THE COMMENCEMENT ADDRESS

esse non videri

This “speech” was not delivered at any commencement, to the best of our knowledge. The first two pages are excerpts from an inspiring manifesto by Professor Sanjay Sarma. The remainder was authored by Dr Shoumen Datta. Opinions in this article are personal views of the authors and do not represent the views of MIT or any other organizations.

Thank you Madam President, students, parents, faculty and friends – it is a great day for all of us to celebrate the achievements of the graduating class of 2015. Congratulations!

While preparing this address, I reminded myself that some people come in our lives and it is a blessing but others come in our lives as lessons. Today, I think, I shall serve as a lesson to some of my young friends in the audience. I propose to ask a few questions. It is not for the faint-hearted and business will not be as usual. I apologize if it offends a few. It may.

Today, especially today, as you graduate, is your 6th sense telling you that change is afoot? Are you afraid or excited that you do not have immunity from the risk of disruption?

Are you able to navigate through the explosion in engineering tools which is collapsing the time between conception and realization of an idea?

What an engineer took years to accomplish a decade ago, she might be able to accomplish it in a matter of a few weeks, today. Is that engineer among you and graduating today?

→ Need 20 plastic cases for a new Internet-controlled thermostat you just invented?
- Design it with a CAD package in the cloud and 3D-print it in your garage.

→ Need a complex circuit to control the system?
- Hire a designer in Pakistan for $11 an hour. Delivery time: 5 days.

→ Need that prototyped?
- Send it off to your favorite PCB fab and have it expressed to you within a week.

→ Need customers?
- Pretail on Kickstarter

→ Need to make a million devices now that you've pre-sold a million units?
- Find a manufacturer on Alibaba or work with an emerging class of plug-in companies that can act as your virtual manufacturing arm.

→ Need a complex piece of web technology to run the above system?
- Prototype it using "Ruby on Rails" instead of writing miles of code in C or Java.

→ Need to have it up and running for your first million customers?
- Deploy it on the Amazon Cloud (AWS EC2).

What did I just describe?

I described an express version in the engineering and product development process cascading from each other in a chain-reaction.

- Did your curriculum, industry internships and peer pressure prepare you to imagine, undertake the challenges of innovation, manage technology explosion, expose you to entrepreneurship and the social business of science in society?
- Can you exude and embrace balanced impatience as a virtue?
- Did your education teach you to think?
- Did you question the *status quo*?

Conventional wisdom encourages patience, planning, deliberation, steadiness and a "look before you leap" attitude. All good virtues and all sadly outdated. The issue is not the thoughts themselves, but the fetishized weight we give them and the paralysis and risk-aversion they have come to represent. The competitive world values action over over-planning. It rewards impatience over stodgy patience. It values agility over static steadiness. It values deliberate aggression over passive deliberation. And here is the key: the new way of thinking is not about taking risks, but about controlling risks using quick, small actions and experiments followed by rapid and agile adaptation.

In this age of systems of ecosystems, the risk lies increasingly in not realizing that you are in a manic episode of the Hunger Games. This is about "ready" "shoot" "aim" – not ready, aim, shoot.

If you have only one bullet, it makes sense to follow the mantra: ready, aim (carefully) and then shoot. If you have many bullets, then, get ready, shoot first, then correct your aim and shoot again. And repeat. Or your opponents will shoot first and a bullet will likely hit you.

Innovation is transitioning from breach-loaded dueling pistols to machine guns in a sort of massively multiplayer parallel innovation.

I know you are rolling your eyes and thinking, hey, don't you know that the first instinct of institutions to disruptive thoughts or to innovative people is to expel them, prevent them from entering or locking them in a cage of red tape if one happens to enter through the cracks?

That is where the cultural chasm deepens. Unlike old school institutions, innovative companies are ruthless in breaking rules to get the job done. Entrepreneurs do not fear failure. Entrepreneurs have fought battles and lost and lived to fight again. Failure is the new road to success. Learning is expensive and painful, but death is the nail on the coffin (just ask Nokia).

In 1997, one of my friends helped a major city and a venerable academic institution to start an online tutoring program in mathematics over a fixed point to point Ethernet connection using the "new" medium of the Internet.

Fifteen years later, in the Winter of 2012, MIT launched MITx, a MOOC-esque effort to offer learning using digital tools to transform the way students learn on campus and the way students might be able to learn around the world. MITx was launched almost overnight. The time from its announcement in the end of December 2011, to the launch of the first massive online class (6.002x, Circuits and Systems) was just 3 months. More than 150,000 students registered for the class but don't conclude that all 150,000 students took the class or completed the class. But I think a few did and we may have changed a few lives.

In the summer of 2012, MIT and Harvard launched edX, an independent not-for-profit entity to offer free courses to the world. They each invested $30M into edX. Today, edX has over 2 million enrollees and courses from 30 universities offered to students in 195 countries. EdX is the only not-for-profit in this space (Coursera, Udacity and NovoEd are MOOCs-for-profit). EdX is the only one whose platform code has been open-sourced to enable massively parallel innovation. Anant Agarwal, an MIT professor who happens to be an entrepreneur, spearheaded edX. In short, MIT embraced innovation, it jumped on the engineering express, it leveraged an intrapreneur, it protected the idea from institutional antibodies and grafted on to itself the Office of Digital Learning at MIT (directed by another brilliant intrapreneur Sanjay Sarma of MIT) and placed it in the Office of the Provost at MIT. Leadership from the top, directly from the Provost and President of MIT, in order to create a new world order.

I see a hand waving in the audience, "Yes, do you have a question for me?

"Yes, I do. My name is Aziz Boxwala. I am the Vice President for Human Resources in this University. How many applicants did you have when you advertised for the position of CEO of edX and Director of Digital Learning at MIT?"

"We often do not advertise for leadership positions that require vision and institutional knowledge."

"How amazing! There was no process, charter, by-laws and committee approvals. You just did it by fiat?"

"Yes, Mr Aziz Boxwala. Things are not "as is" and we have moved beyond the box. Charters and by-laws are relics found in the old countries."

Let me return to the students. The task that lies ahead of you, students, requires that you must break rules and must climb out of boxes in order to innovate toward a better *karma*.

That is your task, students, to unchain the shackles of solipsistic bliss and proactively help to create a new world order. The new order of things is not about the internet of things or polishing the chrome, it is about tuning the economic engines using a trinity of platforms which are inextricably linked and must be pursued using the same mantra of massively parallel innovation. They are as follows -

[1] education of girls and women in math, science, engineering, economics and philosophy

[2] access to energy for all nations at a cost which is feasible, at a level of sustainability which is balanced with respect to the dynamic socio-economic context and at a quality of service which acts as an egalitarian purveyor of civilization

[3] catalyze affordable healthcare and endow it with the dignity of human rights.

For the remainder of my time, I will drive toward my conclusion, which will significantly digress from the "speech" and the rhetoric. I will present a tangible grand challenge that I continue to dream about and I wish to pursue, if the opportunity presents itself. May be you can help or if you are fired up, you can pursue it. It is neither a proprietary idea nor a recipe for a secret sauce. It is a confluence of ideas including platforms [1] & [2] outlined, earlier.

My idea is about the global business of carbon neutral energy manufacturing and distributed cooperative ownership of the energy enterprise by women, who know math.

Before you tune off from me and turn on your Pandora, please allow me to explain the out of the box thinking. Let us start in this state, locally, but it is applicable, globally, where ever the sun shines. Yes, this specific example is about renewable solar energy but there is more.

In California, by 2020, we have a mandate to generate about a third of the state-wide consumption of energy from carbon-neutral or renewable sources. This energy can be produced by private corporations, such as the recently completed Ivanpah project. The utility companies are mandated to buy the renewable energy from these sources.

Efficiency of solar panels and photo-voltaics are driving down the cost from a high of around 80 cents per kilowatt-hour (kWh) to less than a tenth of that price. Government guaranteed loans combined with 9 to 1 leveraging of private capital and free government land available in the US southwest may bring the cost down to about 6 cents per kWh or about twice the cost of coal generated electricity. We may save a few more cents with Nest-like devices or standard wireless sensor networks (WSN) to monitor, reduce waste and optimize usage.

The gigantic nature of energy may be gleaned from the fact that a three reactor nuclear power plant produces about 3 GW. Compare that to the US annual peak demand for 786 GW and another 117 GW to meet the NERC target reserve supply. The Ivanpah Solar Power Plant took six years to construct at a cost of about $1.6 billion to tax payers and another $168 million from BrightSource Energy Company and Google. It was inaugurated on February 13, 2014 by US Secretary of Energy Ernie Moniz. This solar plant will generate 392 MW (0.392 GW) of electricity. The total amount of solar installations in the US generate just above 2 GW while the US peak demand is creeping toward 1000 GW or 1 TW.

Solar energy is time dependent and electricity is perishable. The solar peak does not match the demand peak. Hence, the importance of storage to make the energy supply agnostic of insolation and add mobility to energy in order to divorce the distribution from the grid infrastructure. Transporting energy to serve geographies with local micro-grids or an absence of electricity grids (major parts of the world) is of paramount importance for developing nations.

The era of lithium nano-phosphate batteries may be reaching its zenith but graphene based storage systems may offer hope with nearly 50% more capacity and charge density. Ask Anne (Sastry) or Samir (Mayekar) or Bob (Robert F Curl) or Harry (Kroto) to explain.

The convergence of insolation-dependent production with high density storage is a far better solution that is implementable. The abundance of high insolation areas in the US, Africa, India, Brazil, Indonesia and China makes this combined solution a sustainable approach to reduce dependency on fossil fuels and greenhouse gas (GHG) emissions.

Building and operating solar farms require no new invention or imagination. Distributing the energy through conventional schemes (grid) and new storage (nano-tech or graphene based batteries) offers room for [1] technology innovation, [2] financial innovation in the use of price as a supply-demand control parameter and [3] social innovation to deliver mobile energy units (truck load of energy containers) to areas devoid of grid or any other source of electricity. The latter immediately enables the operation of cell towers and explodes the potential penetration of mobile telephony, smart phones and the connectivity to the internet of things or the industrial internet of intelligent machines or smart objects.

What stands between this simple idea and reality is the relative availability of investment to create and operate solar farms. OECD nations are less likely to struggle for investors but the emerging economies may remain immersed in the vicious cycle of cost versus profits or the length of time necessary for the return on investment based on the cost per unit which the local market can bear. It is the same argument that asphyxiated the bio-butanol effort which can help 80% of the world even if photo-butanol production remained sub-optimal.

This economic segregation is in no way less perverse than the "legal" social segregation in the US in the first half of the 20th Century. I have to digress to present you with the context.

In the fall of 1944, Soledad Vidaurri took her children and those of her brother, Gonzalo Méndez, to enroll at the 17th Street School in Westminster, California, a part of the Garden Grove School District. Although they were cousins and shared a Mexican heritage, the Méndez and Vidaurri children looked quite different: Sylvia, Gonzalo Jr. and Geronimo Méndez had dark skin, hair and eyes, while Alice and Virginia Vidaurri had fair complexions and features. An administrator looked the five children. Alice and Virginia could stay, he said. But, their dark-skinned cousins would have to register at the Hoover School, the town's "Mexican school" located a few blocks away.

In *Méndez v. Westminster*, James L. Kent, the superintendent of the Garden Grove School District, took the stand and under oath, Kent said he believed people of Mexican descent were intellectually, culturally and morally inferior to Euro-Americans. Even if a Latino child had the same academic qualifications as a white child, Kent stated, he would never allow the Latino child to enroll in an Anglo school. U.S. District Court Judge Paul J. McCormick was also appalled by Kent's blatant bigotry. On February 18, 1946, he ruled in favor of the plaintiffs.

The Orange County school boards filed an appeal.

By now, *Méndez v. Westminster* was drawing national attention. Civil rights lawyers in other states were watching the proceedings closely. For half a century, they had been trying to strike down the "separate but equal" doctrine of *Plessy v. Ferguson*. Among those following the suit was a young African American attorney, Thurgood Marshall. Marshall and two of his colleagues from the NAACP submitted an *amicus curiae* brief in this case.

On April 14, 1947, the Ninth Circuit Court of Appeals in San Francisco upheld the lower court decision regarding *Méndez v. Westminster*. The court stopped short, however, of condemning the "separate but equal" doctrine of *Plessy v. Ferguson.*

Seven years later, the NAACP did find a successful test case to reverse *Plessy v. Ferguson.* Thurgood Marshall argued the landmark *Brown v. Board of Education of Topeka* before the U.S. Supreme Court, presenting the same social science and human rights theories he outlined in his *amicus curiae* brief for *Méndez v. Westminster*. Former California Governor Earl Warren, then Chief Justice of the U.S. Supreme Court, wrote the historic opinion finally ending the legal segregation of students on the basis of race in American schools in 1954.

In 1954, by an unanimous vote (9-0) the U.S. Supreme Court declared "separate educational facilities are inherently unequal." However, sixty years later, US public education may be still separate, still unequal, but what is even more alarming is the fact that the ethos appears to be infectious. It has infected the renewable energy economy.

The rich and the powerful are using energy to drive a wedge between nations. Access to energy and development of non-fossil alternatives are at the heart of this quagmire. Sixty years from now, the energy economy will dictate if nations are "still separate, still unequal" because of the reluctance of seed investors to invest in alternative forms of energy with lower return on investments. Thus, the power of investment is depriving the emerging nations of energy and creating more "have-nots" if measured by purchasing power parity.

A few months ago in Brussels, seated in the basement of 5 rue Duquesnoy, I heard a fine gentleman from the famed Tata Sons talk about the mantra of social responsibility that Mr Jamshed Tata expounded before the West claimed social responsibility as a buzz word.

That morning, in Brussels, it dawned on me that the obvious idea of the solar energy farm, may be an instrument to improve mathematics education among girls and women. Math to a basic level, for example, a US high school standard of math comparable to students graduating from Stuyvesant High School. Delivering math through MOOCs should be easy.

To inspire and reward women who are able to grasp the fundamental principles of high school mathematics, can we offer them a percent ownership of the solar farm energy cooperative?

If you are an investor in the audience, you may want to walk out. I can't stop you. But, those of you who may have open minds, consider my suggestion before you begin to deride me.

If Mr Tata were to invest in creating the solar farm, I suggest that he retains 51% ownership of the enterprise and recovers his entire investment from the energy sales (which may take 10-20 years). After Mr Tata (or Mr Gates or Mr Khosla or Mr Slim) has recovered the initial investment plus interest, the "energy company" morphs to an "energy cooperative" which continues to provide 51% of the profit to the investors.

It is the remaining 49% which can ignite global productivity and usher in a new era of civilization if 49% of the company is owned by women who are proficient in high school mathematics. Hence, 49% of the profit from the energy cooperative will be distributed between millions of math-proficient women-owners. What if you owned 0.01% of Apple?

This plan lifts many boats. Natural resources belong to people and a right to share in the economy. Investors must obtain the ROI but is it so difficult to uphold ethical globalization?

You are the first group to hear of this plan, this radical idea, this dream, this fantasy. I acknowledge that energy is not a panacea to solve everything, but, I don't think it is absurd or impossible or financially untenable. Women will apply for their ownership in droves. If they are not qualified in math, we will offer temporary ownership with the expectation that in about three years, with a stipend and access to Khan Academy, they will qualify for the mathematics proficiency test. Imagine the impact of millions of math proficient women.

Once they pass the test and are owner-members of the energy cooperative, visualize the quantum leap in their self-esteem, knowledge and confidence not to mention the dramatic rate of socio-economic evolution which will change the tapestry of life in every domain.

Can you force a math proficient woman to accept domestic abuse?

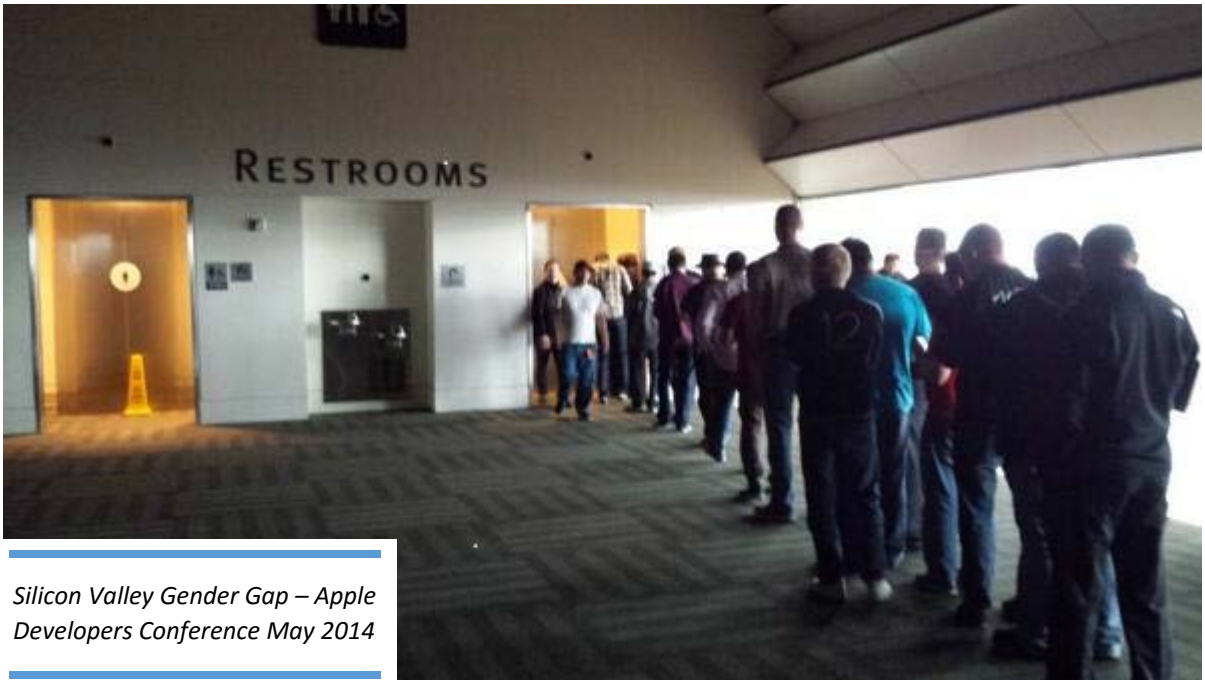
Can you force a math proficient woman to become pregnant each year?

Can you force a math proficient woman to submit to female genital mutilation?

Can you force a math proficient woman to ignore math education for her own children?

The education of a boy can change the fate of a man. The education of a woman will change the destiny of a nation. Your task, students, is to change the world, one solar cooperative at a time. Your task, students, is to create a cottage industry for energy. Your task, students, is to change the fate of freedom and education.

It is time, students, for your tryst with destiny.



Silicon Valley Gender Gap – Apple Developers Conference May 2014

This is the true joy in life, the being used for a purpose you consider a mighty one, the being a force of nature rather than a feverish, selfish clod of ailments and grievances complaining that the world will not devote itself to making you happy. (GBS)

The best people possess a feeling for beauty, the courage to take risks, the discipline to tell the truth, the capacity for sacrifice. Ironically, their virtues make them vulnerable; they are often wounded, sometimes destroyed. (EH)