

## **Transcript of talk by Bill Gates at the University of Chicago**

### **College Tour**

#### **University of Chicago**

#### **"Bill Gates Unplugged: On Software, Innovation, Entrepreneurship and Giving Back"**

**Moderator: Edward A. Snyder, Dean; George Pratt Shultz Professor of Economics, Graduate School of Business**

**February 20, 2008**

**BILL GATES:** Thank you. Well, good afternoon. It's great to be here in Chicago, and have a chance to answer some questions, and talk a bit about the future of software.

The University of Chicago, of course, is a world class institution, and there's a lot of ways that there are important connections. It was mentioned some of the collaborations with the foundation on education. That's a big, big focus and something that I'm looking forward to spending more time on myself.

The university also has great connection to Microsoft in terms of joint projects and some great people that have joined Microsoft. I'll just give one example: Satya Nadella, who has perhaps one of the most challenging jobs at Microsoft, he's merely in charge of competing with Google, runs our search business. He's a graduate from the school, and we're in very good hands with the great talent and education that he received.

Well, as was mentioned, I will be making a bit of a shift this summer. I'll stay quite involved in Microsoft on a few projects, but the very broad role I've had in terms of overseeing all the R&D and knowing all the projects, I'll get a chance to turn that over to some very capable people, including Craig Mundie and Ray Ozzie at the company.

And what I'll get to do is spend more time on how technology can be applied to some broad needs, particularly the needs of the poorest: how it will change education, how it will change health. So, I am looking forward to that.

It's the first time I've changed my focus literally since I was 17. Writing software products for Microsoft, and thinking about that day and night is what I've been doing most of my life.

So, as I approach this last day and this change, it's hard to imagine what that's going to be like. So, to help me out, to make sure I'm ready for it, some friends volunteered to help make a little video so that I'd be prepared. So, let's go ahead and take a look at that.

(Video segment.)

(Applause.)

**BILL GATES:** Well, we had fun making that, but I'm sure it will be a fun and busy day, and no challenge keeping my time busy, partly because the period ahead of us in terms of the role of software is even more exciting than the past, and, in fact, I think people are vastly underestimating the advances that will take place, and the central role that will play, not just in the sciences but in all types of endeavors, and different types of jobs, and in even our activities outside of work.

It really goes back to the early days of the microprocessor. At that time, the 1970s, computers were very few in number and very, very expensive. And when you thought about them, you thought about something that only governments or big companies could buy, and they would track data about you, and might send you a bill that was wrong, and if you stapled the punch card, you might mess up the machine somehow. So, it was viewed as not really for the individual.

Now, personal computing, which started in the '70s, changed that, and the dream there was to build the best tool to leverage our creativity and to let us communicate that we'd ever had, something that was completely open-ended in our ability to model and try things.

An important element of that was the creation of a big software industry. So, Microsoft created a platform, starting with BASIC and then MS-DOS and Windows, to let other companies come in with their expertise and write software packages.

But there was a heroic assumption there, which was that we needed to get millions of these machines in use so that it would be economic for companies to spend tens of millions developing software, and yet be able to offer that for only \$100 or less, and yet be able to fund their R&D and the success model to keep making that software better and better.

And as we achieved that, it became a virtuous cycle: The more machines that got out, the more demand there was for software, and therefore the more opportunity for new software companies to come in, and do a diverse set of things. And that really got going in the 1980s.

In the 1990s we got enough power to do graphical interface. In the late '90s we got the Internet, which was connecting everything together, and tools that let that become a platform not just for publishing but for all types of transactions, literally turning the Internet itself into a way that software could call other software, and becoming an underpinning for digital commerce, and really the revolution of a broad, broad set of activities.

So, where are we today? Well, we have over a billion personal computers that are in use. We have about 2 billion cell phones that are in use today. We have about 300 million people connected up with broadband connections.

It's interesting how global that is. China just recently passed the United States to become the country with the most broadband connections. It's not like the U.S. is ever going to catch up. They've got more people. They're going to have more than we have people within about three years.

So, it really is a very big and diverse marketplace, and a marketplace that's making the world a smaller place. The ability to do collaborative R&D, whether it's within a company or across company boundaries, globally, in any area -- digital product design where cars or any physical good is more done on the computer and tried out there before you have to physically do anything, and that ability to delegate work and collaborate around things -- these digital approaches, modeling, together with the Internet fabric, let us do things in very different ways.

Now, part of the reason we were able to come so far is that the hardware and the software have both been improving very rapidly. At the hardware level it goes back to Gordon Moore's prediction even in the '60s that we'd double the number of transistors every couple of years, exponential improvement, not seen in other parts of the economy.

We have exponential improvement in our storage capacity, and that too will continue out into the future.

We have exponential improvement in our bandwidth, how many bits per second we can send across an optic fiber.

We have things that go beyond just quantitative improvement, really create a qualitative difference. For example, the ability to represent a 3D scene on screen, that's not today much part of the user interface at all; it is in games, but not in other areas, because it's not rich enough and not easy to build, we can't refresh the screen enough. That type of virtual map like Virtual Earth or the different mapping products that does it in 3D, so you can walk down the street and the point to a building and go in and see what's going on there, that will be standard stuff, you'll just take that for granted.

The idea that even your metaphor of how you find information and navigate will be including three-dimensional interfaces. Once we have the speed and capability and development platform for it, people will wonder how they got by without it.

One of the biggest qualitative changes will be the way we interact with these devices. Overwhelmingly it's been the keyboard and the mouse, and those are great things, they're not going to be eliminated, but they'll be complemented by about five additional ways of interacting, with I broadly call natural user interface.

One of those is simply the touch screen, the ability to point to things and move them around, a very natural thing.

A second would be the pen where you can point but you can also ink, so you can look at e-mail, write a note on it, send it to somebody, look at an article, circle something, send

that off to someone. This would be a device that once it's cheap enough, small enough, light enough, that would be preferable for reading. You wouldn't want paper textbooks, you'd want this device. In fact, there's a lot of schools, including one that my daughter goes to, where they all have tablet computers today, and they're already learning both for high school and for universities how you change the curriculum once you have that kind of tool.

If we look at what's happened with encyclopedias, where the print-based encyclopedia that I got to read when I was young, is so inferior now to the online things like Encarta or Wikipedia, not just in depth but in having animation and cross-links and images and movies and things that really bring the subject to life, the digital form is superior.

So, as we can take and have a pen, that's another way of interaction, including ink recognition.

Speech recognition is very important. That's been a problem that computer science has worked on for a long time, and now Microsoft has made big bets there, and finally it's getting to the quality that it will be mainstream.

On your mobile phone we have a piece of software called TellMe that you can just talk and ask for what's nearby or what's the news you want or to connect up to a friend. No need for phone numbers or having to use the little keyboard; just speak the way that you would naturally. And once that works well, people will say of course that is the way it should work.

Another piece of natural interface is using cheap cameras, and doing visual recognition. Who's walked into the room? What gestures are they making? We apply this in a number of ways. We apply it looking into a room, but also we can put it into a table or a desk, and that's called Microsoft Surface. We can see when you point, when you put objects on it. It can be horizontal or it can be vertical. Vertical would be your whiteboard, or the mirror at home won't be a mirror, it will be a device you can project reflections or any enhancement that you might find interesting.

So, it will be pervasive to interact with information. If you want to look at project and blow up look at the milestones, look at what's going on with sales trends, you'll just walk up to your whiteboard, pick things out, move them around, and if you want one of those parts of that screen to be tele-presence and video from somebody remotely, or a group of people, that will just be commonplace. So, we'll blow open the whole idea of how you do communications.

And so natural interface will get built in to the operating system, and people who do applications will have a very nice abstract way that they can take advantage of those services, and they won't have to do that in their own application.

The very way we think about the platform will be broader, because instead of running on one device, it will work on your behalf across many devices. So, if you update your

schedule or change some files, any phone that you have, any PC, when you're in the car, when you're in front of your TV set, your personal preferences, the information you care about, the shows you like to watch, those things will be available there. Even if you borrow a device, as soon as you authenticate, you'll have access to that information stored in the Internet, or we sometimes say the cloud, that will make it easy to work with different devices, and so it won't be just the one thing and you're having to move that information around.

So, if we take this and we apply it to the various types of activities, how will they change? Well, for the person who works in an office, they basically have been starved of information. Their ability to track customers, simulate things, try out new designs, look for trends, that has not been easy. They've had pieces of paper where if the number is surprisingly large or small, what do they do? The circle it, call somebody? You should just be able to point to it and see it by time, by product, by salesperson, and really dive into it, and then when you finally get the point where you're seeing there's something good or bad going on, you can take that, annotate that, share that with a colleague who may be somewhere else. These are very basic things to gain understanding about what decisions should be made, what marketing approaches, what product designs should take place.

And people don't even realize today in terms of how they go to meetings or work with paper or look in and dive into information or resource allocation, how information starved they are.

So, we can make them far more effective. We took modest steps in that in the 1990s with things like office productivity software, and a little bit of browsing.

In the next decade we'll take that to a level where things like collaboration and business intelligence, and the ability to model aspects of your business, try things out, really see those patterns, will become available even to the typical office worker, so, a great deal more empowerment at that level.

For somebody like a student there are some interesting things going on where the world's best lectures are all being put out on the Internet, largely for free. The ability to accredit yourself, to prove that you have knowledge, there are people with high reputation that are putting out tests that you can take there. And so you take education, you can unbundle it into the lecture piece, the study group piece, and this accreditation piece, and those aren't necessarily provided in the same way by the same institution. You have just a breadth of choices there.

Already today I go up, I'm taking a nice solid state physics course that somebody who went to MIT to get that course paid a lot of money, but today it's available for anyone.

So, education will change.

Entertainment today a lot of that is TV, which is done on a broadcast basis. It's not personalized, it's not interactive. If you watch something like the Olympics, you have various events you're interested in. If you see something and you'd like to see more about it, maybe other people don't develop that same interest, your TV set should respond to you in that way. Even the ads should be personalized, and if you have an interest in more information, they should interact to provide that for you.

Across any genre -- sports, news, educational shows, game shows -- this ability to take TV over the Internet is a fairly obvious thing that now is starting to happen. In the United States we have close to a million people who receive their TV through AT&T over the Internet, and that will become the standard way that it's done.

In some ways things in the videogame online world are more predictive of what TV watching will be like, where you can talk to your friends and try out new things and take things in a different direction, because, of course, that today is delivered over the Internet.

Things like organizing memories that are very hard, even as photos have gone to digital form, taking all the different artifacts about say a kid growing up, and organizing those, and being able to view them and review them, it's still very difficult. But as we get better sensors, better software, that will be something that's commonplace because it's an application. Once you make it easy, people are very interested in it.

Even the very idea of how we match buyers and sellers, the digital systems that help make it have less friction, those are not nearly as sophisticated as they can become. So, you take the very mechanisms of the capitalistic market, and make it more effective, make community reputation, make the ability to find out what somebody has done, or how products have worked in the past, make the online world one where buyers are far more informed, the number of choices they can look at, the amount of evidence they can look at is smarter, and the efficiency, the cost, the overhead of somebody presenting a superior product can be extremely low.

This type of innovation in the economy, which is actually accelerating, is a very hard thing to model, but certainly something of great importance that I think people are vastly, vastly underestimating, because they just don't know in the domain of software the level of richness we're getting to.

Now, part of the reason for this great progress is the combination of commercial investments, people like Microsoft, who spends over 6 billion a year, and the work at the university level, and it's really both working on concert that has driven things forward.

You see that in the other sciences. Biology as well has benefited from that dual investment in innovation. Sometimes some things are very basic, done more at the university, sometimes things are more large scale, more complex, done more commercially, but most things actually involve aspects of both.

I felt very excited when Microsoft got successful enough that we were able to create a research group, and make sure that not only it had great people, but that those people were reaching out to universities, and collaborating, finding out the great work going on, because there's such a diverse set of ideas, different approaches being tried, and that is part of the strength, particularly of the U.S. university system. The top U.S. universities are really incredible, and keeping that strong, keeping it healthy in terms of the great students, the amount of research money, that is something that's very important to the entire industry, because it has been such a source of innovation.

Now, in software we have very tough problems that we need more breakthroughs on. The ability to prove software correct so that we can say that when we have a medical record that nobody can access that; the ability to prove that something is secure so that as very critical things are going online, that we see that certain things can't be tampered with; the way we take all this hardware power and build redundancy to make things work very well. For IT people we need to get them out of the business of thinking which file is where and which application is running where; we just have a pool of resources, either in their datacenter or in our datacenter, and we automatically run those things and deal with any hardware failure or resource limitation, it's actually just automatically dealt with, so their work is at a higher level and not babysitting these individual parameters or programs or load balancing type things.

We need to revolutionize the way programming is done so it's much higher level. We need to take these IT tests and make those higher level. That's where there are these wonderful collaborations with ambitious ideas about how research groups and universities can tackle these problems.

Now, at this university one of the themes that has been adopted is that this applies not just to computer science but to the sciences as a whole, and I wholeheartedly agree with that. If you take astronomy, it's no longer being the person who was there at midnight who happened to see something cool happen, and you write a paper and you're a great astronomer. Today, it's more about the vast amounts of data that's been gathered over time at different wavelengths and ways, and stating things about systems that only can be verified by looking at that data and patterns in that data; very interesting challenge in terms of the kind of software that needs to be developed there. Biology is even more extreme in terms of the amount of data, and the context of not just genomic data but full blown systems data as well.

And so we need to have our best software people throughout the world and these domain experts come together, and develop modeling environments, rich runtimes, and so the people who are the domain experts, say you know how clouds form, well, you should be able to state that and then plug that in to see what the implications are; you shouldn't have to be handed a programming manual and start writing lines of code to implement what you have in mind. So, these are very rich systems that need some in-depth architecture.

I wanted to show just one example of that. This one happens to be some brain research that we're doing with a professor at Harvard, who's Jeff Lichtman. Let's go ahead and

look at a little video where he'll describe the challenge that he's taking on, and then I'll show how software can help with that.

(Video segment.)

**BILL GATES:** So, I've got the software that he referred to, which is called HD View, and I'll just give you a quick sense of how rich visualization is important to do this science.

You want to take a piece of image data like this and let people navigate very rapidly and look at different things and try it out. We can go through and look at different slices, zoom in and zoom out at different levels.

But we also want to see it in kind of a 3D view. So, here we see a set of slices stacked on their side. We can look at one in particular at a time, and then just decide we want to go up and down, and see, okay, how are things changing there.

So, visualization is important, but also we want to take this data and make it accessible for pattern matching; deep software that will actually figure out what types of neurons, what the connection from one to another is, and be able to do comparisons, so if you get multiple mouse brains you can see those changes over time.

Here we've taken the image database that we've gotten, and applied an algorithm to find boundaries, and then those boundaries we apply an algorithm to go through multiple layers, and then we map those into what these connections are, and we are trying out different algorithms for this.

But it's really the performance here, being able to map this onto these huge parallel computers that is extremely difficult. And the goal is quite simple: It's to have the domain expert in the brain be able to state their theories, state their ideas about how things work, and try them out against this system without them having to write a single line of code. That's an ambitious goal, but it's exactly the kind of thing that we need to take a number of areas and write very rich runtimes to achieve.

Now, as we've pursued these things, obviously we want to not only have universities but students at a very young age, students in any departments get at the software. Making it so during the time you're a student you have access to all the different tools, that's something quite important to us, and so just this week we expanded quite dramatically the ability of students to just get free software and download it.

We actually had that through relationships with the universities, but it tended not to be easy to get at outside of a few departments or different institutions, and we just didn't have that for high school students. Thinking back to the fact that Paul Allen and I did our work, our insight came in high school, we'd like people to have tools and connections to these large computing platforms even at a fairly young age, and across many different domains. So, there's a lot of creativity that has to be applied to draw people in.

If we look at programming contests, now we can see huge levels of participation. We have one called the Imagine Cup with 100,000 entries last year. We'll have 150,000 this year. Again, quite global; the U.S. isn't too far behind India and Brazil, and actually a little bit ahead of China in terms of the number of people who are participating in these things. And the quality of some of these things, of the submissions that get made in these contests, is really phenomenal.

It's a good example of this thing where I said accreditation can be separated from other things. If you go online and you compete and win in one of these contests, there are a variety of companies, including Microsoft, that will say, look, we've never met you, we want to hire you because you're good at this particular skill set. So, it almost bypasses the sort of normal credential system, and yet anyone with a broadband connection can have access to that.

The last topic I want to touch on is with all these rapid innovations -- material science, agricultural science, medical science, entertainment, the quality of the videogames, enhanced commercialism -- we should really not just focus on what these breakthroughs mean for the richest 2 billion of the 6 billion on the planet. I think it's worthwhile to also focus on what it means for that middle 2 billion or the poorest 2 billion.

Now, somebody might say, well, geez, you know, as they get richer they'll buy these things, or is it just as simple, why don't we make cheaper personal computers, what if we could make \$1 personal computers. Well, the answer is that is of no value at all to the poorest 2 billion. They don't have electricity, they don't have a teacher, they don't have textbooks, they don't have a network connection. So, there are projects where people have gone out and put those things in, and they're not maintained, they're not used. It takes some really brilliant thinking to take these advances and think through how they can be made relevant.

There's wonderful examples of this taking place, for example, some that our India lab, who's had access to what they call the bottom of the pyramid, this bottom 2 billion, has been a real theme of that lab. They've actually realized that DVD players that can be carried in and battery operated are about as high tech as you need in order to take things like farmers and show them best practices.

So, what they do in a district is they have a contest of farmers adopting best practices, they go in and film the ones who do it well, so it's kind of like American Idol except this is about not starving, but the level of interest and the desire to be the one that gets picked to be videoed in these new practices is just phenomenal.

And what we've seen is that where we use this DVD technology, carry in the TV set and the DVD player, and show these smallholders who have little farms these new practices, the adoption rate is three times what it was when we weren't using this approach, where we weren't spreading best practices by having them listen to other farmers talk about how you do it and where it goes.

We're doing a similar thing with digital study hall where we take the best teachers and video them, make sure the right ones are picked, and let other teachers either learn from that or use that as part of that teaching experience.

So, whether it's microfinance and getting transaction costs down through the cell phone or health records where some type of diagnostic things can be done through a cell phone and not require the wired or complicated infrastructure, there are ways that with a little bit of effort these things can have a huge impact on where it's needed the most.

The market signals are not there. If it was true, these people's needs would tap into economic demand, and the right things would happen. But we can see in something like malaria that kills over a million a year less than 10 percent as much is spent on malaria as is spent on baldness. Malaria kills a million people a year; baldness hasn't killed anyone yet, but, boy, some of those top 2 billion they really want that to happen.

So, you see these disparities where only by creating recognition, reward systems, awareness, can you make sure that the innovation isn't very disproportionately only beneficial to a small subset.

Speaking for myself, I went through the amount of college education I had, not the full four years, and I had no awareness of the conditions that the poorest were living in. I had no sense of that at all, and it was literally about 15 years later when I heard about a disease called rotavirus that kills half a million children a year, and I said, no, that's not possible there's a disease I've never heard of that kills a half a million children a year, and, in fact, it was a disease that almost no effort was going into.

That's a good news story. Now seven years after substantial investments by some partners and the foundation, that is a vaccine that will go out and be used very broadly. So, it will save those lives, and that has a huge impact in terms of reducing population growth and making it possible to get into the virtuous cycle of nutrition, education, job creation, good governance that we've seen fortunately in most of the world, but there are parts of the world that unless we do some things you don't get the key factors that create that environment that things really come together.

I have to say this is another area I'm optimistic. I mean, I talk, whether it's to students or businesses, about some of these ideas of getting the exposure and getting the innovators to think about solutions that apply to these areas, I see a very positive reaction. In fact, if we just took universities and made sure people were exposed as part of their education, if we just took businesses that had the average business do as well as the best are doing today, whether it's food companies, pharma companies, cell phone companies, technology companies, that would make a dramatic difference.

And so when I say I think technology will do wonderful things, I mean at all three tiers, and therefore encompassing all 6 billion people.

So, that's another part of why I'm so excited about the role that software can play, and the kind of entrepreneurialism, new thinking, innovation, particularly those of you here who are young and just thinking through your new ideas and how you're going to change things, it's a wonderful time to be doing that, and I look forward to seeing the great things you can do.

Thank you. (Applause.)

**MODERATOR:** All right. We've got some good time for questions. So, let me invite people to queue up, and you've got access to Mr. Gates.

**QUESTION:** Hi, Mr. Gates. You've spoken in the past about charitable capitalism. I was wondering what you think education and places like the University of Chicago, how they can play a role in that.

**BILL GATES:** Well, there's a very tough question in terms of how we bring the kind of reward and incentive systems that work so well in large parts of the economy, bring those into education, things that you know how good of a teacher you are, you know who's better, you have access to see the technique they're using, perhaps your income is somewhat related to your sustainability to do things like this.

Now, it's very hard, you know, coming up with a design that will not be viewed as capricious, that's kind of predictable, and that broadly open-minded people would accept. There are some very tough design problems to go and do that.

Today, there aren't the right -- there wasn't even the right visibility of how poorly the system was working for say the bottom 30 percent or even the bottom 50 percent. There wasn't even an awareness of what the dropout rate was.

The foundation funded some work with the Urban Institute where instead of just taking dropouts to be people in their senior year, we went back and looked at the size of the 9th grade class, and did the comparison, and people had to admit that dropout rates were dramatically higher than they'd been.

Why were they fooling themselves? Well, if an individual high school said, okay, if somebody disappeared in 9th grade, maybe they went to another high school, there was no tracking system, and so they took the definition that, well, if they left their senior year, they probably didn't go to another high school, let's just take that number.

The fact that there wasn't testing going on at the various grades, and that only came into being with the NCOB, No Child Left Behind, it allowed there to be sort of just not paying attention to the problem.

So, exposing the data, making it easy for the public to see that data, helping with things like Charter systems where the University of Chicago was involved in some very particular schools, and helping us measure actually some of the schools even beyond the

ones where there's direct involvement, I think there's a that can be done in education, and this city is actually the second -- New York is our biggest city of funding, but this city is the second biggest. It's an experiment that could succeed or fail, and there's plenty of need for bright people to get involved in that.

**QUESTION:** Thank you.

**QUESTION:** Yes, hi. My name is Chichi, and I'm a graduate student in the biological sciences division.

I was really encouraged to see that you have a research group that makes inroads to speak with scientists, and I also wanted to know what your ideas were about as far as allowing scientists to be able to communicate with their research groups more easily. Is there a way to create filters or more of an open platform so people who do have expertise can actually reach a company? A lot of the issues that we have in science and technology that we're the experts, but someone who's designing software for us that we cannot really manipulate, we're kind of limited in what's offered. So, I wondered if you could give your insight on that.

**BILL GATES:** Yeah, I'd say there are two parts to that. One is if you want to connect with the people in our research group where they're pushing the state of the art in software, and you want to combine that with your domain. In that case Microsoft Research is very good about putting the people, their interests, their biographies up there, and all those profiles have e-mail addresses so that people can get in touch directly with them, and they talk a lot about how they're pushing into the sciences.

We have a whole theme we call our Technical Computing Initiative, and I'd say about half of our researchers are connecting up with science domains and seeing how their work, database queries, software proof modeling, machine learning for things like an AIDS virus, seeing how that applies.

If it's the more traditional products, that's also input we're interested in, if you want more flexibility in Excel or Visual Studio or Expression, and there you can just send mail into the product group alias, which we have those listed on the site, or you could even send a letter to me, I'll make sure it gets to the right person.

So, we do want to make sure our product fits for science. We've done things like math equations, now we're doing chemical formulas, even some very specialized things so that we have rich visualization modeling runtimes for the science type applications.

**MODERATOR:** I did note with the first video you've got a lot of spare time now.

Next question.

**QUESTION:** Hi. Thanks for coming to speak with us today.

I was wondering about your foundation's stance on the rehabilitation of New Orleans. Specifically I'm interested in the foundation's efforts in applied higher education. One of the strongest organizations in New Orleans is Tulane, but after the hurricane the university was under such financial duress that they massively reduced the school of engineering. Specifically the school lost computer science and five accredited engineering disciplines, including electrical, mechanical, civil, and computer engineering.

And one fiscally solvent rehabilitation effort for these applied fields would be to sort of develop professional masters and continuing education programs to benefit the professionals already working in New Orleans and continuing its rehabilitation.

So, I was wondering your foundation's stance on applied higher education to bring about the rehabilitation of New Orleans.

**BILL GATES:** Well, our foundation has done a lot of work in New Orleans. We've taken the areas that we have expertise in -- you know, we're not just a bank account, we take things like libraries where we did a project across the United States where we went into 18,000 libraries, virtually all the libraries, and we put computing in, and were able to help with that. We're very involved in high school reforms.

So, our special grants we've done in New Orleans have focused on three things: the libraries, getting them back in place; the nonprofit organizations, getting them financed to be back in place; and the high schools where that's a big theme, and we have a staff that understands that stuff.

New Orleans is a very interesting example where nobody can say, oh, we have these existing facilities that don't work for this. Well, they're going to be building new facilities, and so the question of are they built in a new way, and how the foundation can help with that, those are the three issues that we've picked to go in and provide expertise to help things be even better than they were before.

**QUESTION:** Thank you, Mr. Gates, for coming. My name is Holly. I'm a fourth year in the college.

My question is two-pronged. You were talking a little bit about security, and I'm interested in issues of encryption, and where you see that going to, and how we're going to address the basic architectural ideas to make the Internet more secure, and if you see that being regulated by private companies as it has been in the past. A lot of people say university should be the place that kind of maintains the security of the Internet.

My concern and second question has to do with where you see governments having an impact in this, if you see kind of a transnational government emerging, and what do we do about the legality behind that, if, for instance, we help people prop up movements in another country that we don't necessarily agree with, and how that issues with security and encryption.

**BILL GATES:** Well, the Internet is a global resource, and it's pretty amazing how well it's worked where the design is fundamentally quite distributed. There's only one single point of failure that has to do with the domain name system, and that actually this group has done a very good job running it. There's been no problems at all, no bias with anything. There are various people lobbying and saying that that ought to be put into a UN organization. There are other people who say, look, it's working perfectly; putting things into UN organizations doesn't always work perfectly, why don't we leave it alone. Fortunately, it's a very narrow piece of the system that is subject to this question of making sure that that zero node of the domain naming system stays up.

So, the Internet infrastructures, there are interesting governmental issues that come up. Any country is going to have its own views of what allowed speech is. You know, is Nazi hate speech allowed or not allowed, what's the boundary of pornography, what's the boundary of libel, what's the boundary of couple of years, and those laws, the Internet is not a sort of law-free zone where musicians or people who are libeled or various things, you think, hey, that's great. If somebody puts nuclear bomb plans up on the Internet, do you think, hey, that's great, let's get them out there, it should all be available? There are rules, and it is interesting that different countries are going to have different rules. Yahoo! got in this where they had some Nazi items on an auction site, and Germany said that's illegal, but the country that it had been posted in it was legal. You get this in trademark law.

The ideal for certain of these things is that there's common regulation, for example, privacy trademarks, various things, and there will be some homogeneity that takes place on that.

In terms of security, each government has to think through how it's creating a boundary so that nothing malign could happen. It's just like your electrical infrastructure; you want this thing to keep running. There's a fairly deep set of things that go on between industry and the U.S. government to make sure that say the Internet in the United States will be a very reliable thing; more reliable than the electric network would be a goal that we'd set for that.

There's no simple answer on security. There are some deep problems here. The original Internet was not designed to assume there were bad people on the same network. It was designed assuming that bad people were bombing the network, and so that the various pieces would keep running.

So, we're layering into the Internet certain things in terms of being able to track what's going on that were not there from the beginning. And you do actually get some tension on some of these issues between privacy and security type things. If the Internet is used to blow up a city, then people want security. If the Internet is used for political speech, people want privacy. And being able to get both of those is a non-trivial thing, and is often more policy restricted than technology restricted.

**QUESTION:** Hi. Thanks for coming out today.

My question is sort of related I guess. You've mentioned personalization as part of the future of innovation in technology. So, I guess I was wondering how do you see personal privacy fitting into that, if at all, or is that not really going to be relevant in the future?

**BILL GATES:** Well, personal privacy is certainly extremely relevant. If you're an individual, your communications, you want those to be private. Your health record, you want that to be private. I don't see technology changing that whatsoever.

Now, if we could make it clear to you that certain information about your buying preferences were being used in an appropriate way, you might choose to release those so that ads could be targeted to you, and you should be compensated for giving out that information, and you should be able to withdraw that permission at any time.

And so being able to communicate with users about what is going to happen with their information, and where it might be beneficial to them to let it be used in some ways, this is a very state of the art problem. We have Microsoft Research people who actually look at databases and see like a health database, what kind of query and pattern matching can you allow before somebody could abuse that and actually get down to a level where you could see what were specifics of a particular individual or a family. There are various companies that release their search logs about understanding that you can track those logs back to an individual a lot more precisely than they thought when they did those releases.

So, I'd say the industry is doing a lot to create options for privacy, and let you understand that model, because when we ask users what are they afraid about in terms of computer technology, privacy comes up as the number one issue, even ahead of is my child reading pornography or is my identity being stolen. They care about those things, too, but privacy is even above those.

**QUESTION:** Hi. Thanks so much for coming in today. I'm Ansel, and I'm an undergraduate in the computer science department.

I wanted to ask you about the Gates Foundation. It's known for taking a results-oriented approach to charitable giving. I wonder what kinds of innovations we can expect to see in terms of structuring financial incentives, and turning the power of the market towards achieving the social goals that you're looking at in the Gates Foundation.

**BILL GATES:** Well, there are some cases where there's just a plain market failure, and the way you have to deal with it is by -- say take the creation of a malaria vaccine. There's no corporation who can take the risk of the billion dollars and say to their shareholders, hey, we're going to go spend this billion dollars.

The deal we struck with a very enlightened pharmaceutical company, GlaxoSmithKline, is that they take a little bit of the risk, most of the risk is ours, but they put some of their best people on the work, and they hope to get some credit in terms of hiring people or their proud reputation, by the focus they've brought to this program.

And that's very similar to what we're doing with the food companies on micronutrients, Unilever and Nestle are great on these things; what we're doing with some of the banks on microfinance. They are putting forward a lot of their best people.

In terms of measurement, I'd say it's pretty straightforward. When we make a grant, like we did a coffee grant for Eastern Africa, we state how many smallholder farmers we want to double their income. And that's a very verifiable thing. You'll be able to look at our five-year goal and our 10-year goal, you can go into Tanzania and see if these coffee farmers are making twice as much money or not. So, it's a great thing to say, hey, we failed, let's figure out why, or we succeeded, maybe this is a model that ought to be done.

That very basic thing of having a metric, a clear metric, is fairly obvious coming from the business domain, but it's not always applied, and sometimes it takes a lot of creativity to think, okay, what should that metric be to incent the right activities.

I have to say that even though we're very results oriented, and we think that our putting effort into that makes sense, we're not the only foundation or the first foundation to do that. Rockefeller Foundation back in the days when they funded the University of Chicago, and funded schools for blacks, and they funded vaccine research and a wide variety of things, they were incredibly good at picking causes that would be very impactful and picking things where they as a foundation could do it and nobody else was going to do it. There was no other player who was natural for it.

So, for things like these infectious diseases, there's no agency of the government whose mission is to discover drugs for infectious diseases of poor world countries. Just it's got too much risk, it's too long term, it's not in their nature or their skill set.

So, we try and pick things that we're fairly unique in terms of our scale and expertise and that requires some focus.

**QUESTION:** My name is Justin, and I'm a first year in the college.

My question is kind of similar. My understanding is that one of the long term goals of your foundation is the eventual eradication of the malaria disease in many parts of Africa. And I was just wondering what kind of role technology innovations, like the ones you presented here, will play in reaching the success of that goal.

**BILL GATES:** The key for malaria elimination is either an extremely effective vaccine or a variety of other interventions. You may know that malaria, the malaria map used to be twice as big as it is today; that is, the southern United States had lots of malaria. Italy had malaria. That's why it's called "mal-aria", bad smell. They thought the swamp, some smell out of the swamp made you get these fevers, and it took until 1898 when they figured out, oh, it's this mosquito that's biting people. This very bored British captain who was down in India would sit and dissect mosquitoes for years on end, and finally noticed that.

So, we need advances in medicine, and what does that mean about software? Well, we need to understand genomics better, we need to understand shape space better, we need to understand immunology better, we need to understand epidemiology better. In fact, I was talking this afternoon with some of the scientists at the university about the fact there needs to be a platform for this type of modeling.

We are funding a model that -- and we've brought in brilliant people and we're very optimistic about malaria right now, because it looks like with multiple interventions we'll be able to shrink the malaria map in half a lot sooner than anybody expected. Now, we could be wrong, and we want our model to help us understand this.

In the past, the only way you eliminated malaria was one strategy: reduce the vector population, actually the average length that the female mosquitoes lived using DDT, and that's why the malaria map is half of what it was. But now we have multiple interventions, and the question is how those come together, particularly if you have three years of intense activity.

So, it looks like this can work, and we need the software models, we need the medicine, we need the people in the field, a lot of elements will have to come together, and I'd say although software is a piece of it, it's actually not the hardest piece that we need.

**QUESTION:** Hi, Mr. Gates. I have a question for you more on the software side. I'm wondering what you think about Open Source software in terms of both a model for innovation and a model for distributing the software. Is it something that you think works, do you think it has flaws, or will something always cost \$300 for a new piece of software?

**BILL GATES:** Well, in fact, the ecosystem of having free software and commercial software, if you have both, that's the ideal. Of software in use today, free software is actually a lower percentage now than it was 10 years ago, 20 years ago, 30 years ago, because there's a tendency for the users who want, businesses who want to depend on things, they tend to buy the commercial packages.

Now, the virtuous cycle that you want is that out of the university environment you create things that are often free, and if that's good enough to solve the problem, great, use that.

You should also allow that to be taken by a startup or even a large company, enhanced, and turned into a commercial package. Creating jobs, paying taxes, letting people have some remuneration for their work, that's an incentive system that works in many domains.

Then that creates taxes that go back to the government. If the government is properly enlightened, they send some portion of that back to the university, so you get more free software, and it goes around and around.

That's what's happened here in the United States and created a massive number of software jobs.

There are people who think there should be no commercial software, that if you're a good software person, you should cut hair during the day and do software at night. And so they actually put this license on that locks software in, so you can never create jobs. That's called the GPL.

There's another form of free software that is neutral that can stay free, which is great, or it can go into that commercial domain.

So, I think we'll always have a mix, because people want 24 hour support and they want richness, they want proof against security and things like that, that tend not to be done on a casual basis. I think the commercial piece will continue to be a very important piece, but there's a lot that comes out in this free piece that helps feed that ecosystem.

**QUESTION:** Hi. My name is (Charmaine Chasa ?), and I'm actually an immigrant from Bangladesh.

I was wondering what can we do to bring technology and education into the rural areas of countries like Bangladesh, and how can foundations like the Gates Foundation help in bringing that into those areas.

**BILL GATES:** Yeah, Bangladesh has been an interesting country for us, because in terms of there's a lab there that for diarrhea is the best in the world, and we've funded a lot of research there. There are various things about zinc and infants, and how you can reduce episodes of pneumonia that researchers there in Bangladesh have done.

The foundation has also funded -- there's these various libraries, some of which are actually boats that go in during the flood season that are mobile libraries, and we've made sure that they can get personal computers with Internet connections on there. In fact, they were our award winner; for all our global libraries it was this NGO in Bangladesh that did the best work there.

So, for us our biggest focus is our health-related issues, and we do believe that as you improve health, that reduces the population pressure, that has this affect that then the ability to provide nutrition and education gets a lot better.

Another place that Bangladesh has been very interesting is it's the place where there's by far the most microfinance in the world, about 50 times as much per capita as any other country, through Grameen and BRAC.

So, we've funded BRAC to take those microfinance ideas and take them into other areas, and to broaden the product set to include savings, and to use more technology to get transaction costs down; so a number of collaborations there that we're very excited about.

**QUESTION:** Hi. My name is Julie. I'm in the biological sciences.

I'm interested in hearing about the most difficult time in your career. (Laughter.)

**BILL GATES:** Well, I'm not really in a position to complain, I'd have to say, you know, like, geez, why did they make me go through something really hard.

I think when I was in college the question of was I just going to go into software and build a company or was I going to stay and work on artificial intelligence or was I going to do math, what thing would I go and do, I had a lot of uncertainty about that. Then when this kit computer came out and it looked like somebody else might go and write the software for that, then it just eliminated the decision, and Paul Allen, who had wanted me to drop out and do this software company for a long time, all he had to do was bring me that Popular Electronics Magazine, and he won the argument, and I was gone. Then I haven't had to be very indecisive ever since then, because that led to the broad set of things.

I definitely think as you get a large company there are some challenges where your role changes. Up until we had 30 people, I looked at every line of code, made sure it was really good, then I had to hire people who would look at every line of code, then I had to hire people who hired people to look at every line of code, and at some point you accept if you want to have big, broad impact, that maybe the average quality in some respect, the intensity of the employees or whatever measure you might have, you're going to accept it, it's not quite the same as when you had two people or five people or 10 people. So, learning how to manage and lead in a large organization, it's a transition.

Dealing with situations where people don't scale up with the company, and yet you really like the person and they're not too bad, a lot of my mistakes were picking engineers and saying, well, if you're a high IQ engineer, then you can manage people, basically a belief that IQ is fungible, because I don't understand why it's not, but it turns out it's not. (Laughter.) So, over time we learned to weigh in a more multi-factored set of choices, and more about how we would develop people to be very good managers. So, it was certainly painful whenever the people we had picked hadn't worked out.

In terms of the success of Microsoft, I mean, virtually every year we've had lots of things we were scared about, lots of new things going on, and every year it felt like, okay, this is the most difficult year or the most interesting year. I still feel that way. We've got interesting competitors, we've got interesting frontiers.

So, I don't think I'd complain about any time in my career, but I definitely have had times where getting to the next growth level required rethinking a lot of approaches.

**QUESTION:** My name is Carl. I'm a medical student.

You mentioned briefly in your talk a bit about the explosion of biomedical information that's kind of been happening recently. And I was wondering if you can kind of touch on

we're kind of at a point now where the molecular diagnostics have gotten so good, and the visualization and the technology has gotten so good, and then a lot of the doctors like who teach me have trouble opening their e-mail.

So, I mean, at one point we have kind of the technology is moving so fast, and we have this just cloud of information, and then at the same time we're all trying to kind of sort it out and try to deal with it. So, what are your thoughts about that and how to try to solve that problem?

**BILL GATES:** Well, if you were born in Mozambique, the chances are you'll never see a doctor by the time you die, so we'd love to have even a doctor who can't open e-mail in parts of the world. There is a real shortage of skills in the places where that poorest 2 billion live.

In terms of where we actually have the trained doctors, a little bit I'll just say, hey, the software needs to help them do their job better. The way that they're dealing with paper forms, the way those lab reports come back, and just looking at all those numbers, the way that we don't pattern match and do machine learning across all those data sets, we're really asking a doctor to do more than they probably should, and there's a whole view that some doctors resist that software assistance in terms of various checklists and various advice will play a fairly big role in helping raise the quality in the same way that say in aviation that rigid approach to repeatable activities has made a big difference there.

I think the amount of knowledge doctors are being asked to absorb is pretty unbelievable today. Electronic tools do let you get at more information, do let you find things in a better way, but no doubt we'll probably have to have more specialization and then more creativity about how the specialists are collaborating on behalf of a patient, because already the patient can sometimes get lost between those boundaries.

**MODERATOR:** We are out of time, but I thought I would maybe ask you one last question. Many of you know Mr. Buffett decided to allocate a big chunk of the resources at his disposal to the Gates Foundation, which -- and we talk quite a bit about the foundation and just in listening to you, and obviously that's going to take up a lot of your time and energy going forward. I'd like you to maybe identify what you believe was the single most important factor in his decision.

And I will just mention as I listen to you, and listen to a lot of these questions, there are a lot of candidate answers. One would be the performance orientation that you bring. Another is just in this last question, the global scope, you see things. Well, if a doctor can't open e-mail, that's not an issue of Mozambique.

So, that big picture, you mentioned the intensity at Microsoft, and I think for those of us who followed Microsoft and know a little bit about the culture of Microsoft, it's a very intense place.

Another is simply what are the passions in terms of what you want to work on.

So, I'd like to ask you, what -- if you were to pick one thing that led Mr. Buffett to make this huge decision, what was it?

**BILL GATES:** Well, I won't really ever know his exact thinking on this, and it's a huge responsibility. I remember the first time he mentioned the possibility to me, I thought, well, that's very flattering, but he doesn't really mean it. And then he mentioned it again and I thought, ooh, he might mean it, because he's not someone who says things idly, and then finally got to the point where he said, yes, this is what I'd like to do.

What it meant was a doubling of the resources of the foundation, which in a certain sense we're already large, but relative to these problems even just take half of what we do, which is curing these 20 infectious diseases, AIDS, malaria, TB, our resources are actually quite small compared to what needs to be done there.

I think when you think about Warren, he loves his work, and so he doesn't want to distract himself from doing that job. It's not just that it's very remunerative, but that he's built his whole life around running Berkshire Hathaway. He calls it his masterpiece. It engages him, he says he skips to work every day.

He's got the best schedule of anyone. He keeps his schedule so free, you know, I call him up, he just picks up the phone, there he is, always available to talk about things.

So, he didn't want to impact what he's up to, and he thought it would be a little strange to be making money in the morning, and giving money in the afternoon, that you get confused about -- (laughter) -- which way you're supposed to be going, and maybe -- and he also likes the crispness of the business environment, where if he buys a business and it does well, that's very concrete; if he makes an investment and it does well, it's very concrete.

The world of philanthropy, the measurements are not as clear, and they're not as near term. As we get on scientists to do an AIDS vaccine, we won't know for five or six years, and even if that person is brilliant, it may be a complete dead-end.

So, some of the domain expertise, the uncertainty, the lack of clear measures made it not something that he would enjoy doing. For most of his life he thought that his wife Suzy would take on the giving back of the fortune and delegating that down to other people in various ways. And so when she unfortunately passed away, then Warren had this challenge for himself of what was he going to do, knowing that he wanted it to go back to society and have a very big impact.

And he actually put it into multiple pieces. Each of his children got what makes their foundations have a little bit more than 50 million a year to give away, so very significant, and each of them are off doing creative things with that.

The biggest portion he chose to put in essentially to the foundation my wife and I have. I was a bit intimidated by that. That meant doubling, but then again we can do great things with this.

Over the years, as I'd talk to Warren, and he'd seen my enthusiasm for software, and then he saw in addition to that my enthusiasm for these new causes, he must have thought it looked like a great way to delegate.

He's known as a great delegater. When he bought -- there's a company, the company that owned World Book. Anyway, there are various companies he buys where he doesn't even have to go visit. He meets the person, looks at the data, and then he says, okay, you can run it, I don't need to even talk to you on that regular of a basis. So, he's a very good delegater. He did agree to become a trustee of the foundation. So, he's one of the trustees, and does give us a lot of very good input on things.

But he's delegated it, and so I'm like a manager at Berkshire Hathaway, hoping to fulfill the incredible trust that he's put in me.

**MODERATOR:** We might instead call this specialization instead of delegation, but with that let me invite up Scott Duncombe. He's president of the University of Chicago student body.

**SCOTT DUNCOMBE:** Hi, Mr. Gates. On behalf of all the students at the University of Chicago, I'd like to present you with this baseball cap of the Maroons. We're the Maroons. And thank you for coming and sharing your time and your wisdom with all of us. It's been a great pleasure. I wish you the best in future endeavors.

**BILL GATES:** Thank you. (Applause.)

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