A Flatter World

Closing Remarks
(As prepared)
IEEE Humanitarian Technology Conference
Seattle, Washington
November 1, 2011

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I want to say, first of all, that I'm impressed. I'm impressed with the energy I've seen here at this conference. The enthusiasm. The dedication. The sense of responsibility to the rest of the 7 billion. It's been a great pleasure to be a part of this conference. On behalf of IEEE, I'd like to thank the committee for their work on this, and I'd also like to thank the sponsors for their support.

But now it's over, and I'd like to suggest some things for you to think about on your way home.

Theodore von Kármán, a famous scientist and engineer from the first half of the 20th century, described the work of engineers as creating a world that never before existed. It's a powerful phrase. It highlights what engineers have done over the past century or so to improve quality-of-life and to increase prosperity through much of the world, those parts of the world that we commonly call the developed world.

I'd like to suggest an idiom, an idiom for what we've been thinking about and talking about for the past couple of days.

What I've been hearing are stories about engineers working to create "a flatter world" – "a flatter world than has ever before existed."

Of course, my "flatter world" idiom is a reaction to Thomas Friedman, and the book he published in 2005, which he called "The World is Flat." At least initially, Friedman spoke about flatness in a narrow sense. He spoke about the possibility of doing many jobs, including engineering, wherever there's access to high speed data, for example, at the end of any optical fiber connected to the internet.

Friedman saw that as an opportunity for workers in remote parts of the world and a threat to workers in more developed and affluent parts of the world.

With high speed data connections, jobs can move easily to countries where labor costs are lower. And we've seen that happen, as multinational companies have established R&D and manufacturing facilities around the world.

But in a broader economic sense, the world is not nearly as flat as Friedman suggests.

Punkaj Ghemawat was, for many years, a professor at the Harvard Business School. He's now at a university in Spain, and he's written a new book called World 3.0. He says that if the earth *were* flat, certain things would flow between countries as though they were water on a flat surface – communications, information, investments, people, and goods should flow freely across national borders. And he proceeds to show that they don't, for whole variety of reasons, legal, cultural, and geographic, among others. In this view the world is not flat.

Joseph Stiglitz, the Nobel Prize winning economist from Columbia University, has a different view of flatness. He says that it should be associated with equality of income. He says, and I quote, "Not only is the world not flat, but also there is growing inequality around the world, and there is a growing gap between the rich and the poor. The world is becoming less flat as that inequity grows."

Various online lists tell us just how much GDP per capita varies by country. $400 or $500 per day in Qatar and Lichtenstein, $130 per day in the United States, $90 or $100 per day in Japan and the European Union, $20 in China, $10 in India, all the way down to 30 or so countries where GDP per capita is below $5 per day, and four or five countries where it is below about $2 per day.

And we must not forget that income often varies dramatically within countries, even highly developed countries. If you look at per capita income in the United States by county, it varies by a ratio of more than 10 to 1.

Some argue for a third definition, that flatness should be related to the subjective concept of quality-of-life. Perhaps to income we should add health considerations, literacy and education, political freedom, maybe something about a sense of community.

Then there's still another view of the "un-flatness" of the world, one that I particularly like. Shortly after "The World is Flat" was published, sociologist Richard Florida published a paper in *The Atlantic Monthly*, in which he said "The world is not flat, it's spiky." He plotted population as the vertical dimension on a flat map of the world. You can visualize that as a spiky picture. And then he took one of those pictures of the world from space at night – I'm sure you've seen them, spots of light – and plotted the light intensity on a similar map. Light intensity is a surrogate for economic activity. That's spiky, too.

One of the things I like about Florida's analysis is that it gives us a visual impression of where the needs are and how large they are. There are huge parts of the world, where there are many people and there is no light. And we should remember that, when we reach out to help a hundred, or a thousand people. We need to develop solutions that will scale to a billion people.

The other thing I like about Florida's pictures is that they remind us about the importance of electricity as an enabling technology. Those spots of light are primarily electric lights.

Electric power is something that we as engineers – electrical, mechanical, civil, and others – know something about. And I'd like to argue that it is the most powerful tool we, as engineers, have in creating a flatter world.

I'd like to tell you a family story, which may, in some respects, be a useful case study.

My parents were born in 1906 and 1907, in a very rural part of Illinois. Their parents, my grandparents, were basically subsistence farmers. Each family owned 80 acres or so of farmland that had mostly been cleared of trees a generation or two earlier. With the help of neighbors, they built their own houses and barns. They raised most of their own food. Their properties provided water, from a well and from creeks, and wood for building and fuel. Muscles, their muscles and their horses' muscles, did the heavy work. They used kerosene lamps for lighting. They earned, and needed, very little money.

Electric power arrived at my parents' homes when they were young adults.

First, there were lights. They put away their kerosene lamps. No kerosene to buy. No kerosene smell in the house. No fire hazards. (Incidentally, I inherited those lamps and used one briefly last week, when a snow storm took down our power in Boulder. And I didn't like the smell, or the smoke.)

After lighting, they a got a refrigerator, ultimately one with a freezer. Food could be stored longer, and was safer. The ice box was obsolete, and they didn't need large quantities of ice. I remember the ice houses that still stood on many farms, and the ice saws that had been used to cut ice from ponds and rivers.

Then they got a water pump, so they could use a deeper well, so they had a larger and safer water supply.

A washing machine. An electric iron. A sewing machine. A vacuum cleaner. Electric tools. Other labor saving devices.

A radio for news, weather reports, and entertainment.

A telephone, and eventually a television.

Health, improved – safer food, safer water, better sanitation. Health care improved – much of it, directly or indirectly, because of electronics.

They needed more money to buy products and services, but they were also able to expand their farms and earn more money. Their purchases supported the companies that produced those products, and the local businesses that sold and maintained them.

So electricity dramatically improved the lives of people in the 20th century, especially in rural areas.

It did not happen through the magic of capitalism; power companies found it too expensive to extend service to rural areas.

It did not happen through the generosity of the government or of NGOs. In fact, it started during the great depression, when money was scarce.

A new government agency, the Rural Electrification Administration, more commonly known as the REA, was created to provide loans to rural cooperatives. That was 1935, when only 11% of American farms had electricity. And the REA was successful. Over the next 18 to 20 years, electricity service reached nearly all American farms. And then the REA's authority was extended to include telephone service, and that worked, too.

<u>The REA created a flatter world than had never before existed.</u>

But here we are in the 21st century, and over a billion people still do not have access to electricity. They're off the grid. They still haven't taken the first step toward what my parents started to experience many decades ago.

The importance of electrification, the centrality of electrification, as a strategy for improving quality of life and economic circumstances is not news to the international development community or to most of you. IEA, the International Energy Agency, says, and I'm quoting, that "individuals' access to electricity is one of the most clear and un-distorted indications of a country's poverty status." It's another candidate for specifying flatness.

IEA also tells us that 21% of the world's population currently has no to access to electricity. That's over 1.4 billion people, four and a half times the population of the United States. It includes nearly 800 million in the developing parts of Asia and 600 million in sub-Saharan Africa.

In a relative sense, the problem is most acute in Africa, between the Sahara and the country of South Africa, where only 28% of the people have access to electricity.

IEA believes that, with current and announced policies, the percentage of people without electricity, worldwide, will decline from 21% today to 15% by 2030, but with the projected population growth that will still leave 1.2 billion people without access.

It's not an easy problem, or it would be solved already. Unfortunately, the Millennium Development Goals that the United Nations adopted in 2000 did not include targets on access to electricity. But now people and organizations are working on it.

The next time you have your web browser open, search for "universal electrification," with quotes. The last time I tried, I got over 5000 hits. You'll find reports and proposals from economists and policymakers, from the IEA, from the United Nations, from the Organization of American States, from the Organization of Petroleum Exporting Countries, and others.

The United Nations has declared 2012 to be the "International Year of Sustainable Energy for All." Universal electrification will be one of the topics at the United Nations Conference on Sustainable Development in Rio de Janeiro next June. And one of the proposals the UN is considering is to establish a formal goal of universal electrification by 2030.

The IEA has done some valuable work on strategy and costs. Technically, they propose three approaches.

The broad solution, especially in urban areas, is to extend the electric grids, though grid expansion is costly and requires more generating capacity.

Mini-grids can help; those are village or community systems with capacities of the order of 500 kW.

And local, off grid, solutions, such as local wind and solar generation, can also contribute.

IEA's analysis suggests that universal electrification will require additional investments of $34B per year (2010 US dollars) for 20 years, over and above the $14B that they estimate is currently being invested.

That's a lot of money, but it's less than 3% the current world-wide investments in energy. And according to IEA's scenario, total generation in 2030 would be just 2.9% higher than with current policies, and CO_2 emissions would be just 0.8% higher.

A couple of weeks ago, the UN held a conference in Oslo, called "Energy for All: Financing Access for the Poor." One of the published conclusions was, and I quote, "Universal access to affordable, reliable and sustainable energy services by 2030 is financially and technologically achievable."

They further concluded that, I'm quoting again, "All energy sources and technical solutions must be utilised to reach the goal of universal access whilst aiming to make the energy mix as economically and environmentally sustainable as possible. There is a large untapped potential for using renewable energy resources in many developing countries."

Next year, I plan to ask the IEEE Board of Directors to endorse the goal of achieving universal access by 2030. I'll use the pulpit of the IEEE Presidency to promote it and I'll ask the Board to help me. We are the professional community that can speak with authority about both the problem and the solutions. Policy makers need input from technology professionals, from people like us. I hope you will also join me in telling the story.

I don't think there is another initiative that could have as much impact, on as many people, as would universal electrification.

And I urge you to think about that as you make your way home.

Thank you for participating in this conference.

I wish you all the best.