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## **Where Have All the Rocket Scientists Gone?**

Ladies and Gentleman,

It is a pleasure and an honor to take part in the National Academy of Engineering Grand Challenges Summit.

I appreciate the opportunity to provide the closing remarks to what has been a truly remarkable gathering of minds committed to profound and game-changing approaches to solving hard technical, political, educational, and societal problems on a vast scale. Over the last day and a half, we have all heard the gory details and we have seen the frightening data. I am here to provide closure in a brief summary, with a bit of my own personal twist.

The series of Grand Challenges which the National Academy of Engineering has identified constitute a “Sputnik moment,” as we heard Caltech President Jean-Lou Chameau say when he opened the Technology Panel yesterday. We in this room clearly realize that indeed we have a critical Sputnik moment at hand – the question is: does your neighbor realize this? Does your dentist? Does your congress person, does your own child?

This particular Sputnik moment is more complex than what we were facing back in 1957, since we are simultaneously trying to tackle many diverse challenges, challenges that are not only facing the U.S., but are also global. As we have heard over the past few days, if we fail to address these challenges, the results could prove catastrophic in both the short and the long term. Global climate change, energy, the environment, natural disasters, terrorism, cyber-security, health care – this list is long and this list is very daunting. In the short term, failing to address these challenges as a nation means degraded global competitiveness and a weakened economy. In the long term, failing to address these challenges means eventually facing successive crises of global proportions.

I am going to pose several questions – actually pose and re-pose – several questions and challenges this afternoon – with the hope that you will help me answer and address them in your own ways in the years to come. Really, we do not have more than a few years. I would say that we do not have the luxury of decades.

I count myself as extremely fortunate to be able to tell you that every day I am in the inspired company of “game-changers” – the Caltech community is full of them – and we are working in some measure on each and every one of the Grand Challenges that has been identified by the NAE.

I work in a vibrant and intellectually charged atmosphere at Caltech – a residential campus nestled in Pasadena. I know that this atmosphere also exists in various permutations in all the engineering schools across the country. Let me tell you about these schools. These are places where problem-solving, persistence, ingenuity, and creativity are developed, nurtured, and most especially, *they are valued*. Places where the deep personal satisfaction one feels from discovering, from understanding, from building, fixing, mitigating, improving, and creating is developed, nurtured, and again, valued. The emphasis is on the word valued. Please keep this in mind.

My job, and I argue all of our jobs, is to first extend the excitement of this atmosphere that exists in the engineering community out beyond the confines of our sheltered meccas. But even more importantly, our job is to shift the perceptions of society toward valuing the engineering profession, and engineers in particular, in renewed, concrete, and, let me emphasize, very material ways.

A society without engineers is an impotent society. Will the United States be learning this the hard way? Is a descent into mediocrity inevitable? Where have all the rocket scientists gone?

It is true that the best engineers – and the best scientists – have never been locked in their labs. And one can name names, and easily come up with an engineering “rock star” hall of fame. Unfortunately, the broader society seems to be no longer enamored of the kind of rock stars we produce. And the few engineers who are considered successful, who become household names, are not known for their technical achievements so much as for their business acumen and great wealth.

So how do we galvanize the broader society? How do we create the conditions in the United States that elevate – or re-elevate – engineering in a way that the dismal statistics we are facing reverse course? We engineers know that we are rock stars – but does the Disney Channel know?

My own particular obsession with these themes revolves around what happens with teenagers at the time when their hormones start flowing. I have noticed that boys and girls in grammar schools and middle schools delve into science and math like they do in all other subjects. There may be hesitation here and there, but the excitement about learning extends broadly and extends very deeply. Let me tell you that I believe that it is easy to excite and inspire the pre-adolescent mind, but probably it stops right there.

However, the moment when young men and women begin to notice each other, and need to appear successful – and begin thinking about what a “successful” life is composed of, the capacity to earn lots of money seems to dwarf all other measures of societal success.

We as educators, engineers, policy makers, and business leaders need to first, *radically inspire and then, effectively incentivize*, those whom I refer to as “the bright and the undecided.” Let me repeat, inspire first and then incentivize, two different things. In this conference we concentrated mainly on the first one – the inspiration. Who are “the bright and undecided”? These are not the very small percentage of kids who were essentially born to be society’s problem-solvers. These are not the kids who absolutely adore conic sections, and later calculus.

These are the kids who are capable of taking one of many diverse paths – to Wall Street, to court rooms, to arbitration hearings, to hospitals, to surgery theatres, to city halls and to state capitols. These are what I call the really “bright and undecided”. They are the pool of talent that we have to draw from to increase the number of graduating engineers from 4.5% of the degreed population to 10, to 15, or to even 20%, as we see in Asia.

Some of the questions these kids are rightly asking themselves are: What are the rewards of choosing arduous coursework in high school and college – while my friends are partying or sleeping? What are the rewards of choosing a challenging career without the quick, six-figure salary? Will anyone be interested in hearing about my quest for a more optimal algorithm at the party on Saturday night? Will I even be invited to the party on Saturday night?

Engineering for engineering's sake is a fine idea, and some will always answer the call. And some will even write poetry because they must, or teach, because that is what they were born to do.

But for the vast majority of the bright and undecided, we, as a society, have to be able and willing to offer more. We have to offer more at every juncture where choices are being made. More engineering scholarships. More mentoring. More opportunities for material success. More opportunities for not just 15 minutes of fame – but for real glory in the pantheon of individuals who grace the covers of magazines for their engineering achievements, not only their material ones. More input into the decisions made by policy makers. More input into the political process itself. More, more, more.

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Caltech engineers are ending up working for hedge funds. Should we be proud? Should we be alarmed? What is being gained? What has been lost?

My personal opinion is that we are squandering our intellectual resources. We have an internal brain drain. Intellects are being under-utilized. And where they could have been utilized, there has opened up a chasm. Are we as a society prepared to invest, truly invest, to heal this chasm?

I think about young mechanical engineers turned hedge fund operatives. Will they be asking themselves, after the allure of money fades: What am I contributing? Am I personally satisfied by the challenges I undertake everyday? What are the problems I solve in society? Can I return to engineering? After one year? After 5 years? After 10?

Of course the problem is not as easy as I am trying to make it. And I must, in all honesty, rightly ponder: Will the resources that he or she amasses ultimately be used to fund a start-up company that manufactures the components of a robust, large-scale solution to energy storage challenges, for example?

Well, as I promised – I have given you a few questions that need to be addressed and attacked from all quarters. The NAE has found a very good way to explain to the public – and to ourselves – how exciting our profession is, to identify Grand Challenges, to help solve them, and to tell the world. We need to tell the world how great engineers have been and how great engineers are.

Grand Challenges capture the imagination, propel the effort, and inspire communities. Maybe some day, high-school kids at a party can talk about the Grand Challenges without being embarrassed, and maybe the Disney Channel will profile engineering rock stars.

Engineers are the ones who will meet our Grand Challenges head on, again finding their valued place in society. I can only hope there will be enough of them around. This is perhaps the greatest of the nation's Grand Challenges.

I would like to end by thanking my good friend Yannis Yortsos, our fearless leader, for hosting this remarkable event and all our organizing partners: Richard Miller from Olin and Tom Katsouleas from Duke. I would also like to acknowledge the profound and sustained contributions to education and the engineering profession of our Summit keynote speakers, Max Nikias and Chuck Vest. Also we are very grateful to our panel keynote speakers, Jean-Lou Chameau, John Martin, Linda Katehi, Henry Jenkins, Maria Klawe, and Jose Reyes, for opening the discussions with great insight and enthusiasm, and of course our moderator, the wonderful Miles O'Brien, or as he now calls himself, Milos Obrienopoulos, for his great humor and truly Greek passion. Finally, thank you to all for participating in this wonderful event. Our work is just beginning.

Before I leave the podium I would like to say that I have just spoken to our august leader, Yannis Yortsos, who informed me that this event will not be the last, and we are going to follow-up with something much grander on the international scale. So the Grand Challenges are going to go international in the Davos style. You will hear more detail about this from him soon, I am sure.

Thank you.