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Open Education for an Open World

It really is a great honor and privilege to be back, and to speak to this extraordinary international gathering. I wanted to just begin by saluting the effort that has been undertaken under the acronym LINC. There are two things that I think are particularly important to note. One is that the “C”, as you know, stands for “Consortium.” I think that is probably the most important element of that acronym, because it means bringing together people and resources from around the world for a common purpose. But I also want to take this opportunity to point out that this is one of the few things of substance in the world that really has been the idea of a single individual. And Dick Larson is a hero. He conceived LINC. He pushed it through all the brick walls and made something really quite extraordinary. So Dick, I just don't want to miss this opportunity to say that you're one of my heroes and I appreciate what you have done.

I want to begin my talk by giving you four quotations, four great thoughts that have shaped my own view of education and particularly of higher education. You will see, not too surprisingly, that I am going to start off my discussion today with the world I know best, the world of higher education in the form of research universities. You're going to hear just a little bit of engineering and scientific centrality—again no surprise—and then a few comments about what is really, I believe, at the core of LINC and this meeting.

As Dick mentioned, I did my graduate work at the University of Michigan. The University of Michigan's epigraph since the turn of the last century has been this: “An uncommon education for the common man.” And today, everybody has to stutter a little bit because of that word, “man.” It obviously today is for men and women. But it is this idea that is at the heart of America's— particularly public— research universities, the idea that a first-rate education is due the common person.

The second, those of you from the United States will recognize as being the start of what we know of today as the American research university. In the closing years of the Second World War, the U.S. President at that time, Franklin D. Roosevelt, wrote a letter to a very famous MIT person, Vannevar Bush, who was on leave the MIT in Washington, and was very much in charge of pulling together the scientific, engineering and industrial communities in the United States for the war effort. Roosevelt became convinced that the Allied victory was going to come very soon. He wrote a letter to Vannevar Bush, and in that letter, he said this: “New frontiers of the mind are before us, and if they are pioneered with the same vision, boldness and drive with which we have waged this war, we can create a fuller and more fruitful employment and a fuller and more fruitful life.”

What Roosevelt was saying was that science and technology had contributed immensely to the war effort. How could we now use those same forces and harness them to make a better nation, a better world, in peacetime? He asked Bush to put a group together, think this through, and come up with his recommendations. When Bush submitted his report to then President Harry Truman because, even though it was only nine months later, President Roosevelt had died. Bush wrote to Truman and said, “If ability, and not the circumstances of family fortune, determines who shall receive higher education, then we shall be assured of constantly improving quality at every level of scientific activity.” This quote is pulled from the famous report “Science the Endless Frontier,” that mapped out the vision that in the United States our universities should be the core of our research enterprise, as well as our enterprise of higher learning. But the key phrase here, again, relates back to this uncommon education for a common purpose, because Bush said it should not be circumstance or family fortune— that is, wealth— that determines who gets a good education.

Finally, to bring us a little closer to today, I turn for my fourth quote to another wonderful colleague, Sir Tim Berners-Lee, another hero. Tim is a person who really had a singular idea and vision, and that, of course, was the World Wide Web. In accepting the Japan prize in 2002, Tim said this: “May we now use every ability we have to communicate to build a society in which mutual respect, understanding, and peace occur at all scales, between people, and between nations.” These words summarize very much— when coupled with the previous quotes about education per se— where we are today, and what programs like LINC not only aspire to, but help to achieve.

The world is changing in many ways, and I just want to throw out three or four metrics about ways in which it is changing, particularly for those of us involved in science, engineering, research, and development. The point of this slide, this map of the world, is simply to say that even back in 2002— the most recent good data that I have for this— we had already reached a point where about one-third of the world's R&D investments, by both governments and industry, are in North America, about a third in Europe, and about a third in Asia. Such a map, a decade or two previously, would have looked very different, with a huge swath in North America, a moderate swath in Europe, and a tiny swath across Asia and indeed the rest of the world.

The message here is that the financial input that drives science and engineering is beginning to be smeared amazingly uniformly around the world, at least region by region. Of course we all know it is not uniform country by country. We have new players in science, engineering and industry these days. This little graph that I got from a U.S. organization called the Council on Competitiveness— with data from 2007— would probably be even a more stunning today. It asked the following question: “Where are the young professionals in the three areas of engineering, life sciences, and what's broadly called finance and accounting, or management? “Young professional” is defined as a woman or man within seven years of graduation, working in these various fields. The council compared three of the world's large countries and large economies, China, India and the United States.

If you look at the blue bars, you will see something that I think we all know: there are a lot of engineers in China, lots of people out in the workforce within seven years of their graduation. There are a modest number of young engineers in India, and a little bit more in the U.S., but there's a big domination here by China, and we'll return to that. If you look at finance and accounting, India by far in absolute numbers exceeds the other two nations, with the U.S. coming in second, and China, third. In life science, the United States has traditionally had the most scientists, before the last decade or two. Only in life science does the United States lead, and that's very slightly. That number is close to being uniform across the three countries.

So new investments and lots of new educated talent are coming into the workforce. As President of the National Academy of Engineering, you'll forgive me for putting a little emphasis on engineering, but this is something that is very important for industrialization, for development, and for competitiveness today. The big story is the rise of the number of engineers graduating in China. If you look back to the early '80s, the left-hand side of the graph, comparing three countries— the U.S., Japan and China— you'll see that we were all educating about the same number of engineers each year, about 70,000 at that point. But then, as we came into the early 2000s, there was a terrific rise of numbers in China, a modest increase in Japan, and a decline in the United States. These data a couple years ago were rather controversial, because everybody thought that the estimates for China were too high. This is the most conservative figure. It comes from the U.S. National Science Foundation, which I will use, as I have learned it is the same number the Chinese themselves use. But here is what has happened in the meantime. This rise in absolute numbers is huge. Talent, education and investment in research and development are spreading around the globe. New investments, scientific engineering and business talent are all spreading around the world. Of course, underlying everything we think about is the concept that people everywhere are smart and capable. They just need to be given the opportunity.

Who provides primary opportunity? I believe at the level on which I'm discussing, it is education, and in particular, our research universities. So it's a fair question to say, "If everything's beginning to move around the world, and we know that economies and production of goods and services and so forth are all virtually fully globalized these days, what about our universities?" Well, I see two phases of this. One is pretty much history, although it comes up to the present moment. The other is what we're doing now and moving forward. Phase one, I will call diffusion. The basic concept of the research university as we know it today, that is intimately coupling teaching and research, really came out of Germany in the 1800s, specifically from Humboldt University. This concept was ported across the Atlantic Ocean to the United States. Most people would point to the Johns Hopkins University as the first university to fully embrace and build around this concept in the US.

In the century and a half after that, we saw a great diffusion across the United States of large-scale public universities: Berkeley, Stanford, Michigan— Stanford is private, but the University of California, and so forth are public— and also some somewhat more focused institutions, like MIT, Caltech and Rensselaer Polytechnic. This idea began to

spread, took on its own shape, and became the core of higher education in the United States.

I have to tell you this story. In the year 2000, I was at a dinner, and was seated next to the rector of Humboldt University. Halfway through dinner, he looked over at me and in all seriousness said, “Do you think that this idea of the research university you guys have in the United States could be adapted to Germany?” I still kid him to this day. He was absolutely serious in asking this question. But there has been some continual feedback. Much more important to today's meeting, this idea began to be adopted and spread all over the world. I point particularly to the Indian Institutes of Technology, which I think comprise one of the great success stories in higher education of the last century. But also it's now accelerating through Asia, through the Middle East, and of course in Europe, some interesting related concepts, such as the Bologna Accords and so forth, are coming into place.

Starting with its origin in Germany over two centuries, the idea has spread, been adopted, and been changed, depending on context and location, but remains a real driving force in the world. About a decade ago, I was on a panel of higher education leaders, and the question put before us by the person chairing the panel was, “Which university will be the global university of the 21st century?” This sort of competitive view is, I believe, really the wrong question. I think the right question is, “What is going to happen to the research university, and what does its globalization mean?” Because I don't think it's going to be a matter of a single university that becomes the leader and drives everything.

That brings me to the second phase, and to my own view of the world, which is that we are now moving into a second phase that is based on cooperation and openness. Lots of things are going on. There are many ways of interacting globally, from a given university. You can have a physical presence in other countries, building campuses and building laboratories. You can forge strategic alliances among universities in country A and country B and country C, and work jointly on educational or research projects. Or you can use technology— as all of those of you who are gathered here today do, to have some sort of a virtual presence in other countries— through distance education, synchronous or asynchronous, or through the dispersal and dissemination of open content: teaching materials, scholarly archives, tele-present laboratories and so forth. That is what those of you in this room are engaged in, and it is something I am very passionate about. I believe that we are seeing the evolution not of a university that is the global university, but something I call the meta-university, something that's above all this, something that is enabling.

As Dick said, maybe not exactly in these words, at MIT I became very passionate about the concept of sharing education, a passion, by the way, shared with amazing uniformity across the faculty of this wonderful institution. The reason I'm so passionate about this is that I believe the role of universities is to create opportunity, pure and simple. We create opportunity for the young people we educate, for our cities and regions and nations, through our economic-development related activities. Everything we do is, or should be,

about creating opportunity. I said a minute ago, people everywhere are smart and capable. They need to be given opportunity. Therefore they need to be given education.

One of the things that we were fortunate as a faculty here to pioneer was MIT's Open Courseware initiative. I know you all know about it, but the concept was very simple. Put the teaching materials on the web for all 2000 subjects that we teach here, for anyone to use, anywhere, anytime, free of charge. I learned that many people sought this knowledge. So you see over time, the use grows relatively dramatically. The different color bands here represent language. The lowest and largest band is in English. The higher bands are translations of our MIT materials into other languages. OCW materials are used all over the world, and they are appreciated. When we first launched this activity, we got literally thousands of extraordinary emails. I've quoted one here that came from someone in Latvia in 2002: "MIT OCW is the eighth wonder of the world! My sincere, heartfelt thanks to all of you out there who have been involved in the making of this project. Keep up the excellent work!" A couple of the letters, and actually one newspaper letter, referred to it as being the equivalent of the invention of the printing press. I wouldn't go quite that far, but it is an exciting idea. It is so rewarding to see that it has begun to spawn additional initiatives in the intervening years, because others clearly think it is a good idea. Today MIT is less than a third— it is close to a fourth— of all the serious, well-structured, open courseware activities of universities out there. There are many, many other examples. I know that in all of the talks and discussions here, a huge number of these things are coming out, so I didn't attempt to summarize them, but there are many other things that are open today, either freely or inexpensively, rather openly available on the web: entire libraries; all sorts of scholarly materials, from artwork to specialized journals; online education in both the for-profit and nonprofit sectors; even at an embryonic stage, the accessibility of laboratories that can be operated by students around the world, through the World Wide Web.

The philosophical point I would like to make is that in my view, this is all about openness and sharing resources in higher education. It is the true spirit of education, democratization and empowerment. It is not a spirit of control; it is a spirit of working, and thinking, and learning together. Openness underpins innovation, cooperation and competition worldwide. After all, in today's world, we are forever balancing cooperation and competition. We want to compete in order to drive excellence. At the same time, we want to cooperate to build things up. So we have to find that balance. It is quite an interesting exercise. Openness in higher education enables sharing and accessing expensive and intellectually intensive materials. That's what this open movement is all about: making big investments of time, money and intellect in one place, and then letting it be accessible to others in return for making this a two-way path and sharing.

Finally, it speaks of institutional and national values. Now, we all know, if we concentrate for just a moment on science, that the open flow of scientific information is essential. That's been accepted for two centuries or more. Science thrives through unfettered communication. It's an international culture, and it requires criticism, testing, and repetition for its actual conduct. In a sense, that's not new, but what we do have now is the open flow of educational resources. You might say that educational resources have

forever been flowing around the world, from the days of wandering professors in Europe, to the promulgation of textbooks, to meetings and conferences. But what has really happened, of course, is that the Internet and the World Wide Web have given us unprecedented scope, reach, speed, and increasingly, interaction.

I think something very fundamental is happening. I call this the meta-university. What we are observing, I think, is the early emergence of a meta-university, a transcendent, accessible, empowering, dynamic, communally constructed framework of open materials and platforms on which much of higher education worldwide can either be built or can be enhanced. This will enable, not replace, traditional universities. It will bring cost efficiencies to institutions through shared development. It will be adaptable and not prescriptive. If there's one thing I want to underline here, it is that. The idea of open materials is: use what you want, add to it, subtract from it, and shape it for your own uses and contexts and locale. Be adaptive, not prescriptive. That will serve both teachers and learners. It will speed the propagation of high-quality education and scholarship, build capacity for economic development, and build bridges across cultures and political boundaries. Heaven knows that is something we need today. It will be particularly important to the developing world, to accelerate their climb up to better health and quality of life.

Out of this came another great thought, which is really the logo, if you will, or the by-word, for LINC: "With today's computer and telecommunication technologies, every young person can have a quality education regardless of his or her place of birth." Note how that relates back, in a more structured sense, to what I said about the University of Michigan providing an uncommon education for the common man. Therefore, LINC and BLOSSOMS were born, bringing consortium and partnership with nations, and expanding to secondary education - broad learning - not just at the highest level of education as we do at a place like MIT. BLOSSOMS, bringing specific partnerships with Jordan, Pakistan and now Lebanon. And I would put a big emphasis here, Dick, and I think you will agree, that it is really the human-technology interface, the interaction of people and technology, for the purpose of learning. Learning videos by volunteers is a really nice, and I believe, at this point quite a successful undertaking.

Now I would like to take a moment to relate all of this to something else that I am engaged in this year as President of the National Academy of Engineering. We established a set of grand challenges for the world that require at their core, engineering, and as you will see, many other things. How did we do this? We put together a committee. It was chaired by Bill Perry, former Secretary of Defense of the United States in the Clinton administration. You may recognize some people here. It is a quite diverse group. What they have in common is they're all really highly accomplished folks: Bernadine Healy, who ran the National Institutes of Health; Sir Alec Broers, former Vice Chancellor of Cambridge University; the great inventor and engineer, Dean Kamen; Calestous Juma from Harvard, who is a great scholar of technology in the context of Africa; Bob Langer; and Jane Lubchenco, down here in the corner, who now is head of the NOAA in the U.S. Federal Government. You will see there: Mario Molina, a Nobel laureate who figured out, together with Shelley Rowland, the problem with CFCs in our

atmosphere; Larry Page, one of the Google twins; Craig Venter over here, who has been in the newspapers constantly for the last two weeks, with his more or less artificially developed cell. They are a lot of really terrific people. The committee came up with 14 grand challenges. I'm not going to walk through each and every one of these, but just point out that they fit into a set of four boxes, having to do with energy, global warming, sustainability; healthcare; security against both manmade and natural threats; and finally, a set of challenges that just have to do with expanding and enhancing human capability and joy.

So why do we want to do this? Why do we want to inspire, challenge and educate? There are two reasons. One, we need to build a vision of exciting futures for young men and women. And second, in a very serious way, almost all of these challenges are associated with survival on this globe. Through education and innovation, we can create exciting futures for young men and women. I would say, without any fear of contradiction, that this is the most exciting era in engineering and science in human history. Engineers and scientists together create the tools of scientific discovery. CERN, which some of you have visited, and certainly all of you know about, is just beginning to be wound up toward full-scale operation. One of the other challenges, re-engineering the brain, has to do with increasing interaction between the human brain and mind and computing, each learning from the other. Making solar energy economical— this is a photograph from China, as a matter of fact. But I wanted to end by pointing out the things that have to do with our ability to survive, or at least survive with a reasonable quality of life on this earth, as our population approaches nine billion people.

These are really profound challenges, but in them, as always, are great opportunities for contribution to human advancement. So again, some of the challenges are associated with improving global health. By the way, you may have seen that there are some actually encouraging statistics out this last week about the work the Gates Foundation and others have been doing worldwide. We're beginning to see:

- Much lower mortality rates among infants
- Provision of clean water, something we are all going to be living with over the next decade, as are our children and grandchildren
- Urban sustainability, and of course, dealing with all the carbon energy and climate problems
- On the security side, securing cyberspace, something we all care about
- Advancing personalized learning, something that LINC and especially BLOSSOMS are directly engaged in doing
- Enhancing virtual reality and restoring and improving urban infrastructure.

There are so many exciting challenges out there that can form the basis of educational programs, and help us to educate the young men and women who are going to need literally to save us here on earth. Well, I am an optimist. There are lots of reasons to be worried these days, but I think the world continues to get better. I believe that if we can learn together, we can also meet big challenges together. So learning and problem-solving are obviously related well to one another. People become educated and then can

solve problems. Things we learn, solving problems, feed back into education and learning. And all of this is speeded up and spread around through the digital world.

So this is really a very exciting time to be undertaking the kind of things that LINC is doing and that have brought all of you here to MIT today. And I am an optimist because here's my view of the future. This is a term you all know from your own local context, "brain drain." This mostly refers to the United States, which for three or four decades has been extraordinarily fortunate, because of our tradition of openness and welcoming, to have attracted many of the best and brightest young women and men from all around the world to come to this particular country to study, and frequently, to stay and work, to be faculty members, to be entrepreneurs, and so forth. It really is the single greatest factor of success, I believe, of the United States.

But many people have a more negative view of this. They say, well, yes, that's great for the U.S. To some extent, that helps the world, but you know those brains are needed back home, in many cases. So they think of it as a brain drain, rather than as a positive thing that we see here in the U.S. But I think today we are slowly but surely beginning to move towards an era, which is better called "brain circulation." People are moving around. They work in country A, then they move on to country B, and so forth. Particularly among the newer generation, a lot of folks moving around, which in the long run is probably going to be good. But my closing point is really this: I think what comes next is what I'm going to call "brain integration" and in a very real sense, that's what LINC is all about. It's about making use of technology to bring people and ideas, minds and brains, to bear, commonly, in this case, on education. It is also going to be happening in the way in which we will approach the solution of these grand challenges, believing that people and technology together can share ideas, build a synthesis and synergies in ways that we've never been able to do before.

We cannot undertake this naively, because we don't want the technology controlling the minds, but I think this really will characterize the coming era. Brains will not only circulate around throughout human lifetimes, but also, we'll be literally connected and working mutually in brand-new ways that we have hardly thought of.

So to conclude, thanks to Dick Larson and to all of you in the room here. Today we are LINCed to learn. But we can also be LINCed to meet grand challenges that are facing this world, and improve it for all people. Thank you very much.