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HOW WILL EMERGING TECHNOLOGIES AFFECT THE FUTURE OF WORK?

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P R O C E E D I N G S

MR. WEST: Good morning. I'm a Darrel West, a Vice President of Governance Studies and Director of the Center for Technology Innovation here at Brookings. So, I'd like to welcome you to our event on AI and the future of work. So, we live in a time of tremendous innovation. Artificial intelligence is advancing rapidly and being deployed in a number of different sectors. Autonomous vehicles are being tested on the road in major cities. Robots are being deployed in manufacturing facilities and mobile technology is transforming life in many places. But at the same time that we're seeing all those advances, there are considerable fears about the impact of these emerging technologies on the workforce.

There are lots of scary stories in the press about robots taking jobs and AI displacing human capabilities. There's concern that we are at a major turning point and that the future may be more challenging. I wrote a book that was published last year entitled the Future of Work Robots, AI and Automation that explores some of those issues and proposes a number of steps that we need to take in order to help people deal with this transition to a digital economy. And that includes making benefits more portable so that as people move from job to job, they are not losing their healthcare, a greater focus on lifelong learning so that people can regularly upgrade their job skills at various points during their lives. And then renegotiating our social contract for the digital era so that we can update some of our public policies.

Today we're going to discuss the impact of AI and emerging technologies on the future of work. What are the kinds of skills that people will need in the digital economy? How should we think about education and worker retraining in the digital world and do we need new kinds of policies to deal with a workforce ramifications? To help us think about these issues. We have three distinguished experts here with us. they include Makada Henry-Nickie, who is a David Rubenstein Fellow in governance

studies at Brookings and she writes about the digital economy and emerging trends. She actually has a new Brookings paper out on trends in the IT sector, which is free and available on the Brookings website at brookings.edu and she'll talk a little bit about that paper in a moment. Greg Morrisett is the Dean of Computing and Information Sciences at Cornell University and previously he held the Allen Cutting Chair in Computer Science at Harvard University. In his current position, he is overseeing several projects on education and a labor and a partnership to educate young people about blockchain, machine learning and human computer interactions. He also is working on a new initiative at Cornell in applied AI initiative that is bringing both AI and data sciences into the classroom.

David Hoffman is the Associate General Counsel in Global Privacy Officer at Intel. And in those positions, he thinks a lot about AI and emerging technologies and its impact on the workforce and on education. And we also want to thank Intel for providing financial support for this forum. We appreciate its generosity in supporting our work. So, I want to start with Makada. So you've written about a trends in the IT sector. So, what are the important technology developments that we're seeing in this area and how are these trends, luckily to affect the workforce?

MS. HENRY-NICKIE: So, I think first it's on, up until the last 2018, it was difficult to even capture the impact of the digital economy, ICT sector, the terminology switch depending on the tables that you're looking at trying to capture that real impact in the economy, you can feel it. So, thank goodness, has updated the statistics updated how we capture software and ICT producing goods and services. In the economy, we've seen that over the last 10 years between 1997 and 2017, the ICT sector has grown on average 9.9 percent. That out stripping even the general average growth in the economy, which sounds at 2.3 percent. And it's really technologies that are so key critical techs that are driving this growth. Cloud and edge computing, AI, blockchain,

Internet of things; the line goes on. I think there's some key mechanisms that are really going to be important for us moving forward.

And that is on the one hand, how transformative these techs in that sector will be to the non-ICT components of our economy, particularly in the small business ecosystem. Now, we've got small business, small and medium size enterprises, being able to access technology that previously was unavailable because of huge cost barriers and being able to not access and grow through a global markets before were not accessible. But the real challenge, here, of course, is workforce. The ICT sector only contributes, I think, about 3.3 percent of total employment in the U.S. and that is a decoupling in terms of the growth and its contribution to proactivity versus employment. And that sort of like where the key issue is.

We've -- what we're seeing on the one hand, it is the sector that is at the forefront with grappling with issues, whether it's skill shortage, scale supply and mismatch. And also beginning to learn what kinds of initiatives and the kinds of scale of investments that's going to -- it's going to take to begin to crack this knot and make sure that the U.S. stays or maintains its our global competitive edge.

MR. WEST: Okay. So, Greg, you have been involved at Cornell in several initiatives designed to help young people understand AI and emerging technologies as well as data sciences. So, could you describe some of these activities and then I'm also just curious how young people on your campus are thinking about their economic futures.

MR. MORRISETT: Yeah, so one of the big changes that Cornell made recently, was the Arts and Sciences College just reworked its core curriculum. And one of the things that they did was they introduced data science requirements for all students. And this is opposed to engineering where in essence you were already taking probability, statistics, computation. But now, essentially every liberal arts student is also being asked

to take data science because we think it's really going to be crucial to whatever they do. And in fact, combining it with other disciplines is really important. There's a new class of students called the Milstein Scholars that are really combining AI machine learning and data science with their own disciplines. It could be music; it could be a sociology; it could be economics; and they're spending time in Ithaca taking courses on that and then coming to New York to our new Cornell Tech Campus to interact with companies and industry and also to work with the faculty down there. So, that's one big initiative that we have going.

But Cornell has a long history in AI. In fact, the first perceptron-based machine, the first neural network was actually built there in 1960 by a guy named Frank Rosenblatt. He was trying to study brains and model them very cheaply, very easily. And so he built the first Mark 1 Perceptron back then. And these days researchers are working on a range of sort of core technologies, like translation or language understanding. One of our faculty has developed a really cool algorithm to look at online discussions and predict when they're going to turn into heated arguments based on the language that's being used. And you know, the hope is maybe you could intervene then and sort of diffuse an argument.

But also a lot of work on automation and robotics. So, for example, Cornell's been deeply involved with the design and execution of the Mars Rovers and this sort of thing. So, the students are flocking to it. In fact. we're kind of overrun right now with students wanting to take courses in computer science, AI, machine learning. In fact, a senior level course in machine learning these days, which has a lot of prerequisites, maybe three, three or four prerequisites, has on the order of 300, 350 students each semester in it. So, the students really see this as the future of their economic path and are really flocking to it.

MR. WEST: Okay. So, David, I know you spend a lot of time thinking

about emerging technologies and their possible impact on society, both positive as well as a possibly less positive ramifications. How are you thinking about this issue and what should we be focusing on?

MR. HOFFMAN: Sure. As the entire society has been transforming to this data economy, Intel's been going through what transformation also. We've been moving towards becoming a data centric company with three major focuses that we've been moving forward on. One is investment in autonomous driving, the second is in 5G connectivity and the third is in artificial intelligence. And as Makada was pointing out, the idea here is what's happening is that we're creating what we like to call a virtuous cycle where advances in memory and field programmable gate arrays and data analytics and conductivity, creating a situation where can deploy more computing both out to the edge and then through greater conductivity in the network. Bring that back to the cloud and to the enterprise. And then throughout the network we can deploy greater memory and analytics and artificial intelligence to do the computing at the best place where computing really should happen.

So, what that does is as you've got more capability back in the cloud and the data center that allows for new transformative experiences for people out at the edge. When you have new transformative experiences out at the edge, it's creating new data that can be fed back to the enterprise and the cloud and use to develop even more capability and insight and inference. So, as we do that, we know that there are going to be impacts on individuals. So, we want to make sure that we can maximize the great potential from all of this technology and this virtuous cycle for driving forward to help solve some of the great problems that we have in society. Whether that's precision medicine or whether that's advances for the environment or for agriculture. But we know it's going to have great impacts and one of the places we know what's going to have an impact is in the area of employment.

Intel's not only one of the leading developers of technology in the world. We're actually the largest manufacturing enterprise here in the United States. We employ over 50,000 people here in the United States. So, we think all the time about impact on technology and what we're doing there, but also impact on employment in the workforce.

MR. WEST: So, a question for each of our panelists. This week I gave a talk on the Future of Work at Brown University and, of course, in the Q&A, students wanted to know, well, what's all this stuff going to mean for me? They're seeing all these advances, robotics, AI, autonomous vehicles, and so on. How should young people be thinking about this? And Makada, I'll start with you on this, and just in terms of like, in my book I talk about the need for lifelong learning. How should young people think about it? Not just like in the next five to 10 years, but perhaps even during the entire course of their adult lives.

MS. HENRY-NICKIE: So, I think we have to sort of shift from a, I'm going to college to get a degree, to get and then have a masters because I want to sort of announce that this is some sort of symbol that separates me and announces that I'm sort of better than the general lay person. Now, credentials and degrees matter because that's how you set and I think, transference first through a pathway. And so you've got to think about a job and the tasks and the finite skills that are involved in that job and sort of think back into what sort of courses do I pick? What's the course -- what's the major and make that decision more concrete than even in my time when I just went to school and said, hey, I want to become an economist. Just I like the field.

And what we're seeing when I dig down, I spent a lot of time thinking about how jobs have changed. And when I look at job titles and look at job postings you're seeing a demand for a new combination of skills that before were just unlikely. In the automotive sector, a web and design mixed with GPU programming, mixed with

robotics, a mix of software and how it hardware, all of that is combined into one job posting, looking for maybe a robotic software engineer and that's being driven by advances in a self-driving cars. So, we have to demystify what kind of work and tasks are involved in selecting occupations and B, I think there needs to be more student agency in that process.

I'm very heartened to hear Cornell say that there's data science in the arts and science programs and making that now a prerequisite. If you look at UX courses, which is a mixture of traditional social sciences or liberal arts sciences, there's now an emerging demand for tech skills. Can you put together a topic modeling a program using an LPM -- NLP algorithm to mine and understand how our customer sentiments are shifting over time. You don't find those kinds of skills in our traditional liberal arts curricular. So, we have to develop, I think, more, we have to be more intentional about how training and education matches to actual tasks and jobs.

MR. WEST: So, Greg, you're on the front lines of dealing with the young people. So, when you're Cornell undergraduates and graduate students come to you for advice, what are you telling them?

MR. MORRISETT: Essentially what Makada just said. One is, a really good a firm basis in the foundational things. Math, statistics, in particular, statistics was always undersold in the liberal arts curriculum. And yet, it's really critical to all of these fields that we're talking about. Some computation, you don't necessarily have to go become a GPU programmer, but having some computer science under your belt, no matter what you're doing, I think is vital these days. Those will serve you well. But I think just as importantly a design, a humanistic aspects, philosophy. One of the big challenges we have now is we've created a generation of people that are very good at the technical stuff, but really don't understand, for instance, policy implications or some of the disruption that the technology has brought. And so I actually think the standard liberal

arts curriculum is a good foundation, but it's just a starting point. And we have to convince students first of all, to work in teams together across different disciplines. And second of all, to go on when they graduate, they're not done with their major. They're going to have to change every four or five years, as Makada said, and continue to retrain.

MR. WEST: David, your thoughts on this.

MR. HOFFMAN: Yeah, I think this is exactly the approach that we need and what I see at Intel is having teams that can work together, but also bringing together different folks who have different skills that they've been able to combine both whether those are legal expertise, technical expertise, general humanities expertise. We should have a team of anthropologists that we employ in our labs organization that looks about how people use technology.

One thing that we've seen also is that almost all jobs are becoming technology jobs. And particularly this applies to the trades. So, actually I don't know how many folks here have seen the show on the Discovery Channel, dirty jobs, but Mike Rowe who hosts that show has done a lot of actually research with his team looking at where the trades are going and seeing this, the use of technology that we actually think the use of artificial intelligence to assist people in the trades, whether you're a welder, or whether you're looking at installing cell phone towers, or any sorts of odd job like that, it's going to be tremendous. So, not just at a place like Brown, or place like Cornell and infusing the curricula there, but taking a look at our community college programs, going down to the high school level and getting people comfortable using technology and thinking about how do I, how am I going to be able to use technology to continue to live throughout or learn throughout my life and continue to make myself competitive?

MR. WEST: So, it's funny when I give talks to young people, I'm always reminded of one of Charles Darwin's insights when he was talking about evolution. He said that survival is going to go not to the strongest or the most intelligent, but the most

adaptable. And I've always thought as we think about this transition to the digital economy and especially for young people that that's an important insight that in an era where lots of things are changing, we need to be teaching young people about adaptability, flexibility, persistence, resilience. Like, how you deal with the changes that are going to take place during the course of your lives. So, Makada I want to focus now a little bit more on what we should do and how we should kind of respond to some of these emerging trends, either in terms of policy changes, legal changes, changes in the way companies are operating given possible workforce ramifications. What should we be thinking about? What would you recommend that we be doing?

MS. HENRY-NICKIE: I think that depends on their perspective to much of the last round of comments was centered on what students who eventually become employees need to do, but very little focus on what employers should be doing in that regard. There's a steady this morning by Morning Consult that showed that about 44 percent of millennial students felt that their college degrees weren't worth anything. So, setting Cornell aside (laughter) on average, there is a general sentiment of dissatisfaction. And that's not sustainable or healthy and that is not a problem we can set aside and say, well you millennials, you really don't know what you're talking about. There is a genuine mismatch that's going on in the labor market. And it also has to do with the fact that one, sometimes we as employers don't really understand what the skill requirement is. So, we've got some degree of degree inflation in there. Then, we also have this expectation that employees should walk in the door fully beat.

Robotics engineering let me just talk about that for second, it's a brand-new emerging field. Exciting and innovation in that industry or that micro industry as I call it, is outpacing the supply of skill. So, oftentimes we refer to this as a pipeline problem, but think about Uber wanting to maintain its competitive edge over Lyft and they want an engineer who has had research experience; who has a track record and prototype design

that works and come can commercialize and can scale in less than a year. It takes on average maybe seven years to graduate a PhD. And so some of that burden belongs to the stakeholder, the employer who is going to benefit disproportionately from that talent.

And so going back to the Morning Consult statistic about this dissatisfaction, a lot of it's coming from student debt, right? So, the cost of student debt is rising astronomically. All that burden is being shifted onto workers. Whether you're retraining, upscaling or now emerging into the market. And there's a fierce competition for scarce talent. So, there's a mix of stuff that we need to begin to disentangle. And governments, there's no national strategy, setting aside the announcement this afternoon around AI or 21st Century workforce in this country. Globally, we are behind. Whether China gets it right, or India gets it right, or Canada or Netherlands, there are strategic cogent conversations around a need to produce a 21st century workforce. I always have to think about Tim Cook's response or his interview last a year when he talks about, why are you still -- why can't you move your tooling factories to try LA or the West Coast. I said because I can't find tooling engineers, it's not about cost. He can fill a football field full of tooling engineers in China in barely a conference room on the West Coast. There are some major issues here and in response we have to think about maybe employers offering, besides, I'll pay for you to get one or two credentials, maybe subsidizing your next level of training or next academic degree as part of the compensation package.

Pell grants, lowest purchasing power of the Pell grants. We've hit historic lows, $5,700. Let's not talk about what the average cost of education in this country is. Those kinds of data points sit -- are glaring to tell you what are the kinds of directions we need to begin to move in to move this conversation forward.

MR. WEST: So, Greg, your thoughts on what we, as a society should be doing?

MR. MORRISETT: Well, I just want to pick up on something Makada

said, it's not just that students take seven years to get a PhD and they're bearing that cost and so forth, but right now, we're at a point where the frenzy is so hot around people with deep technical knowledge that they're ripping away the faculty --

MS. HENRY-NICKIE: Yes.

MR. MORRISETT: -- who could teach the PhDs. And so we're really eating the seed corn right now in a bad cycle that is just going to make the labor supply in these key areas --

MS. HENRY-NICKIE: Tighter.

MR. MORRISETT: -- worse and worse, at least in the short run. So that's an immediate concern where partnership with industry about research, I mean, if we're going to cannibalize all the research that's needed to push us into these areas by pulling people out of universities and labs and into feeding Uber today, then we're going to really hurt down the line tomorrow in comparison to other countries or other places where there's deep investments being made in these key technologies.

MR. WEST: David, what are your thoughts either on what companies should do or are there changes in policy that we need to think about it?

MR. HOFFMAN: Sure. I would follow what Makada said, I think this needs to be a fundamental component of any country's national artificial intelligence strategy. We've been going around the world talking to governments about the current state of their national I strategy and I will say many of other governments are making this a critical component and are running very quickly to understand what the impact is on employment.

Looking at the research, what it shows is that it's difficult to discern and to forecast the extent of what the impact is going to be. How many more new jobs are going to be created versus how many jobs are going to be lost. One thing though that is very clear is that there's going to be a huge amount of displacement to individuals. And

Darrell, you had mentioned that the adaptability being the most important thing. What countries need to understand is adaptability is not going to be uniform across the population.

You have differences in geographic region; you've got differences of socioeconomic status; you've got differences of cognitive learning different style; and what people are going to be able to do. This is something the government's got to take a hard look at because the implications not just there on the individual and what's going to happen to them, but these have implications, particularly in democratic societies for the political environment that we live in and creating the right ability to understand that displacement's going to hit certain populations more than it's going to hit others. And having programs in place to be able to mitigate those impacts is absolutely critical.

MR. WEST: Yes, and certainly not only the impact on particular parts of the population, but the regional disparities like the tech revolution is going to play out very differently in different parts of the United States. I do want to point out that I believe President Trump this afternoon is going to make an AI announcement, at least according to some of the news reports that are out, possibly creating a $20 billion AI fund to encourage more development in that area. I think all of us, we'll be watching to see what the details are and like, what's the strategy? How are we going to get there? Right now, we're basically relying on private companies to come up with a strategy.

So, David started to mention international perspectives and what's going on in other countries because these technology trends, obviously this is not a U.S. story. This is a global phenomenon, so I'm just curious, when you look outside the United States, are there good models? Are there countries that are actually ahead of us in terms of thinking about the workforce ramifications and making policy changes that would help people handle this adjustment; are there countries doing it poorly. How should we think about this from a non-U.S. standpoint? Makada you want to start with that?

MS. HENRY-NICKIE: So, I think like the innovation and the tech, there's a lot of dynamism in trying to answer the question and different countries are heading in different directions. But to the extent that we can learn from their experiences or their pilots, I think that that's probably the best we can hope for at those point. Canada, for example, I wrote a few months ago, there's a report on the future of skills lab initiative that they're launching, which tries to bridge the gap between understanding where the skill market is heading and maybe how educational institutions can adopt to provide those skills. So, that sort of feedback loop, which is I think impressive, but at the same time it raises questions around who's burden is it to really pay for updating the entire workforce, get up the skills level of the entire workforce and it's those kinds of pain points are sort of puzzling, difficult questions that I think we can (inaudible) and learn and begin to at least get off the sidelines and start crafting some sort of strategy as opposed to focusing on whether who's right or wrong about how many STEM workers we're exactly short.

I think one of the -- to your earlier comments around the impact, a lot of our focus is on the sensational part of job destruction, but there's a lot of job creation going on. We just have to dig very deep to find it. And in there lies, I think, the direction on the front like, where we're headed. China and India are offering us important lessons around when you over train hard skills to the detriment of soft skills, you get a pretty deficient workforce. So, that extreme isn't good either. So I'll just leave it there.

MR. WEST: Okay. Greg, your thoughts on what other countries are doing?

MR. MORRISETT: Frankly, I don't know enough to say anything too intelligent except that I think I worry a little bit about the U.S. education system and it's so strong, but that may be the weakness in the sense that other places are trying to innovate, trying to catch up and they may crack this nut about how to do lifelong training

and getting a more adaptive, nimble workforce. Whereas, we're sort of left behind if we, if we continue along with the same institutions that we had.

MR. WEST: Okay. David?

MR. HOFFMAN: I would just say the engine of employment in the United States for a long time has been small business and entrepreneurs. Artificial intelligence has the possibility of being a democratizing force for allowing smaller companies to start up and do tremendous things. Other countries are making that a critical component of their national AI strategies. That's a critical component of the India's strategy. For example, China has taken a lot of efforts. There are a lot of that's about opening up data, making data available, making it a job for individuals to actually structure that data, tag that data and make it usable by organizations, create API so that organizations (inaudible). I think we need to realize the connection between some of these efforts that then would democratize it. Artificial intelligence make it easier to start companies and how that will spur employment.

MR. WEST: Okay, Greg. Just one more question for you. Then, we're going to open the floor to questions from the audience. So Greg, you mentioned at Cornell it's a university wide requirement now that -- to take a data sciences?

MR. MORRISETT: In the Arts and Sciences College, so Cornell's complicated. In seven different colleges and there's a School of Hotel Management. I don't know that they have a data science requirement, but Arts and Sciences is by far the largest college. And recently we've just reworked its curriculum to require data science.

MR. WEST: Okay, great.

MR. HOFFMAN: Can I add one thing there? I just wanted to add, emphasize something that (inaudible) said, Greg and I have an academic appointment down at Duke University also working with their law school in their public policy school. And what I've seen at Duke, and I hear that this happening all across the country, the

importance of cross disciplinary cooperation between departments and then having an understanding really on the implications, on ethics and overall, on the public policy environment. And I think what Cornell has been, has done is tremendous. I know, Darryl, we were talking about what Brown has done. I think the more schools across the country can focus on that be tremendous benefits.

MR. WEST: And we certainly hear a lot of interest on a lot of college campuses in both the societal ramifications of AI and the ethical dimensions of AI. Let's open the floor to questions. In the very back, there's a microphone right behind you that's coming up. If you can give us your name and your organization.

MS. COPE: Good morning. I'm Margaret Cope. I'm an independent consultant. And also, I'm a senior advisor at Serve USA. When we talk about competition for talent and workforce development, one example that comes to mind is Israel. They have a new video out on how national service has enabled them to go from pretty nondescript to one of the top five in cybersecurity. We talk about lifetime learning. What about lifetime service? Is it time to consider a national service program that encompasses a lot of areas, not just the military, but perhaps reviving the CCCs for infrastructure; a medical corps; a cybersecurity corps and others? Your thoughts?

MR. WEST: Okay.

MR. MORRISETT: I have just a couple quick (inaudible), I just would want to echo that I spent a reasonable amount of time in Israel. I think it's not just the fact that they use their national service requirement to target people who have certain skills and get them to invest it in those areas and create capability there. But they tie that to their investment in startup economy. And so they take people that that and then they, once they have done that, their national service, then they in sort of the reserve units, they tie those reserve units to investment firms that then are going to help those entities or those individuals create new companies and new innovations. I think that's something

we really need to look at here in the United States. We've had a model oftentimes of people join organizations within the government and which thought of as a failure if they leave for the private sector. We need to think of that more as a feature and not a bug.

MR. HOFFMAN: Yeah. I think also, I mean there's a big difference between an 18-year old that's coming out of high school and going directly into college versus one that has spent a couple of years in the military or in some other service organization. The maturity level and what they bring to the classroom then is very different. And they're confident. They're mindset is the, I can do this, I can solve that. And I think having more of that before, gap years I love, because I think it really helps students mature and grow into wanting to understand what they want out of life. What do they want to get out of college?

MS. HENRY-NICKIE: And I would just add that I like the idea, but I think operationally because innovation happens where it happens organically, we have to be flexible enough to see that trend, see that shape and respond to that dynamism. I'm not sure we get that in a national model. I think Singapore offers some kind of lesson in that regard. So that would just be my caution on the optimism on that piece.

MR. WEST: Okay. There's a question. Oh, actually we're over there, the gentleman on the aisle.

MR. ARNONE: Hi. Bill Arnone with the National Academy of Social Insurance. I'd like to get your perspective on a public policy aspect of this. Some who are supporting artificial intelligence as a key to our future, are connecting it with the need for a government program that will provide some type of assured income to everyone regardless of work. Do you see a connection between the two?

MR. WEST: I would say one thing on that. The issue of a basic income was on the ballot once in Switzerland a couple of years ago and it went down 75 to 25 percent. And all the predictable arguments that one might expect of that type of a

program will destroy initiative. People won't work hard. Those were the ideas that killed it. So, people who liked that idea, and there are a number of people around the country who are starting to think about that now, have a major education effort to persuade other people that that would be a way to go as opposed to their other possibilities like expanding the earned income tax credit. There are number of presidential candidates that are moving in that direction. So, there are other models to try and handle either worker displacement issues or helping support people, if they happen to be between jobs as a result of displacement. I don't know if any of our other panelists have thoughts on that.

MR. HENRY-NICKIE: So, I think that is part of our solution set. I think the scale of it depends on how much AI will shift the demographics of our labor force participation. Robotics automation, we are already seeing that there are limits and the automotive industry has shown us that. Tesla has said, hey, we've excessively automated, we still need humans. Japanese hotel fired 50 percent of its robotic workforce because the robots couldn't answer basic questions like where's parking? So, and I mean to the extent that we understand that as a lot of complexity and confusion and chaos in the human service delivery sector that I think sets a natural limit, but they will be people who will be automated out of work or their cognitive process will set them aside. And for those people who probably will be on the older side, what do we do? How do we make sure that we take care of them? Social Security obviously, is not going to be sufficient. So, maybe some form of UBI will be a palatable in 10 years.

MR. WEST? Other questions? Right here, there's a woman with her hand up. There's a microphone coming up from behind you.

SPEAKER: Thank you. My name is Amanda. I'm with the American Association of Community Colleges. My question is, as you talk about lifelong learning and promoting the soft skills on top of the technical skills, that's something I know a lot of

community colleges are working very hard to address. How do we do more shorter-term programs, get the technical skills we need, but still remember to teach people about communication and basic things like remembering your safety gear and showing up on time. My question for the panel is from your research and your experience out in the field, have you seen any promising practices on how to change kind of the thoughts and minds around creating lifelong learning? And how are people promoting that? How are organizations, companies, schools promoting the idea of lifelong learning in a successful way?

MR. HOFFMAN: So, there was an article just the other day about companies such as IBM asking their employees to, or badging their employees for instance, to get certificates in areas that they found valuable to the company. So, there's sort of gaming as a mechanism to try to help push humans along. I think by default, most of us don't -- would rather watch TV late night then to go watch a course on Coursera or something. But on the other hand, I think the new generation is coming up and they have a very different mindset about, at least the students that I see, approaching online material and learning things on demand. So, you don't know how many kids I've talked to you now who've taken (inaudible) AI course in high school. And it's because they were interested and they just dove in and I think we'll see more and more of that where they're taking advantage of online resources to take courses at top places as a stepping stone. It doesn't address many of the other issues like working together in teams, community and communications and so forth. So, I think there's still a lot to do there. And a lot of open questions about how to do this well.

MR. WEST: I mean, one thing I would add to that is I think we're seeing a lot of different kinds of organizations step up to the lifelong learning table. There are lots of companies that are investing in this for their employees. As you point out, community colleges or during this; four-year colleges and universities are moving this

direction as well. Last fall, I spoke the National Governor's Association and was on a panel with the CEO of Udacity, one of the leading online platforms, and he made a prediction and I'm not sure he's right in the magnitude of what he said, but I think he's certainly right in the direction of what he said. He said that within 10 years, the adult education market is going to be as big as the current higher education market. Meaning there's going to be such a need and such a demand that like, there's going to be a lot of money I spent on that. I think the policy question is how we're going to pay for that because now as a society, we invest in K to 12. We spent a lot of money on higher education. We don't tend to view adult education as something that we, as a society, I should support. So, in my book, for example, I suggest the need for something that, I called a citizen's learning account. It's kind of like an art IRA, but for adult education in which the person on a tax advantage basis could set aside money and then draw on it whenever he or she needed it. And if you worked for a really nice company, the company might match your investment. So, but I think that question of how we pay for lifelong learning is a question we really need to address.

MS. HENRY-NICKIE: I would also add Darrell to that, in order for life longer and in a work, there should be some sort of trust and translation from employers to these credentials. So, a lot of our focus is on the supply side. What can workers who'd approve themselves and make themselves appear qualified. However, there's very little information coming out from employers as to do these micro degrees, carry the skills and the value that we think we'd need in our workforce. Udacity is probably the only model that I think has that feedback loop. If you go through X amount of time and you get that nanodegree and you badge, you know that you can pour it around, whether it's IBM or Google, or the other companies in that collaborative, you and them know that that thing is worth the same amount of value that you've invested. So, you want you're okay with doing that. And going back to that initial statistic on why people feel that degrees aren't

worth it, there's very little equilibrium on that value question, very little. And if we don't crack that knot, I'm not sure that lifelong learning is going to get us very far.

MR. WEST: Okay. There's a gentleman here on the aisle.

MR. LIFTMAN: Thanks for your comments. My name's Michael Liftman. I'm an independent consultant in town. I also have a podcast on tech innovation and startups and I just interviewed two Israeli startups. So this stuff has been on my mind never more acutely than recently. Because I also am the parent of a high school junior who was looking at schools like Brown and Cornell that costs, if you don't know, it's about $70,000 all in. And so 44 percent of millennials say it's worthless. That's a lot of money that I don't really want to spend. (Laughter) So, there are a couple of schools like Northeastern and Drexel, maybe others that as part of their curriculum have perhaps half of that four-year period. The kids work there several semesters where they're not in class, but they're out in the real world. Do you see that becoming a more of a trend in places like Cornell and Duke and Brown, or the other super elite universities?

MR. MORRISETT: At least at in Cornell, in engineering, there's also a cooperative. So, Northeastern for instance, has a requirement of a co-op program, whereas, Cornell has the option of a co-op program. Interestingly, in the fields that I represented with computing and information science statistics, a very small fraction of students do that. And the reason is they get the co-op experience through internships over the summer at tech companies like, Intel or Google. And so, frankly, they'd rather spend -- I mean there's many other aspects to college then just the coursework and other things. And so being on campus with your friends, being able to do the drama or whatever, all these other aspects are really important to students. And so most of them prefer to stay on campus even though they have that option of going off and doing a co-op. And they find the internships over the summer provide what I think is very valuable and it's kind of missing from college education today, which is that immediate skillset

capturing, as opposed to sort of foundational questions around mathematics or computing the immediate skill sets that they need to hit the ground running when they graduate. And those are very attractive to employers. When I talked to students today, it's just as much a badge on their transcript to have done an internship at Google and a few other places as it is to taken a machine learning class at Cornell and gotten an A in it.

MS. HENRY-NICKIE: Yeah.

MR. WEST: Or at Brookings, just as an example. (Laughter) Right behind, was a gentleman on the aisle with a question. If we could bring the microphone up.

MR. ESKENAZI: Yeah. Hi, I'm Mark Eskenazi from the National Labor Relations Board here in my personal capacity. I have a question about displaced workers that you all were talking about and specifically about labor unions and the role you think they might play in that. In the Uber-type fields, Dirty Work type fields. So, far as, as I could tell, a labor unions have not made inroads as they had in the '70s, '80s, '50s, '60 even in emerging fields. What role, if any, do you, do you see for labor unions? I know Cornell has the School of Industrial Labor Relations, which I attended many years ago.

MR. WEST: I mean, one thing I will say in response to that, there are two revolutions taking place simultaneously now that will have workforce ramifications. One is like all the technology stuff that we've been talking about, but as your question suggests, the second revolution that is taking place, it's just changes in business models and business practices that have unfolded over the last several decades. Companies moving from permanent to a temporary workers; companies relying on independent contractors. Just the emergence of the sharing economy of people who have jobs, but there aren't necessarily healthcare benefits attached to those jobs. And I think on a policy side, we have to be thinking about not just the tech ramifications, but the

ramifications of these changes in business practices. On unions, they've been some, I would say, very minor efforts to unionize in some of these new fields. They've not gone very far. There aren't very many successes in that area. There have been court cases involving independent contractors. Like, if you're a FedEx guy and you wear a shirt that says Fedex on it and you drive a truck that has FedEx on the side, but you're not a FedEx employee, like is that the proper classification? So, like all those are classic public policy questions that as we're moving to a digital economy, we're just going to have to think about like, how do we want to handle that. In moving from an industrial to a digital economy, we still have a lot of laws that are geared for the industrial economy. We don't have too many laws for the new digital economy that's emerging.

MS. HENRY-NICKIE: And I would just add to that, Darrell, I think unions ought to start thinking about moving from protecting physical jobs or actual sort of codified jobs. I'm thinking about what kind of systematic policy solutions that we can enable -- that we can support to enable work on mobility. That is the new work -- that's the future of work. Workers that are going to shift careers and be mobile. And we need to think about portable benefits or I really liked that idea about, in addition to having a 401k contribution, I'd like a lifetime learning education K, whatever you want to call it, match because it's that kind of resilience that we ought to be thinking about as opposed to you get to keep this job at this level. And if anybody tries to move you, we've got to go through a long set of negotiations. I mean, that's just honestly the life of these kinds of protectionism strategies. So, I would argue that we need to be more on the policy side as opposed to the protectionist per unit side.

MR. WEST: Over here, there's a question. Yeah. Right there.

MR. WENTWORTH: David Wentworth retired from the IMF. As an economist, we sort of all know that, that every change in technology going back centuries has had a consequence that it displaces some workers and has the opportunity to grow

the economy. Is this change fundamentally different or is it just faster? And I guess the corollary that goes with that is that since much of the conversation here is about engineering and very high level skills, is it, how realistic is it for large portions of the population, particularly those who are already out of college and had finished whatever education they have to make the transition from what they used to be doing to the new digital world? Not everybody's a Cornell PhD, or an Intel engineer.

MR. MORRISETT: I would just say, I think one of the things we think there's probably different about the environment that we're in now, is that as we advance artificial intelligence capability, it's going to cut across a great majority of industry sectors. So, if you look back in the past when we've had innovation, it's hit individual sectors of the economy in ways, but hasn't had the breadth of the impact. So, difficult to forecast exactly what the implications of that are. But I think one of the things you can look at from a public policy perspective is then said, this is going to hit more broadly across the entire population. And so we need to be prepared with a public policy response to be able to allow people to be able to adjust to that.

MR. HOFFMAN: I think another point is that the disruption, we don't really know how it's going to unfold, but my prediction is you're going to see the white-collar jobs that are threatened, displaced first, as opposed to blue collar. Because frankly, robotics is hard and we're a long way off on delivering a lot of the Sci-fi that we're pitching it at this point. But in the virtual world where data is plentiful and where you don't need a lot of capital or other things to manufacturer robots or debug them in the real world, you're going to see amazing progress over the next five, 10 years, that's going to displace people in industries like law that are going to be really disruptive. And I think that's different. Usually, it seems like these disruptions have happened, not so much for white collar jobs as for other kinds.

MR. WEST: I think the other thing that is different right now is our poor

governance capacity. Because when you look historically in certain, I think a hundred years ago when we shifted from an agrarian to an industrial economy, like it was chaotic. It was tumultuous. There's violence on the front lines and it took decades to work through all that. But there was a policy response like we developed, Social Security, unemployment compensation, added an income tax to the constitution to pay for an expanded government role, encouraged mass education, which then was high school, eventually became a college. So, it's like we, as a society, and we as a country came together and said, okay there is an impact arising from industrialization and we need new policies to deal with it. I think there actually, our policy changes today that would make me optimistic that we could handle the transition to the digital economy perfectly well, if we had a strong governance capacity. That is the thing that makes me the most pessimistic about the future. It's not whether we can deal with the digital economy, it's whether our government can function to the point where we can make whatever policy adjustments that we're going to need to make. I think we have time for one more question. Over here on the -- next to the wall.

MS. BLAKE: Hi, my name is Oohsa Blake. I am Executive Director of a international nonprofit, Focal Pointe Global. And I guess my question deals with non-traditional spaces. As mentioned before, we are talking on high levels and we are assuming that the workforce is going to go to Cornell or to university in general to get this training. Most people don't go to college. That's not only in the U.S., but that's worldwide, so are companies or organizations looking in non-traditional spaces? And if so, where are they looking? Because we commented on how has the global IT movement affecting how we see things in the U.S. and we mentioned places like Canada and India and China, which we should, but are we looking in places like South America and Africa who are also in the digital transition; who are also making great strides, but are often overlooked because traditional stereotypes of how we look at those countries in

those spaces. So, where are we looking and are we looking?

MR. WEST: Okay, that's a great closing question. MR. HOFFMAN: I'll just take it real quickly. I think we are looking and looking not just for what's the impact going on unemployment there, but how do we bring tools and technology to allow people to be successful? I'm just commented, the advances that are happening in Africa, particularly, around communications technology, how empowering that can be and micro-financing to allow people to create jobs and become entrepreneurs there and to then teach them, people to use the technology to for self-empowerment. The advances are tremendous. And the individual countries that have been able to adapt that, spur a level of economic development, that's just tremendous. There's incredible lessons to be learned from the last few years in Africa until it's been very involved in a number of programs there. And we're looking to advance those further.

MS. HENRY-NICKIE: And I'll just add to that, we are looking, I think a structurally, the issues remain the same. (Inaudible) just launched a type yield this morning and it is a similar to Amazon. And so they're either trying to solve that last line problem in a very innovative way. It's going to open up markets and really kind of be a transformative economic mobility vehicle. But when you begin to sort of peel back and ask, is your workforce ready? South Africa and Nigeria have come up with a short answer of no. They're similar to the Chinese and the Indian models that really were sort of focused on hard skills to the detriment sometimes of soft skills and, but, there, I think an issue has been they've not been delivering the kind of hard skills even that the market expects. So, we are looking. Structurally the problems probably shift and vary, but not that much. So, to my earlier question, we're looking. We should look around to the extent that these countries, South Africa and Nigeria included solve some of the problem that we can bring those lessons home and hopefully a leap frog over that curve.

MR. WEST: Okay. We are out of time, but I want to thank Makada,

David and Greg for sharing your thoughts on the future and thanks to all of you for coming out as well. Thank you very much. (Applause)

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