artificial Intelligence in Society, or CAIS, is a synergy between USC Viterbi and the USC Suzanne Dworak-Peck School of Social Work- with Milind Tambe

leading the Viterbi effort. It helps apply the power of AI to solving societal problems. CHARIOT is a new partnership between USC Viterbi and the Rossier School of Education, based on the use of IoT to enhance personalized learning (one of the 14 NAE GCs)- with Bhaskar Krishnamachari the Viterbi champion. USC Games, a partnership between the School of Cinematic Arts and USC Viterbi is the top program nationally in computer games, expanding to Virtual Reality (another of the 14 NAE GCs), thanks in large part to Mike Zyda's leadership. The Center on Quantum Computing and Communication, involving the campus, Viterbi, Dornsife and ISI, continues a growing effort in this exciting new frontier, led by Daniel Lidar. USC Viterbi and the Annenberg School collaborate on multimedia through IMSC and Cyrus Shahabi. While in the same areas, Professor Narayanan works, among many other things, on quantifying how genders are depicted in the media. Maja Mataric, Terry Sanger, Mark Humayun and many of all other faculty have been involved for some time now in the intersection of engineering and medicine, including HTE@USC, whose 2.0 version we are currently undertaking. And along the same lines, I am pleased to announce the creation of a new Viterbi-Keck partnership in neuroengineering to be led by newly recruited ECE professor Gianluca Lazzi.

On November 1, the Michelson Center for Convergent Bioscience, will formally open its doors. This new convergence collaboration between Viterbi and Dornsife will be housed in the state-of-the art 165,000 sq ft new building, which is the largest investment ever in USC history in science and engineering. Represented in the new building will be Professors from BmE, such as Ellis Meng, Eun Ji Chung, Stacey Finley and Cristina Zavaleta; professor Carl Kesselman from ISE; Professor Niema Pahlavan from AME; Professor Fei Sha from CS; while a core on protein engineering in the new facility will be directed by Rich Roberts, MFD Chair.

More importantly, this facility will be open to all our faculty with nanofabrication and microscopy needs. USC Viterbi devoted considerable resources of its own to build a new modern nanofabrication center, to be named in honor of our late colleague John O'Brien. The new O'Brien center will be directed by his worthy successor Professor Andrea Armani, who will also have presence in the building. This is a truly convergent building indeed, likely unique in the nation.

But I will not do justice to our research excellence without mentioning the phenomenal new energy at ISI. For 45 years, the Information Sciences Institute has made an outsize contribution to advancing information processing, computer and communications technologies- with synergies and applications across many disciplines. Under Prem Natarajan's outstanding leadership, our crown jewel research institute continues being a trailblazer in advancing computer science in creative and groundbreaking ways and in service to the nation. Just this past year, ISI's research expenditures have surpassed a record \$100 million+ ranging from Secure Electronics to Forecasting and to Quantum Computing.

Now, as it celebrates its 45th anniversary, ISI is also expanding its geographic footprint, having recently opened a new Boston office, the first USC presence in the Boston area.

So, with all these initiatives and with many other internal centers, in Controls, Advanced Manufacturing, Machine Learning, Robotics, the IoT, Water, Immuno-engineering, Structures and Materials, and a host of others USC Viterbi is at the forefront of the changing nature of engineering-

following a growth mindset of remarkable breadth and depth, looking forward and outwards. I encourage all of you to think of additional new such expansions- the school through the research office led by Maja Mataric and Mahta Moghaddam will be supportive at every step.

As engineering is poised to empower society, society must provide the human resources to empower engineering. The need is urgent. The future will be won by those with the best technology- the recent headlines on the dominant role of AI in the future are a strong reminder. And it is this area where a growth mindset is mostly needed. How do we attract and educate engineering students from all demographics and different backgrounds in today's rapidly changing world? How do we dismantle stereotypes on who should be an engineer? For many years the stereotypical engineer is the Dilbert of the cartoons. Many, today, still consider engineers as those who simply bring tools to fix problems. The challenge is daunting and it is multifaceted. For sure this is a changing the conversation issue. It is pipeline issue, from K-12 to faculty. But it is also an issue which engineering schools should own and be held accountable.

USC Viterbi has been a pioneer in this effort of changing the conversation, of doing instead of being. Consider: This year's freshman class is nearly 44 percent women (a historic high for the school, which exceeded last year's high of 39%). More than one-third of USC Viterbi undergraduates are female – much higher than the 20% national average. The entering class is 24% URM and 13% first generation, both significantly higher than last year. Importantly and partly as a result of this diversity, our freshman class is the best in its history. In fact, this year was our most selective year since I have been at USC (you can translate this “forever:”): with about 12,000 applicants vying for about 450 freshman slots. 185 students in our entering class are University Scholars; 82 are National Merit Scholars; they come from 24 different countries and from 39 different states.

Our graduate programs are as robust as ever. We matched an all-time high of more than 16,120 applications both for our DEN@Viterbi and on-campus programs, making this Fall's graduate classes as selective as any in USC Viterbi since I can remember (did I say, since forever...) More than 1,650 students in our graduate programs are women. And USC Viterbi enrolled the most women in graduate engineering programs than any other school in the country.

So, we are actively changing the face of engineering in all its forms. But in order to make a lasting impact we must ensure that the engineering freshmen who enthusiastically enroll at USC have all the resources available to them to also stay in engineering and graduate. It is one of my highest priorities as a dean to ensure that the gains we have tried hard to accomplish in enrolling such a talented and diverse class are also reflected in retaining and graduating it. And this is where our growth mindset must be in full force- by dismantling stereotypes on what an engineer should look like, by pursuing the pedagogy and mentoring of our times, by looking forward and outwards, than backwards and inwards.

It is in this context that I would like to announce the adoption of a parity principle. I will use a simple technical analogy to make it perhaps better understood. I tend to look at education as a chemical reaction process (yes, I have the right and the chops to say that!)- and the 4-5 year curriculum as a chemical reactor. Then, as an engineer I think that an important metric of highest possible efficiency is that the output should be similar if not identical to the input. More specifically, the demographics (gender, race, ethnicity) at the output should be about the same as that of the input, always assuming that when we

admit students we have every confidence that they will be successful. But this principle of parity can only be applied if as an institution we take full ownership and accountability. If every institution in the country (from K-12 through graduate school) adheres to it, we can collectively change engineering. It is a principle I ask you to embrace; a principle I ask you to implement- in all that you do, as teachers, researchers, staff, advisors and mentors.

During the last several years, I have been the chair of the diversity committee of the Engineering Deans Council, in which capacity I helped lead a diversity initiative across the nation. As you may already know, this initiative is now signed by more than 210 Deans nationwide. This remarkable commitment entails efforts from K-12 to Community Colleges and faculty. Vice Dean Brandi Jones and her office will help us implement here at Viterbi and coordinate nationally this important effort.

It is because of this mindset that the American Society for Engineering Education awarded USC Viterbi the ASEE President's Award for 2017. This is the first such honor for USC and one of few ever bestowed to an engineering

school. In addition, and at the same meeting, the ASEE recognized USC Viterbi as one of the top four schools nationwide with excellence in engineering for veterans. I received the awards on behalf of the school with great pride and honor.

As the exponential pace of the world continues, how we educate our students becomes increasingly challenging. The disruptive power of change can only be managed with, you guessed it, a growth mindset. The old and fixed education paradigm is increasingly becoming obsolete. The development of a growth mindset becomes increasingly more important- including how to make our own students adopt it and espouse it. Bricks and mortars universities will likely be judged by their ability to provide culture, environment, increasingly interactive activities with peers and mentors that help develop talent with creativity, leadership and perseverance- in short a growth mindset. Deep experiential learning, coaching and mentoring, activities outside the classroom, will become important elements of new education. It is our moral responsibility to ensure that our students are equipped with the skillset and the attitude and mindset to be successful in a constantly changing world. The old and fixed mindset will simply not do anymore.

It is largely with this in mind that in 2009 USC Viterbi partnered with Duke University and Olin College to launch the Grand Challenges Scholars Program. The program is based on acquiring five competencies: experiential learning through research and hands-on projects; interdisciplinary immersion, including communication; innovation and entrepreneurship business models; cultural awareness through global and other immersion; and societal consciousness.

With the end of the calendar year 2016, GCSP completed 7 years of existence as a novel engineering undergraduate program. It has now been adopted by more than 50 engineering schools worldwide (and actively considered by an additional 40 schools), while more than 120 engineering deans pledged in a 2015 letter to the U.S. President to adopt it in their schools. More importantly, the program is now a high priority of the NAE, which has hired dedicated staff to help move the program forward, and particularly to expand it globally. No less, the national leadership of the engineering professional societies gathered here at USC Viterbi yesterday in RTH to discuss ways through which elements of the GCSP will be coordinated through them. This is yet another illustration of the national and global

leadership of USC Viterbi in leading the changing nature of engineering education.

Last May, more than 30 GCS students graduated from USC. We aim to increase this number to 50+. Importantly, more than half of the GCS were women and URM- showing the attraction of the program to the new brand of engineers. Mike Crowley will be the faculty director of the program- in addition to his continuing leadership of ITP. (I will open a parenthesis here to express from this podium once again my warmest appreciation to all ITP faculty and staff for the fantastic work they do, year after year.)

This summer we helped put together the 2017 Global Grand Challenges Summit in Washington D.C. Vice Dean Andrea Belz and I helped organize the Student Day and Business Model competition- an entrepreneurship and innovation competition among 15 student teams, worldwide (think of it as the Olympics of sorts). INTRAM, a USC Viterbi student-led startup making an app to improve post-stroke care, was one of the 5 US finalists (and one of the 15 global finalists).

A number of courses and innovations help us advance these five competencies.

The iPodia alliance, our innovative “global classroom” initiative of joint classes across the oceans, now counts 13 schools spanning four continents, with the University of Patras in Greece the newest member. This semester we have tried a global first- namely to offer the same class simultaneously to all members of the iPodia alliance. A class spanning the Americas, Asia and Europe.

Also this Fall, USC Viterbi began offering a new course in social media and digital communications designed specifically with engineers and scientists in mind. Sarah Mojarad, recruited from Caltech, is teaching this innovative course. The “Chronicle of Higher Education” recently profiled her class, first taught at Caltech, describing it as possibly the first full-length course of its kind to teach students in STEM disciplines about the professional use of digital communication through case studies.

A popular engineering-diplomacy class created last fall by Naj Meshkati returned this fall. The unique course aims to equip the next generation of techno-diplomats to engineer meaningful change in the world through a “systems-

oriented interdisciplinary thought process” – a key ingredient in problem solving and analysis.

Our RPL group, the amazing group of talented undergrads, broke the student world record earlier this year by launching a student-made rocket to 144,000 feet! A truly remarkable accomplishment- and an example of many of the GCSP competencies, technical, interdisciplinary, innovation and entrepreneurship! USC’s National Society of Black Engineers won the Chapter of the Year and second place in their national debate competition at the 43rd NSBE National Convention in Kansas City, Missouri. And the Student Chapter of Construction Management was recognized as the top chapter in the nation.

With the Maseeh Entrepreneurship Prize Competition, or MEPC; the Min Family Engineering Social Entrepreneurship Challenge; the USC Coulter Translational Research Partnership Program; and the Startup Garage Synchrotron accelerator, USC Viterbi students have more opportunities than ever to develop innovative business models, explore technology commercialization, and create inventions with impact. And I am particularly pleased to announce that this year’s MFC

will be dedicated to addressing the natural catastrophes brought by Hurricanes Harvey and Irma.

I will close this part by mentioning briefly our commitment to societal consciousness. This takes a number of forms, from K-12 outreach to service learning in the community through the writing program. It is my goal to increase this participation of our students to the betterment of our society – and particularly our immediate environment- so that we can aim in the near future to claim 100,000 hours of community service by USC Viterbi. This aspirational goal will demonstrate the commitment of USC Viterbi to educating engineering students with deep societal consciousness. I encourage you to join us in this effort.

Our faculty continue to receive international recognition for their excellence in scholarship and research.

Daniel Lidar was named a Guggenheim Fellow, the only candidate this year to be selected in the category of engineering. I also mentioned earlier that Daniel is PI of consortium to build quantum computers that are at least 10,000 times faster than the best state-of-the-art classical computers. The contract, funded by IARPA, is worth up to \$45 million in funding over 5 years.

Eun Ji Chung won the American Institute of Chemical Engineers “35 Under 35” Award in bioengineering; **Mark Humayun** landed the 2018 IEEE Biomedical Engineering Award; **Ramesh Govindan** won the IEEE Internet Award; **Kelly Sanders, Ellis Meng** and **John Carlsson** were selected to attend the 2017 NAE Frontiers of Engineering; Ellis was also named an ASME Fellow and a BMESociety Fellow; **Azad Madni** received the James E. Ballinger Engineering of the Year Award and the John J. Guarrera Engineering Educator of the Year; **Ketan Savla** was awarded the 2017 Donald P. Eckman Award; **Paul Debevec** received the SMPTE Progress Medal Award; **Jonathan Gratch** was named a Cognitive Science Society Fellow; **Yolanda Gil** was named an ACM Fellow; **Emilio Ferrara** won the Complex Systems Society Junior Scientific Award; **Dan Dapkus** landed the 2018 SPIE A.E. Conrady Award; and **Lucio Soibelman** received the 2017 Construction Management Award.

In the past faculty recruitment cycle, we hired on campus 8 tenured and tenure-track faculty, 8 full-time teaching faculty, and one full-time research faculty member out of a pool of 625 applicants. Timothy Pinkston skillfully coordinated with the Departments these recruitments: Here

is a list: **Jyo Deshmukh**, assistant professor of CS, joins us after five years as a principal research engineer at Toyota Motors; **Matthew Gilbert**, associate professor of EE-EP, comes to us from the University of Illinois at Urbana-Champaign, where he was associate professor of electrical and computer engineering; **Mark Davis**, a renowned chemical engineering professor and nanomedicine pioneer at Caltech, will join MFD. Mark is one of the few highly distinguished academics selected to the National Academy of Engineering (1997), the National Academy of Sciences (2006), the National Academy of Medicine (2011), and the National Academy of Inventors (2015); **Bistra Dilkina**, Gabilan assistant professor of CS, will join us in January from Georgia Tech, where she is currently an assistant professor. Bistra works on challenging computational problems that arise in the area of sustainability and sustainable development; **Heather Culbertson**, Gabilan assistant professor of CS, will also join us next spring. Her research focuses on the design and control of haptic devices and rendering systems, human-robot interaction and virtual reality; **Xiang Ren**, assistant professor of CS, will join in Spring. His research focuses on developing automated and scalable techniques for extracting structured information from massive text data. Finally, **Assad**

Oberai, will also join us in spring 2018 as a professor of aerospace and mechanical engineering from Rensselaer Polytechnic Institute.

Three years ago USC became home to a new National Science Foundation Innovation Corps Node (one of only eight in the nation) aimed at helping high-tech university spinoffs succeed. Our Node, led by Andrea Belz, has reinforced USC at the center of the Silicon Beach technology ecosystem.

To date the Node has taught customer and business model development to over 300 teams from over 50 universities and three countries. We have also held signature events, including the Technology Scouting Workshop and The Real Deal, featuring Gen. David Petraeus. In the process USC Viterbi has helped raise grants and private investment totaling roughly \$60 million for approximately 30 teams connected to all the Node schools, including \$10 million to USC-affiliated teams. As a result of this success, the Node has been renewed for another five years of operation.

The support of all these initiatives has been possible in large part due to the outstanding fundraising efforts of our Advancement office. Seven years ago, in August 2010, we

set an 8-year Viterbi campaign goal of \$500 million. Today we stand at about \$430M, which means that we need to raise another \$70M by June 30, 2018 in order to reach that goal. Through Margaret Kean's leadership, we have great confidence that we will be successful in this endeavor. More importantly, such success will depend on achieving priorities, such as naming gifts for a new Computer Science building, for the Student Maker Space, for research centers and academic departments, and for chairs, fellowships, scholarships and other programs.

So, as you can see from this short, OK, relatively short, review, the State of the School is strong. It is strong because of all that you do as faculty and staff. As we move forward in our exponential world, remember the graph on your table, the need for constant reinvention and a growth mindset- thinking and acting forwards and outwards.

My Marcom staff wanted me to finish with a quote from Nikola Tesla, best known for his contributions to the design of the modern alternating current electricity supply system. Instead I will use the less scientific quote from Fleetwood Mac- consistent with our Growth Mindset: (We are in Hollywood after all):

Don't stop thinking about tomorrow
Don't stop it will soon be here
It will be even better than before

Thank you and fight on!