[MUSIC PLAYING]

ANNOUNCER 1: Ladies and gentlemen, put your hands together for Chief Technology Officer Jeff Kowalski!

[APPLAUSE]

JEFF KOWALSKI: Take a look around you. Everything you see is a product of a person and an idea and a tool. Throughout human history, we've always had this impulse, this urge, to shape the world according to our ideas. And it's our technology that's given us the power to make those ideas real.

We started with simple machines. We used wheels and levers to stack stones on top of each other, and these tools gave us the power to imagine things like the pyramids. And then we developed mass-produced steel, as well as rivets, and cranes, and elevators, and yes, even the drafting table. And these new tools helped us to re-imagine what buildings could be, giving us the first skyscrapers.

From there, we made buildings that twist to the sky and even go to the sky and then come back. But with every tool, there is an upside and a downside. Because while they initially expand our capabilities, they ultimately also constrain our thinking. For example, those same drafting tools that gave us those first skyscrapers also gave us cars that look like this-- boxy and boring.

But then do you remember that year when all the cars just sort of melted around us? Well this change was triggered by a new tool, software that could model complex curves allowing designers to express a whole new language. You see, technology's always helped us express our ideas out in the world, but our tools have always been the rate limiting step for our creativity, the filter through which all of our best ideas had to pass. Until now.

Today, powerful technologies are emerging and converging, and taken together, they're giving us not the limited expressibility of the past, but an infinite expressibility that will help us shape the future. Instead of limiting our imaginations, this emerging tool set is going to help us amplify our ideas.

There's four radical technologies that are converging right now, changing the future of work

and giving us infinite expressibility. The first one, possibly the most important thing happening in software today, is artificial intelligence and machine learning. More than 60 years ago, a clever programmer taught a machine to beat humans at tic-tac-toe, and then 45 years later, in 1997, Deep Blue beat Kasparov at chess.

In 2011, Watson beat these two humans at jeopardy, which for a computer is a lot harder than chess. This time, rather than working from pre-defined recipes and algorithms, the computer had to actually use reasoning to overcome its human opponents. This year, a program called AlphaGo beat the world's best human at Go, a game so complex, it has more possible moves than there are atoms in the universe. In order to win, AlphaGo had to develop a sort of intuition about the game, and in fact, at times its programmers weren't exactly sure why it was doing exactly what it was doing.

Now if we look at the time frame for these milestones we see something really amazing. There's something exponential happening here. In less than a single human lifetime, computers have gone from learning a simple child's game to mastering the game recognized as the pinnacle of strategic thought. There's two things responsible for this acceleration. First, unprecedented available computing power through things like GPUs, multi-core and the cloud. And the second is that we've taught computers to teach themselves.

Let me give you a simple example. Think of the classic Atari video game *Breakout?* How did you learn *Breakout?* Spending long afternoons in the family room or den, trying to develop and hone your strategies? Well let me tell you how a computer recently learned *Breakout.*

Told only to maximize the score and that it could twist this one nob, a system called Deep Mind, learned how to play the game. And then it learned how to play the game better than any human ever had in just one night. How did it do that? It played in computer time, which means playing millions of games in parallel in the course of a single night.

Compare that with how we humans learn and share what we know. Just because your buddy got good at *Breakout* didn't mean that you got good at *Breakout.* But machines are different, and once this single machine had mastered *Breakout,* all machines mastered *Breakout* forever.

But machines aren't just getting smarter. They're also getting more creative. As powerful as computers have become, up until now we've mostly used them to solve the left-brain-style problems. Basically, the logical kind of stuff. And even in the case of the designer, the artist,

the writer, or even the sculptor, uses a creative tool, the inspirations really only ever come from our side of the screen.

But now computers are poised to transcend that barrier and make the journey into the realm of human creativity. The ability to grasp the unexpressed, to distill the very essence of a thing-- that's what's going to make the computer a better creative partner for us. And when I say creative, I mean exactly that, including things like the creative arts. We saw how one computer essentially went to video games school overnight so why can't a computer also go to art school overnight. Well, here's one that did. It studied Rembrandt, and then it painted a brand new one.

At Autodesk, we're bringing this kind of machine learning to the 3D world. We're feeding our algorithms huge amounts of 3D model data so they can grasp the essence of the designs that we work on every day. And with that new understanding, the software can take a 3D object, a generic chair, for instance, and apply a specific style to it. Make it more fluid, or more Philippe Starck, or more cubic or more Corbusier.

Playing board games, video games, creating paintings, even chairs. Computers are getting better at things like this which require human-style capabilities. Intuition, generating hunches, making creative leaps, expressing imagination. Another way to put it is that computers have always been a little bit like Mr. Spock, but today they're becoming a lot more like Captain Kirk.

Spock is logical and brilliant, but as we saw countless times on Star Trek, that was almost never enough to save the day. In fact, it was usually Captain Kirk who came up with the ultimate solution for whatever it was that they were facing, and it was usually something that was driven by hunch, intuition, and creativity. Today that's exactly the kind of unbridled imagination that we need to address our biggest challenges.

Here's another technology that's part of the convergence that's going to give us infinite expressibility. I've been talking to you about generative design for a few years now. It's a way of collaborating with a computer where we don't tell it what to do, we tell it what we need. We can tell the computer what we want to accomplish instead of telling it what we already know.

Here's an example of what I mean. This summer, one of our interns wanted to see if she could design a chair using generative design. Now her goal was to design a chair that was beautiful and comfortable and strong enough to support the weight of whoever might be sitting in it. So she fed our generative design tool, Dreamcatcher, her goals, describing what she wanted in a

chair.

And then she stepped back, and she let it explore the entire solution space on its own. It created thousands of options, all of which met the criteria, and including many designs that she would never have come up with herself. Here's the chair designed by a collaboration between Dreamcatcher and Britney. Despite her talent, there's really no way that Britney could have designed and fabricated a chair like this in just a couple of weeks.

The computer augmenting natural talent-- that's what I call infinite expressibility. In fact, I look forward to seeing how all of you harness your infinite expressibility when we release Dreamcatcher and our generative design tools commercially early next year.

Here's another project that I want to share with all of you. Last month, we worked on a project with an automotive partner to redesign this thing. It's a rear suspension upright for a passenger car. Using our generative design tools, we redesigned this part and ended up with two new options. The one on the left removes weight by optimizing the geometry, and the one on the right removes even more weight by adding an internal lattice in the optimized shape.

And the software isn't filling the void with the same repeating pattern. It actually mimics bone by adding material only where it's necessary and removing material where it's not. But computers are moving beyond optimizing geometry and increasing performance of things. They're starting to understand something even more complex-- the needs of people.

Our team in Toronto is moving into a new building so we decided to use it as kind of a living laboratory. We're using generative design to re-imagine what an office can be. As we began the process of planning the space, we knew we wanted to maximize productivity and create a really great experience for all the people working there. So we used generative design, and rather than feeding it the forces affecting parts, we fed it the forces influencing human experience.

We surveyed all of our employees and put their preferences and work habits into the system. And then the system evaluated that survey data against a set of hard constraints, like the boundaries the building, the fixed locations, of the kitchens, and so forth. and it generated thousands of options, thousands of alternative floor plans. And as a planned the space, the system was looking to maximize outside views, minimize distractions, and prioritize personal relationships.

And system was really, particularly good at reconciling multiple, often competing, goals. We weren't just pushing cubicles around like LEGO blocks, and we weren't stuck with the first design that worked. With generative design, we were able to create the best experience possible.

But you know what? Creating a great experience for someone is really hard, unless you, as the designer, can also experience that thing while you're creating it. Now we can finally do this by immersing ourselves in the digital realm through virtual reality, where we can experience our ideas firsthand before they're even real.

When you're in VR, you're more connected to your data. It's more detailed, it's more emotional and meaningful. You can see your data at human scale. If you're designing a chair, you interact with it at chair size. If it's in a building, you interact with the building the way its occupants will when it's built.

Now you can already do this today. Autodesk LIVE can take a Revit model into a VR environment with just a few clicks and open the doors to that building for all to experience. But this is so much more than just seeing. VR goes beyond visualization into the emotional realm. It's about exploring and feeling and experiencing. It's about building a richer connection between you and your work and your customer, and with this connection, you build a bridge of shared understanding.

You can also collaborate in the space with colleagues that are separated by geography but united by a common experience. You could point things out to each other, debate options, try them out. Of course, the ultimate step is actually designing in VR, and we're working on new tools that let you model and simulate in a VR environment from the start.

Interacting with your work, real scale, as you design-- that's going to radically different creative experience. I want you to try it out. We have a VR experience in the Future of Making Things Experience that you're going to get the try it for yourself in the exhibit hall today.

As we approach this notion of infinite expressibility, you know we still need to express ourselves in the physical world at some point, right? All that technological progress and change I've been talking about-- it's only really interesting when we get things real, physical, and tangible.

So let's think about robots for a second. Now there nothing new, but when you team robots up

with machine learning and generative design, that combination enables infinite expressibility like I've been talking about. By giving robots senses and an awareness of their human collaborators, they can work together side-by-side to do things that neither could do on their own.

As generative design gives us new forms, we need new ways to make things real. Now this robot is using machine learning and a computer vision system to 3D print a stainless steel version of Brittany's chair. And it wouldn't've been possible to create that thing any other way.

Speaking of the impossible, just a couple of years ago at AU, I talked about this crazy idea to robotically print a bridge designed by an artist and a generative design algorithm. And that ideas seemed pretty fantastical at the time, but here we are just two years later, and they're getting ready to start printing that bridge in Amsterdam as I speak. In fact, we have a section of it here in the exhibit hall, and you can see the robot printing it live in person.

So far today I've been talking about technology, but for me that's only half of the equation. What about us? How do people fit into this vision of the future? I'm sure that some of you have been thinking about these technologies, maybe as a threat. But I want tell you that's 100% wrong.

These technologies are not a threat. They're more like super powers. So what's the real threat? It's any competitor that adopts these super powers more quickly than you do. Look, these machines, the robots, the computers, they're not coming for us They're coming for us. They're not bringing the apocalypse. They're bringing us beer in a self-driving truck.

But the reason the prospect of these machines and robots is so scary is actually because they're so powerful. These tools of imagination and creation are challenging our thinking, and it's just-- it's not something that we experienced before. But that's the consequence of exponentiating technology. It stretches our thinking and also, our capabilities. I don't think that's daunting. I think that's exciting.

Another part of this equation that we have to think about is talent-- the people doing the work and using the technology. They used to be about stability. Now it's about mobility. You know, 40% of the US workforce is composed of freelancers, consultants, and other contingent workers. How does that impact all of you?

All of this mobility means that you now have access to a vastly larger pool of talented people

than you had in the past. So imagine the flexible resources that you can now bring to bear on any challenge you face. Just as you should be embracing new technology, you should be welcoming new kinds of talent.

Here's my last point about what we need to do to really embrace the changes that are coming. I've talked about machine learning, but what about human learning? Today the increased speed of change is creating pressure on all of us to learn more quickly, and if you're going to keep up with tech and talent, you're going to need to upskill at the same pace.

If your education stops when you get that one monolithic degree, you're doomed. In this dynamic environment, you can never stop learning because ongoing learning is the antidote to fearing technology and new talent and embracing and using it instead. New technology, new talent, new ideas-- for millions of years we've been using this powerful combination to shape our world, but never before have we had such an abundance of opportunities, so many things to learn, so much to debate, to incorporate, to create.

You've made a great choice by coming to AU this week. Right here, right now, this morning, we are all living in the earliest moments of an amazing new chapter in the history of making things. And AU is the perfect place to explore one critical question. What role will you play in the future of making things? Thank you.

[APPLAUSE]

ANNOUNCER: Ladies and gentlemen, please welcome, from Mass Design Group, Christian Benimana.

[APPLAUSE]

CHRISTIAN BENIMANA: Good morning. I come to you from a small country in the middle of Africa, a country of a thousand hills and the best coffee in the world. That's a true fact.

Now I've always dreamt to become an architect, despite the fact that I never met an architect in my life, and my country Rwanda didn't have a school of architecture until I was 18 years old. So you can imagine my life path until I was 18 years old was pretty simple-- graduate, go to university, go to medical school most probably, get married, have kids, build my own house, work for a government run hospital, and live happily ever after, right?

Now you must be wondering how I became an architect. So when I was about 19 years old,

that in 2001, I applied for scholarships abroad, and I was accepted at the College of Architecture and Urban Planning of Tongji University in Shanghai, China. But first I had to learn Chinese in about 12 months.

You're still wondering how I became an architect. But remember that time China was going through a major transformation, in terms of architecture and design, to support its incredibly rapid development. But together with all that rapid transformation, China was facing three major problems among others that seemed familiar to me.

The first challenge was to design with environmental issues in mind. The second challenge was to deal with massive population, especially in urban areas. And the third, and this is an important one, was to develop the talent needed to design and build contextually appropriate infrastructure and buildings.

Now I have to tell you when I went back to Rwanda in 2010, I had a very serious case of deja vu. Because all those three Chinese problems that I saw when I was at school, are also problems in my [INAUDIBLE], problems that Rwanda has or African problems. And today I'm just going to focus on the problem of population growth and urbanization.

The population of Africa is set to reach 2.5 billion people by 2050. Now to give you an idea of what that means. It is the current population of China and India combined. Now the infrastructure needed to accommodate such population is huge, and to put this into perspective, by 2050, when the population doubles, we'll need to build more than 700 million new housing units, more than 300,000 primary schools, and more than 85,000 health centers.

So now the question is how do we build all of this? Do we follow a model that worsens our environments and reinforces the economic and social injustices we've seen in the past, or do we adopt a new model of equitable and sustainable development? Now I chose the latter when I joined Mass Design Group. Now we at Mass, our mission is to research, build, and advocate for architecture that promotes justice and human dignity.

In all of the best examples of a project I'm going to share with you today that exemplifies this philosophy is Butaro District Hospital. Now in 2006, before this hospital was built, this district did not have a single doctor. But we saw Butaro as an opportunity to take a closer look at the health care delivery system in rural settings in the global south. And then instead of just designing the buildings that are going to house this hospital, we looked at the larger issues that our designer would have to address and then tried to address as many as we can.

One big issue is the threat of airborne infection control in rural hospitals in Africa and everywhere. So we took advantage of the hilly terrain of Rwanda and the beautiful climate--because they have the beautiful climate in the world. We designed a fail-safe passive ventilation system that minimized the risks of contamination from these nosocomial diseases.

We also took it upon ourselves not only to design a patient-centric hospital, but there's a challenge. Some of traditional approaches that are actually proven to hinder patients recovery. Simple things like flipping the beds in open wards so each patients can have a view to the beautiful landscape outside improves patient's recovery time.

And the DNA of how Butaro Hospital was designed and built has gone on to inspire other countries to rethink how health care delivery in rural areas in Africa works. We are now working with the government of Liberia and the government of Rwanda to redefine the new standards of rural hospitals in order to provide dignified health care.

Five years after Butaro hospital was built, Munini District Hospital is going to be the first hospital to be built in Rwanda, carrying with it these improved design standards for the country. And now we're completing the design of [INAUDIBLE] District Hospital because these lessons we learned in the rural areas are also informing how we build hospitals in the city.

So we can see we've had some successes, good successes, with Butaro Hospital and our other projects, but we realized that needed to be scaled on a systemic wave. And to do this, we established the African Design Centre because listen to this. The African Union of Architects estimate that on the continent of Africa there are about 35,000 practicing architects. The country of Italy alone has four times the number of professionals. But we know training architects and graduating more is not enough in these modern times.

That's why the African Design Centre equip graduates with both hard and soft skills to prepare them to tackle the most pressing global issues of the future and to empower this new generation of architects and designers to scale what we call the Locally Fabricated Movement. Now the LoFab approach to project delivery is deliver that we are going to use to empower the communities we work for and with. And there are four key principles to look for.

The first one is to hire locally. The second one is to source regionally. The third one is to invest in training and knowledge exchange as much as you can. And the last one, and this is very important, is to always, always, always uphold human dignity.

The design fellows at the African Design Centre learned to understand the link between decision making at policy level and at on site project delivery during capital project implementation. We do this through three tracks, design research, and advocacy.

Now through design there is an undeniable need for architects and designers to understand the whole project delivery process, and the potential that both the design and construction process persists to change and affect human lives. From design initial concepts to production of working drawings, some times unconventional because the context dictates, to material sourcing, processing, assembly. We want them to master the art of delivering good designs, to even those who would otherwise have no access to such specialized professional services.

Through research, we want them to understand the potential of human talent. And we're building technologies, materials that already exist that we can tap into for localized creative solutions. And through advocacy, we want to equip designers with tools for communication to promote the use of advanced technologies and capabilities with the aim of two things. One, improve fabrications practices around our project. And two, improve the existing or teachable human skills. We want to prove that dignifying solutions are achievable.

Not the future of education needs to be versatile because let's face it. The speed of change in technologies and human needs is precedent to nothing we've known as a human race. That's why the African Design Centre is an institute for continued education and the research hub where global talent can come to tackle the most pressing global issues, like climate change.

But the African Design Centre is also a cultural hub where the potential and diversity of all different cultures is valorized, exhibited, and celebrated. The African Design Center is also a think tank so this bigger conversation about the future of architecture and design can take place.

Now you just heard Jeff talk about the need, not only to embrace new technologies and new talents, relationships, but also to keep learning as those two things evolve. That's same kind of thinking is why we started African Design Centre, and that why will work with similar organizations worldwide.

We're excited to learn and teach each other the best there is in technology and design, engineering, and architecture. We all need to be agents of positive change, not because Africa needs it, but because our planet needs it. Because we all need it. Ladies and gentlemen,

thank you very much.

[APPLAUSE]

ANNOUNCER: Ladies and gentlemen, please welcome CEO Carl Bass.

[APPLAUSE]

CARL BASS: Thank you, Christian. That was great. Before I started this morning, I just wanted to introduce you to one more speaker. Now Jeffrey and Christian have been talking about the future of technology and about the future of work and about the future of education.

But for me this next speaker is the future. She's been collaborating with teams as a robot designer for the past nine years. She's founded her own nonprofit supporting girls in science, technology, and math. She's a high school junior from Oregon. She's 16 years old. Please welcome Anna Nixon.

[APPLAUSE]

ANNA NIXON: Thank you, Carl. Hi everyone, I'm Anna Nixon, and I'm currently a junior at Westview High School. Now many of my classmates tend to complain that we aren't learning anything useful in school, but I'd like to disagree. I think that every subject is important in its own, right whether it's literature, chemistry, or calculus.

The reason that so many people seem to find some of these subjects a waste of time is because we're rarely given the chance to apply them. John Dewey, often regarded as the father of education, one stated, "We only think when confronted with a problem."

This is why students need to be given the chance to apply their skills before they can feel satisfied with their knowledge. FIRST-- For Inspiration and Recognition of Science and Technology-- is a program where students get the chance to do exactly that and more. Through the FIRST program, students are given a chance to apply all the skills they learn in and out of the classroom by building robots to compete in fun and exciting challenges.

There's nothing more inspiring than that moment, where after hours and hours of hard work, you finally get your robot working. Or that moment when your whole team is jumping up and down cheering as your alliance scores the winning points of the match. FIRST is divided into

four different sections so that students of all ages can get hands on experience with technology.

Each year different challenges are released for students to solve by engineering robots. These challenges help keep learning fun and interesting, keeping students engaged while they learn everything from CAD and CNC milling, to wiring robots and even computer vision.

Now I'd like to introduce to you one of the robots that our team built for the 2012 challenge, Rebound Rumble. His name is Prometheus, and he's actually a pro basketball player. Prometheus was built for a challenge where we were competing in a field where there were different basketball hoops and the different teams would compete to shoot hoops-- as many hoops as possible-- and whichever alliance scored the most points would move on to the next round. Prometheus actually did really well during that challenge, and we made it to world's with this robot.

Sorry, it seems like Prometheus is having a bad day, ha ha.

So I've been involved in this program for over half my life, and it has shaped me not only as an engineer, but as a person. I started Junior FIRST LEGO League nine years ago when I was in second grade, and I've participated in every level of competition since then. I've learned not only about technical skills, but I've also learned how to be a strong leader, work with a team, and communicate my ideas.

FIRST has made me much more interested in pursuing a STEM career, and I wanted to share my enthusiasm for science and technology with others. So I've co-founded STEM4GIRLS, a 501(c)(3) nonprofit organization dedicated to inspiring girls to pursue opportunities in science and technology.

Now although I have been able to tell you my story, hundreds of thousands of FIRST participants have been able to grow because of this program. And now every single one of you has a chance to get involved in bringing up the next generation of engineers. You can get involved by signing up as a mentor, coach, or volunteer. Teams are always in need of people with expertise to give kids the best guidance they can get.

I'd like to give a shout out to Autodesk here. They are one of the biggest supporters of FIRST. Kids like me have access to opportunities like these because of people like you, and for that, I

can't thank you enough.

Now why does this all matter? Why should all of you care about this? Because students like me, we are the next generation of designers and engineers and builders.

I'd like you to take a look at the picture on the screen. This is a picture of one of my younger sisters. I actually have two of them, but they're twins so if you've seen one, you've seen them both. Now in this picture, she's less than a year old playing around with the clunky desktop at home.

I'm not showing you this picture to show you how cute my younger sisters are. The reason I wanted to show you this picture is to illustrate how we are a generation that has grown up with technology. We are a generation that has been using technology before we could talk or even walk properly. We are a generation that has grown up in a world where technology is everywhere and accessible to anyone.

The internet is probably one of the most influential technologies of our time. Around the world, over 3.5 billion people are online using the internet to get news, complete their work, or simply for entertainment.

And because of the internet, teams are no longer limited by time or location, since everyone is accessible 24/7 from anywhere in the world. Some of the teams I've been on in the past actually had the ability to collaborate with experts from all over the globe to learn new skills and create high quality robots, and this is exactly how we want to work when we enter the workforce in a few years.

As Jeff pointed out, technology has also brought unprecedented change across industries. Many of the jobs of today won't exist in the future, and many of the jobs that will exist 10 years from now have no place in today's world. Technology is changing where we work, how we work, and what we work on. And since the very nature of work itself is changing so quickly, the most valuable asset to a future worker is going to be the ability to learn and to learn fast.

This idea of ongoing learning that Jeff and Christian talked about is very real for my generation. So all of you need to figure out ways to keep learning interesting in order for the next generation of workers to stay excited and productive. And the tools that we'll be using are another important part of keeping us productive.

Since I'm here, I'd like to take this opportunity to make a few requests for you, Carl. Unlike

workers of the past the workers of the future simply won't have time to invest in learning a whole bunch of very complex tools, yet we're going to expect the same capabilities and performance from these tools. This means we need efficient tools that we can learn quickly, and those tools have to be able to learn along with us.

And perhaps the most important thing we need from our tools is for them to support the way we work. I've never worked on an engineering project alone. Ever since I started building robots in second grade, it has always, always been a team sport, and I want tools that let us design our products together as a cohesive unit.

Plus in the future, we're not just going to be designing machines or blueprint for buildings. We'll be designing one-off custom products for the masses, engineering new food, and even body parts. We'll be creating experiences that no one's even thought of yet. And for that, Carl, we're going to need some pretty amazing tools. So what do you say? Are you up for the challenge?

Now don't think the rest of you are off the hook just yet. I have another challenge for all of you too, but don't worry. This one's really easy. You see, there's almost nothing that our generation values more than our voices is being heard. I mean, that's why we're on Twitter, Instagram, and Snapchat all the time. What we want is for you to consider our ideas, no matter how ridiculous this sounds because those crazy ideas could very well be the realities of the future. All I ask is that you keep an open mind. Thank you.

[APPLAUSE]

CARL BASS: Thank you, Anna. When you think about it, given the exponential way we decay and the exponential thing of robots, I may still have, let's see-- maybe three more months before Prometheus can kick my butt in playing basketball. So Anna thanks for challenging all of us, and you know what, I accept your challenge. We're going to build the tools you need to shape the future.

So when we speak about the future, it's really funny. Year after year, I've been on this stage with Jeff, and I have something to confess. Sometimes, maybe even most of the times, when I listen to what's being said on the stage, it seems like science fiction. And I bet to some of you it seems that way too. It feels like this stuff will take years before it becomes practical for you to use. Maybe, maybe even never.

But here's something else I've noticed. As crazy as this stuff seems at the time, I come back a few years later, and many of you are actually doing the things that we were just speculating about. You're doing today what a few years ago seemed totally impossible.

So for example, just this year, our customer SpaceX launched history's first reusable rocket, we delivered beer autonomously, and Zaha Hadid, who we unfortunately lost this year, brought us a beautiful building that's being manufactured, not built. And so I want to thank you all for taking these ideas that we've been presenting over the years and making them real. This willingness to embrace new ideas, to change the way you think and do your work, that's what it's going to take to succeed in a future that's all about change.

So Jeff talked about the new technologies, and he talked about the new dynamics around talent that are going to affect all of us. There are a lot of other industries that are facing similar challenges that I think we could all just spend a moment, and we can learn from these other industries. So let me give you my current favorite example.

In the last 12 months, I've met with more auto executives than I probably have in the last 12 years. And so why are they suddenly reaching out for answers? And the reason is because they're anxious, because the world around them is changing. Now there are three important things that are transforming the auto industry right now-- autonomous cars, car sharing, and electric powertrains. Now some of the car companies are being really proactive about these changes, and some of them, not really.

So let's start with this idea about self-driving cars. For a hundred years, car companies have been obsessed with creating a great experience for drivers. The feel of the car, the responsiveness, the power, the comfort. Some have even claimed to have mastered the ultimate driving experience.

But when cars drive themselves, there there's no such thing as the driver experience. They need to build the ultimate passenger experience. So how do you do that? They need to get good at building complex sensing and control systems. Their new cars will need software that responds to the world in milliseconds. They have to gets smarter the more they drive so that they don't make the same mistake twice. Essentially these cars just can't be building-- these companies can't just be building cars. They need to be building drivers.

But wait, there's more. Not only do we stop driving in our cars, we may actually not own them

either. Most of the people I work with who are under 30? They don't own a car, and they don't want to. And it's not because we pay them poorly. It's because they get around with kick scooters and Uber and car sharing.

That's what's really scaring the crap out of all the auto execs I've been talking to. For a hundred years, car ownership influenced everything the industry did. They design cars to be sold to drivers. Their strength was in their massive distribution network.

Last year alone, Americans spent almost $600 billion at car dealerships. So now car companies have to figure out how to thrive in a new world where people don't pay to buy cars but pay to access them instead. Instead of buying one car from a dealership that you'll own for maybe a decade, you'll start thinking about transportation as a service.

And it's a service you'll get from a range of providers. For example, if you need to get across town, you can get that car that does 40 miles an hour from Google. If you had on a long trip on the highway, maybe the Mercedes that does 180. That's more appropriate. Now companies that embrace this change from ownership to access-- these are the companies that are really going to win.

Now it's funny. Five years ago, I was talking to auto company, and they were unbelievably dismissive of electric cars. They were making fun of them. They said electric cars were a crazy California idea. It wasn't going to go anywhere, and that company spent a bunch of years totally in denial. And now where are they? They're struggling to catch up.

And so even though, I am personally a crazy Californian, I understand why they dismissed electric powertrains. If you've spent a hundred years learning how to make the best engines and transmissions, that's how you see the world. If you only have a hammer, every problem looks like a nail. If you're great at something that's about to become less important, it's almost impossible to see that new thing that's about to become essential.

So if you're great that internal combustion engines, how do you make the transition to electric? Well, I would suggest you experiment. Think about those naysaying auto execs. What they should have done is create a small team and send them off to build a car with an electric drivetrain. That way they wouldn't be on the sidelines today. They would have been-- they would have gotten the experience, and they would be right in the game today.

And so what lesson can we take from this? I think it's this-- that regardless of the scale of your

company, you still need to experiment. Now R&D doesn't need to be this really large research and development facility. It could be just Rachel and Dave. What's important is that you're proactive and not to be afraid of what these seemingly crazy new ideas.

So this is just one example of an industry dealing with three massive changes all at the same time. And that's what we crazy Californians call disruption. Most of us when faced with this, we want to ignore it, or we even want to run away from it. But that's actually the thing I think you need to run towards. The thing to understand is that disruption can be the source of new value. It might really be what makes your company great in the future.

And that's true across industries. It's true in the software industry. At Autodesk, we're facing disruptions. One of the disruptions that's most prominent you heard about this morning. It's machine learning. Now Jeff talked about machine learning as a design tool, but what about machine learning to design new software?

You know, in the past, we used to write code, and the program will do exactly what you told it to do forever. The only way to make that program better, other than rewriting it, was just to put it on a faster computer. Now today this kind of deterministic software programming is being totally replaced by machine learning.

So for instance, we can now use algorithms to understand the work you're doing and monitor how you use your software. Then that software can customize itself to become exactly the tool you need. So some of this is already real. It's available now in Design Graph on A360.

We can recognize the designs you're working on, based on their shape or based on their function, and show you all the other things that look like it or relate to it or even work like it. So for example, if you have a bolt in your design, it will show you the nuts and washers appropriate. It can also make really good guesses about what you're going to need next, and point to you designs that already exist so you don't really need to reinvent that proverbial wheel.

Here's another way we're using machine learning. This example is not about designing more efficiently. It's about making things more efficiently. So one of the biggest headaches for machinists is figuring out the cutting parameters that they need to run their machines. Speeds and feeds. Master machinists spend their entire career trying to hone this kind of dark art, but this summer, some folks at Autodesk figured out how to use machine learning to automate the feeds and speeds.

So now that the engineers and machinists don't need to worry about that anymore. The algorithm just figures it out for them. So this is just a glimpse into the future of machining and machine learning.

Now as Autodesk tools go into the cloud, they're going to be able to learn from your digital designs, from how you work and from how you make things. Unlike the tools of the past which just stayed the same and never got better, these tools will learn from their experiences and from yours.

So here's something else that's changing at Autodesk. And this is for Anna. We are not building tools for you anymore. We're building tools for your teams. And that's just a huge shift. For 34 years, we got really good at building tools for individuals. And kind of like that car company that's really good at combustion engines, we have to look past our own expertise to a new generation of tools that make teams really more productive.

So think about it. It's like sports. Unless your team is collaborating well, you can't even compete, much less win. So when people communicate changes, and they anticipate needs, and they respond together to a changing environment, then the outcomes are successful.

So here's a video I really like. I think it sums up a lot of what you've heard today. Approaching problems differently. Using technology to make new things and new ways. I'm being proactive in the face of change. This video is all about teamwork.

VIDEO: --but Holland comes in for a pit stop. Time to refuel and change tire. Lou Moore himself changes the tires. Only four crew members, including the driver, are allowed to work on the car. It's a tense time. Holland stays in his seat, anxious to get away. Let's watch.

The tires are changed at last. A crewman polishes the windshield as Holland moves away just 67 seconds after he stopped.

[APPLAUSE]

CARL BASS: So that's how effective I want to make your teams. By the way, I got one question. Do you think everyone in 1950 spoke like that? Or was that guy like the Morgan Freeman of the 1950s?

So tomorrow morning, right here on the stage, Omar and his team are going to walk you through the latest tools we have to help you design great products, build the buildings of the future, and engineer the infrastructure that's going to hold it all together. So as you listen to Omar tomorrow, and during your whole week at AU, look around for all of-- all the disruptions, and all the opportunities that are happening in your industry.

Look for ways to go beyond your own expertise and get to work on the future. AU is a perfect place to start. Have a great week. Thank you.

[APPLAUSE]

ANNOUNCER 2: Autodesk University 2016 is just beginning. Please join us in the exhibit hall this time for of the future of making things.

[MUSIC PLAYING]