



Stanford eCorner

Find Your Niche, Help the World [Entire Talk]

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National Geographic Explorer Shah Selbe describes how much Earth needs technologists with an entrepreneurial spirit to address global challenges and conserve the planet's resources. A spacecraft-propulsion engineer by training, Selbe shares profound experiences from expeditions in the wild and calls on the next wave of innovators to find their passion and realize that opportunities exist everywhere.



Transcript

Thanks, Tom. You know it's really great to be back on this campus. College campuses, specifically Stanford, have like this great optimistic energy about them. So you will know what I mean once you graduate and leave and come back. So yes, as Tom said I'm Shah Selbe. I'm an Explorer with National Geographic. So more specifically I'm an Emerging Explorer, which is this program that they have where they look and they find researchers or scientists or artists or even engineers that are doing something that they think could potentially have a big impact on the world and the future and they bring them into their Explorer family. So it's pretty cool that I get the opportunity to call myself an explorer and other explorers are people that you all have heard of people like Sylvia Earle and Jane Goodall and Bob Ballard and E. O. Wilson, really, really cool people.

And the other really great thing about it is, it's fairly difficult to get in. You get nominated, you can't apply for it and they do this big vetting thing behind the scenes and give you a call one day and ask you to be part of the family, which is cool. But it also sometimes ends up people thinking that they're getting prank called, so they don't take it seriously. So I'm just going to kind of jump in a little bit and then I will tell a little bit about my story, but I cannot stress this enough like we are living in an amazing remarkable time with opportunity being literally everywhere, which is why I put up this picture because the time difference between what the picture in the left and the picture in the right is actually not that long, and it's accelerating. You know that it wasn't too long ago where if you wanted to be an inventor, entrepreneur, you couldn't really do it without access to a factory or a ton of capital. But now you can basically design something and print out a prototype on a 3D printer and send that file off to get printed in a world class factory, all without leaving your couch. So it's a pretty amazing time to be alive and that's kind of a theme that's going to go through this talk of mine is the fact that there is lots of opportunity out there and a lot of that opportunity kind of tends to be in places where you don't expect it to be. So another speaker that came to this lecture, I think last year or the year before was the CEO of Box, Aaron Levie and he had a - he sent out a tweet the other day that I thought was awesome. He basically said the tech right now is basically an entrepreneur's time machine. So every company and industry created from the 1890s to the 1960s is being rebuilt digitally.

I would like to add to that is to say that there is even industries and ideas that we haven't previously thought that tech had a place in that, that are being rebuilt now, but there is a lot of opportunity now and it's really up to you to take it. And Stanford is a wonderful place to do it. This is where my story of this started and I will tell you a little bit about that as I go through. But I also want to say, being in the Silicon Valley to try and think beyond the Silicon Valley bubble, there is lots of issues in this world and lots of opportunities that need to be fulfilled by bright minds like yourselves and sometimes that's going to happen outside of the San Francisco, San Jose little bubble. So my story, now I went to school for engineering specifically chemical engineering. But I don't know maybe it's like a lot of you guys, but I didn't know what I wanted to be when I grew up. I knew that I liked technology and I liked toys. I was a little kid that was breaking everything, all the electronics of my parents because I'd try and take it apart. And then when I went through high school, I didn't have a lot of guidance on what was out there, what the

possibilities were out there and I got into cars and mechanics and I liked chemistry, I liked physics, so I put those two things together and I went to school for chemical engineering. So after I went through my undergrad, I went out there and I started looking for the jobs out there and what I could find for a chemical engineer, really was only water treatment jobs.

And I don't want to - I want to just preface that. I think water treatment is a wonderful career and it actually winds its way into my story, which is why I brought it up right now. But it wasn't something that I felt particularly inspired about at that time. So I started looking at grad school and during that time I got an internship at Boeing. So that kind of brings me to the first point that I wanted to get across, and that's get industry experience. If some of you guys are earlier in your career, I would say go out there and get an internship somewhere. I know that being an intern isn't necessarily the most fun thing with a lot of companies. They usually give you the kind of the crappier things to do. It's the thing where in a company if there is something you don't want to work, you just pass along to the interns, so they have to take care of it. But I guarantee even if you're doing crappy things in that job like the lessons that you'll learn from being in that kind of industrial setting inside of a company will stay with you for the rest of your career.

So it's definitely something that I think you should push forward and do. And that's what I did when I got that internship at Boeing. I worked really hard and got hired into Boeing halfway through that internship opportunity. And so I want to stress right now that there is ways at being entrepreneurial while you're still at a big company. You don't have to do a start-up thing and be an entrepreneur. You can be - have an entrepreneurial mindset when you're working for a large corporation like Boeing. And the way that I want to explain that is just kind of through this chart and if we just imagine for a second that when you look at a big company, especially one that was like born of maybe like an older industry, so someone like aerospace, a big engineering company a lot of times you get two main types of people there. And let's call those people techies and jobbers. So jobbers are the people that come to the - come to job - come to their work everyday only 9 to 5 and they just - they're coming to it for a paycheck. They don't want to get anything outside of that.

There is not anything necessarily wrong with that. I mean, there is more to life than just work, but that was never me. I was never of that jobber type. The other people are the techies and those are the people like the brilliant engineers, the specialists, the program managers, the types of people that want to become very, very good at one thing and they care very much about that, but they really don't care about anything else in the company. Now the interesting thing that I've learned about being in a company full of jobbers and techies is that if you are entrepreneurial minded and you want to do things, basically both those groups of people move aside and let you do it. They won't stand in your way. And if you do it in the right way and if you think about it in the - the correct method in terms of trying to change things in a company, you can get the resources of a giant corporation behind you, which can be pretty beneficial. So the opportunities I have had at Boeing in the last 10 years have been amazing. I have been kind of in charge of the engineering and design for multiple space craft, the propulsion system specifically. So I'm a rocket scientist or a propulsion systems engineer.

I've gotten to be part of a team that launched over 11 spacecraft and worked the mission control. Many of those times I was lead propulsion engineer for that. And when you get to do that, you get to do things like sit - cool things like sit in mission control and say propulsions go for launch, doing the countdown. When I did that I could check that off a bucket list that I didn't even know existed, because who has that on a bucket list. And I got to learn quite a bit about the different things that you can do in that industry. It's been a really, really wonderful opportunity. And then the other good thing that came out of being at a big company was that I got my education all paid for. Boeing had a phenomenal education program and I went to graduate school at USC here at Stanford, all without having to pay a dime. So that's a really amazing thing that big corporations allow you to do, because they can kind of absorb those costs. So the one thing I would have to say though about working at a big company, and that you really have to keep track of and make sure it doesn't happen to you is get too comfortable.

The problem with working at a company like that it's very easy and you don't - a lot of times it's easy to go into that comfortable lifestyle and enjoy happy hours and all that stuff. The next thing you know all that entrepreneurial energy you had deep inside of you has kind of gone out, that fire has been put out. So the one thing I would say is kind of hold on to that fire, don't let it go out. So I wanted to talk a little bit about engineering, because this is something that I talk about a lot. I feel like engineering is in a little bit of a crisis of character, but thankfully now with tech being cooler, it's starting to change a little bit, but I'm a firm believer in engineering's ability to change the world, and so I'll talk a little bit about that. A lot of times when people talk about engineers like when you see how they are portrayed in the media or on comics and stuff like that, they're always kind of the nerdy people, the introverts, the ones that don't really talk to people very well. They are the Dilbert for those of you that are old enough in the audience know who Dilbert is. But I want to say engineers are much more than that. Leonardo da Vinci was an engineer. I have Ada Lovelace there, the daughter of Lord Byron, she was the first computer programmer and the Wright Brothers' technology turned us into a global society.

So engineers are the ones that create the society that we live in, they create this - the built society that you and I enjoy every single day. They give us the tools to solve humanities greatest mysteries. They save lives. There is lots of stuff that engineering does behind the scenes that it don't necessarily get credit for and in my opinion there is a lot more that you can do

with engineering that we haven't quite tapped into so, including marketing it better. So, while I was really excited about the work I was doing at Boeing, I was technically challenged by that kind of stuff. I still tried to find something where I felt was maybe more aligned with kind of the amazing nature of what an engineer is to me. And during that search is where I found Engineers Without Borders. So I don't know if any of you guys have heard about Engineers Without Borders? I know Stanford has a similar organization called Engineers for a Sustainable World. But basically it's a humanitarian organization. And the purpose of Engineers Without Borders is to use engineering to help solve the problem that we have across a lot of this planet, which is people's lack of access to things like clean drinking water, sanitation, and electricity.

It's a really great organization. It was started in 2002 by Bernard Amadei, who is a professor at University of Colorado, Boulder. And when I found out about it, I wanted to learn more and kind of work towards it. So I also know Scott Harrison came here and he talked about Charity Water. So you guys might know about a little bit of the statistics behind what the problem is, but there is over 2 billion people over this planet that don't have access to those fundamental human rights things like clean drinking water and sanitation. So a really important thing to work on. And so what EWB does or Engineers Without Borders does is they basically operate mostly in professional and student chapters and the organizations team up with a community for a number of years. And you will go over to the community first for a assessment trip and you will see like what kind of problems they're really facing like, maybe their drinking water problem is tied to something else more serious and it's something that an engineer can come back and look at. Then you will come back and you will do some design and some analysis with the rest of the team state side. Go through a designer view and have a PE or a professional engineer sign off on it and then you'll go back over into the community and you actually build what it was that you ended up designing.

So I have had the opportunity with Engineers Without Borders to work on projects in Mali, Malawi, Tanzania, India, Thailand and Mexico. So it's been a really cool opportunity and quite a bit of fun. So that brings me to the second lesson that I wanted to talk about, while I was here today, and that was to volunteer for something. A lot of the times people don't volunteer because they think that it's going to take a lot of effort, but I want to stress that like if you put yourself out there and you find a cause, it doesn't matter what the cause is, there are so many issues out there that need our help. So if its something that speaks to you and doesn't speak to another person then still go through with it, but I really want to stress that the feeling that you get, the impact that you get out of working on something without expecting something in return, it has profound effect on the person that you are and the things that you end up doing with your life. And if you want to look at this in an entrepreneurial sort of way, if you want to end up working on this problem or working in an industry associated to that problem through volunteering is - you could really start to understand the problem more deeply and gain credibility in talking about that. So I volunteered for Engineers Without Borders for a number of years. Didn't really have any expectations other than I wanted to really do some good work and I wanted to try and help some people. I wanted to solve that problem that I said about the 2 billion people who lack access to those fundamental human rights. And so basically I went into it and I just - I worked hard on that and I ended up rising up through some of the ranks in the LA Professional Chapter and I did stuff in the Regional Chapter.

And it was a lot of years where I was trying to convince a lot of the other engineers at Boeing to come and join me and a lot of people didn't want to do it, because they are afraid that it was going to take up too much of their time. But the great thing about volunteering is that it only takes up as much of the time as you want to give it. So after years of talking to everyone about it and telling everyone at Boeing to join Engineers Without Borders, I actually ended up getting a little bit of recognition for it. And so Boeing named me their volunteer of the year, their exceptional volunteer of the year which is out of 170,000 employees it's the person who wins that award. And I got to fly to Chicago and meet with the executives out there and have lunch with the Los Angeles Mayor and lots of random things like that, but the reason why I wanted to bring this up was because in the whole mindset of using kind of entrepreneurial thinking in a big company, I used that opportunity to talk to Boeing, talk to the management at Boeing and kind of convince them that they need - that the things that Engineers Without Borders wants to do and the things that Boeing wants are kind of one and the same and they should kind of look at that a little bit more deeply. And they did, I mean, Boeing ended up getting behind Engineers Without Borders in a big way after that. They sent their entire executive Council to Management training which was important because EWB grew fast. They started in 2002 and in nine years they started from one chapter, one professor, in the University of Colorado, Boulder and in nine years they had 12,000 volunteers as part of their thing and they couldn't quite keep up. They also added - funded some board positions on the thing and they gave away \$1.1 million in grants to projects. So both EWB and all the communities that EWB supported were better off as a result of that.

But I'm going to tell you a little bit specifically about one trip that I took and this is an implementation trip to southern Tanzania. So the village we were working in was Ipalamwa, you see it up there in the corner, it's about eight hours from Dar es Salaam. Eight very rough hours, it's not an easy trip. But we were asked to come and talk to the community and help them with their problem, which was water. So this community is in the Southern Highlands and they said it's a very hilly terrain, it's very different than any of you guys thinking about the Serengeti when you think about Tanzania. It's a completely different environment down there, which also means that it's a difficult environment for dealing with the transport of water. We were asked specifically to come to the school and help with the water situation at the school. So the school is at the highest point in the village, which basically meant that all the students would have to spend a couple of hours in the beginning of their days,

everyday hiking down to the catchment, filling up those 5 gallon buckets and bringing them up to the school, so they can have enough water to drink and cook with for the entire day. This was time that the kid should have been spending in class, but they're really just spending it moving water. So we designed a rainwater catchment and filtration system.

Luckily the area that we are working in had ample rain and we can size this thing big enough that it's basically will cover a lot of the school year. So that was our plan to go in and build that thing. Now we ended up going to a city of Iringa, which is nearby it's kind of the closest construction town in the area to try and gather some of the supplies. And in doing that we found that a lot of things that our stateside team assumed that would - we would find fairly easily in Tanzania were not found at all. And so we had to do a lot of kind of reengineering, the recalculating on the fly which was both exciting and frustrating at the exact same time. And the roads going back were very small and kind of curvy and so this is just a quick snapshot of one of them, but when we took that truck back it had a lot of difficulties getting around these roads. We had to slow down and take the turns really slowly. And one of those turns when we were taking it we ended up finding a similar truck facing the other way that was broken down on the inside of the turn, which would not have normally been a big problem. But the issue was that the other side was a big steep drop-off, and so we had to figure out a way to get the truck around the broken down truck without falling into the steep drop-off. And the method that we ended up using was getting all the guys that we had to hang on the side of the truck that's on the inside, so that as we slowly went around the truck, they didn't slide off side of the cliff.

So that picture of 13 guys hanging on the inside of a truck to keep it from falling off a cliff is something that I won't forget for a very long time. And also the gear box kept on slipping. So as we were going up the steep inclines, we'd have to repeatedly throw that log underneath the rear tyres. It was a bit - really big long process, but finally we ended up getting to the school and unpacking all the materials and started on what ended up being a very frustrating build. So things didn't end up getting any better at this point, none of the tolerances were correct. Everything didn't go together the way that we wanted to. The sand for the filter was way dirtier than we ever expected it to be and so it started to get hard. We were a bunch of - we were four engineers and a bunch of villagers that were working together on this thing and tensions were getting high and this was mostly because we didn't know if we can finish the build in the time that we allotted for it. Even that down to the nails that we would use, we would try and bang the nails into the wood and the nail would just bend in half and shoot off into the distance. And so we started kind of getting a lot of - we were getting - there was a high tension in the air about this kind of build.

But I do remember one day where we ended up walking out from the school yard and I looked over and kind of - we saw everything sitting up there finally put together. They had - while I was inside working, they had put the tanks up on those stands and that was the day where it kind of felt like okay, we're going to finish this thing. Everyone had this like whole sense of relief that washed over them and it was a very, very happy day. Well it turns out that that same day ended up being my birthday. It fell on my birthday. So we were there in Tanzania. So we went back to the house and we ate the same bland meal that we ate for lunch and dinner everyday. But I remember that meal tasting especially satisfying, because where we were in the build and that we would actually finish this and it would work. So while we were eating dinner, I heard a bunch of commotion outside and the other engineers told me to go check it out and I walked out back to find the entire village in the backyard ready to celebrate my birthday, which was pretty cool. They don't - birthdays aren't a big thing for this village, so the other engineers kind of organized this whole thing.

But we ended up spending the entire night dancing to drums and drinking corn beer under the most amazing view of the Milky Way I've ever seen. So that's a birthday that it's going to be tough to top, even if I don't ever want to drink corn beer ever again. It was gross, really bad. So we finished the project in time. The kids were happy, the principal at the school was so proud of the work that we did that he had us sign a little guestbook in his house and he gifted us one of his prized chickens to take with us. And the system still works to this day. So I just - I want to stress that if it wasn't for volunteering, I would have never had an experience like that. I would have never met people like that. So I say to you, go put yourself out there and see what's out there. Okay, so but it wasn't until I came here until I was at Stanford that I kind of found what I consider my true calling.

So as Tom talked to a little bit while I was here, I was taking grad courses in management science and engineering and I ended up taking Tom's Global Entrepreneurial Marketing course. So I don't know if any of you guys in here have taken that course yet, but a portion of that is you work on a project with a company that comes into the class and you kind of apply entrepreneurial thinking to it and as a result of that you can - you end up - that ends up being part of your grade. And so when I took that class there was one nonprofit in the entire class and it was the Center for Ocean Solutions, which is a Stanford-based organization. And the problem they wanted us to look at was the problem of illegal fishing. So like many of you I probably didn't know very much about illegal fishing. I knew that there was probably some shady fishermen out there and that it was probably contributing to the problem of over fishing in the world. But I didn't realize like what a big problem it actually was. I mean we - it's a \$23 billion industry, illegal fishing is. Since the 1950s when we kind of invented this modern way of fishing, 90% of the big fish in the world have disappeared, that's tuna and shark and everything everyone likes to eat. Our current global fishing fleets are two and half times what our planet can sustainably handle.

And we're just seeing things getting worse, we're seeing fish stocks crashing left and right. And the worst part about this is that most of it targets developing nations, which kind of robs the poorest people of the planet of their food and their income. And a lot of times, they will even take those people and they will put them on the boats as fishers and a lot of these vessels act essentially as slave ships. They don't let the people off the boats, they're out at sea for a long time, they just dump their catch at sea on bigger container vessels, and barely pay these people anything. So it's actually a human rights issue as well. And 2 billion people on this planet rely on our oceans for their primary source of food and income, primary source of protein. So it's a big thing. And lastly, I know you guys have probably heard of the piracy problem that we have in Somalia. Well, that piracy problem really came from this. The guys who are now pirates, the Somalians who are now pirates were originally fishermen and basically illegal fishing off the coast of Somalia was rampant, there was lots of Italian vessels that were fishing quite aggressively out there and they were dumping pollution into the waters and it basically turned all that water over there into wasteland.

And so, you have boats and guns and no government and so what you do, you become a pirate and that's kind of where that whole thing happened. It's really sad. So, me and two other individuals wanted to work with Center for Ocean Solutions on this problem. And we thought that maybe the right answer to their problem was in technology. So basically the way that we protect our coasts now is the same way we've protected them for centuries. Essentially most of the time what we do is, we will get in a boat and we will just shoot out there until we randomly find someone doing something they shouldn't be doing and then they get in trouble for it, which is crazy. And so we thought that there is much better ways to do this. There is a lot of opportunity in this. And so, we ended up working on the project and I was so inspired by that work that I asked the Center for Ocean Solutions if I can continue on as an independent researcher for a number of quarters and I did for three more quarters and then after that I just started working on it for my career. So that's kind of where conservation technologies - that's what's I call it now.

That's where conservation technology came from, that's where my passion for that came from. And so that brings me to the next lesson that I wanted to share, and that's opportunity exists everywhere. And I wanted to stress this because, when I first started this if you would have come to me 10 years ago and told me, Shah Selbe, I believe that you're going to be working on helping wildlife populations in the world, I would probably say to you that I don't have the skills to do that. And then I would never have found out 10 years later that I actually precisely have some of the skills that can help solving some of those problems. So this is an area where I didn't know opportunity exists and it wasn't until I said what I'm going to take this class and I'm going to do this illegal fishing project that I found that there was this huge potential there. So that could be in all - each and every one of your lives. So I want you to all look back at your careers and what you want to end up doing with your life. And think hard and long about opportunity and where that exists, because so often the limits that we put on opportunity are the ones that we put on ourselves or society tells us that it's there. And it takes a little while until you stand up and say it enough times that people say, oh yes, you're right, there is a lot of opportunity there. So a story about that is there was a time where I was sitting in this meeting and it was full of kind of some marine biologists and environmental lawyers and they're all talking about the big problems that our oceans are facing.

And it was in that meeting where I started seeing the things that they were saying and I started thinking that, that seems like there was an engineering solution there or if they only look at what they did in the shipping industry, that could probably help that problem or here is this little technology that can - we can fill this gap. And it was there where I kind of - I was aware that opportunity can exist anywhere. And it's from then that I've kind of moved on through that. So I got to go with Stanford to Palau and we presented an entrepreneurship seminar there, a conference there and I gave a technology plan to the President of Palau, which was pretty cool. I work with the Waitt institute on a project that they're doing in Barbuda and they're expanding it beyond just Barbuda, but it's just kind of a comprehensive mapping of the science and legislation and usage of the ocean around the island. So it's really a neat thing to be able to create all of that stuff from scratch. I work with the XPRIZE to help them map out what the next three grand ocean challenges will end up being and it's this conservation technology work that ended up in me being named one of the National Geographic Emerging Explorers. So this problem is really, really important and the reason why is because it's kind of out of control nowadays. So in the last 40 years we have lost over 50% of the wildlife on this planet, in the last 40 years. And it's happening so fast that it's having a lot of people start to call it the sixth extinction.

So if you don't know much about the history of life on this planet, we have kind of gone through five major extinctions, ice age and things like that. But those other five extinctions were caused by asteroids or natural phenomenon and the sixth one is caused by all of us in this room. So the illegal wildlife trade is the fourth most lucrative trade in the planet after drugs, human trafficking, and arms, weapons. 35,000 to 50,000 elephants are poached annually just for their ivory, so in the last hour - we've been up for half an hour - in the last hour four of them have died. Four rhinos are poached every day and these are small populations, there is five northern white Rhino remaining and there is 35 Javan rhino remaining. And there is more tigers in backyard of people in the U.S. than there are in the wild. To kind of like work on this I have started Conservify which is like an organization that's focused on bringing some of these ideas to fruit. So it's kind of like an idea lab. It's a nonprofit that works on kind of focusing whatever you need to do to develop and test and put these out in the world.

A lot of that stuff is focused around open source approaches, because I find it's easier to replicate and adapt as needed. One of the projects of that is SoarOcean, which is a grant - a project that is funded by National Geographic and Lindblad Expeditions to use these low-cost drones that you guys always hear about all over the news for ocean conservation causes, we've done a bunch of expeditions off the coast and I'm going to do one. I'm going to show a video of one of the expeditions right now. I'm Shah Selbe, I'm an engineer, ocean conservation technologist and an Emerging Explorer with the National Geographic Society. This weekend we are in San Simeon, on this the beautiful coastline of California. We are here because I'm the principal investigator for a program called SoarOcean, which is a grant that is funded by National Geographic and Lindblad Expeditions to use low-cost UAV or drone technology to monitor and protect our oceans. The value in using UAV technology or drone technology for ocean purposes is, there is a lot of reasons why we need to get an aerial vantage point in order to collect more data about our ocean and something that I specifically focus on is how to stop things like illegal fishing and poaching of our ocean wildlife. It's often way too expensive to fly unmanned aircraft and the resources are limited. A lot of times this role falls to the military, but I believe that communities can be empowered to collect the necessary data and help the authorities to better protect these delicate species that we have in our coasts. Hi.

My name is Patrick Meier and I'm a National Geographic Emerging Explorer which is how I know Shah, who is also a fellow Explorer. We met last year and we immediately hit it off. We've both got a passion for civilian UAVs or non-lethal drones. I come to this space from the humanitarian side of things. I work on humanitarian innovation through technology. I'm here this weekend to really learn as much as I can hands on from Shah and his team of experts in this civilian UAV space and then learn what it means to deploy UAVs in settings like the one we're at here which is somewhat remote and isolated, you don't have all the tools and electricity and everything else you might need, which is very similar to a humanitarian setting. How do we still deploy these UAVs in a timely way and it really behooves us to go beyond our own field, and to talk and interact with experts in other fields like environmental conservation, ocean protection and learn how they're using new technologies like UAV. So I'm very excited about the future of this innovation technology in humanitarian settings, I think it will literally help us save lives and alleviate suffering where people need it the most. So there is going to be a number of different expeditions. This is the first of at least three with the ultimate goal of ending up in the Channel Islands to try and show the power of using these low-cost versions of drones in long endurance flights of patrolling our oceans.

So a lot of the information behind that is coming out pretty shortly, so you can follow it on Twitter if you want to find out more information. But another project that we worked on was how you can use kind of crowd sourcing to help protect the coasts, so you guys have heard of like citizen science? Well this is like Citizen Protection, so create the tools and the ways that people can work together to create like the neighborhood watch for the seas. This program has - it's been folded into something else that we're working on now that will be coming out shortly. And then the final thing that I work on is a lot of different types of sensors and other kind of open devices that allow us to understand more about the environment and help us protect the environment. So I'm going to tell - show a quick video about one of those projects and then tell you some stories about that. The Kalahari is the birthplace of our human existence. It's a sanctuary of the Saan bushmen, who were to, 100,000 years ago, populate our planet and result in all of us. When you come out here, you get to be part of the cycle of life, the cycle of death. The Okavango Delta is our mother, mother of the Bayei tribe. We depend in the Okavango Delta.

All of the food we have, we get it from the Delta. The source of the Okavango river is on the Bie Plateau of the Angolan heights. This river then flows 1,000 miles down through Namibia into northern Botswana where it finds itself in a delta in the middle of the Kalahari Desert. 27 years of war ended in 2002. The development in Angola since then has been rampant. We are looking at the potential for dams, for agricultural developments, for pumping schemes. All of these things are going to change the flood dynamic in the sensitive wetland ecosystem. If the water disappeared, our tribe, it won't survive anymore, animals as well, they won't survive because they're water-dependent. The urgency is now. We are taking dugout canoes down the length of the Okavango River.

The idea of it seems like madness, never forget where you are. Keep your eyes open, so that you know where they are or you listen very well to hear. We've been living out here, used to sounds of hippos like you can hear behind me right now. Used to sounds of elephants in the distance trumpeting about their who knows what, and we've been part of it, in an incredible way. This place is really special. I want to work to make this place stay the way it is to help this place anyway I can. We can bring that place back. We can turn it again into the elephant factory for Africa. In the famous dictum of Henry David Thoreau - "In wildness, is the preservation of humankind" and it is the very pulse of this planet, and when we lose these last wilderness areas like the Okavango Delta, we lose the beating heart of our planet. I don't know how many of you guys know about the Okavango Delta, that's a kind of a good summary on it, but it's in Botswana and it's easily one of the most amazing places on this planet.

There is lots of concern for the development that is happening in Angola. There is - if you go to the capital of Angola, it's actually more expensive than many European cities that you go to, because of the amount of development and the amount of people who are coming to that city. But this was the Okavango Wilderness Project and so the project lead was Steve Boyes, the person that you saw talking, he is a TED fellow and biologist. He does this multi-year expedition in the Okavango to do

surveys of birds and other mammals. The other guy you heard talking was Gregg Treinish, and he was a National geography adventurer of the year. He runs an organization that does - puts scientists in touch with adventures that are going to go climb Everest and other places to get really hard to find data and Jer Thorp is kind of the data artist. He's a brilliant data artist that runs an organization that's rethinking how we're consuming information in everything. And I am the project technologist, so I help to kind of figure out what technologies we can use to monitor the Delta and make sure that that doesn't actually happen. So we - in doing this we kind of wanted to change the way that scientific expeditions are usually run. In the past scientists would go out on an expedition and they would gather a bunch of data and they'd kind of sit on it and wait on it to publish it and gain all these accolades.

When we went on this expedition, and when we go on future expeditions we want to do exactly the opposite. We kind of wanted it to open it up for the world. So we put all the water quality readings, the sensor readings, the wildlife sightings, biometrics and all this other data out there for use for free on the Web site and through the API, so people can take it and do interesting things with it. We were looking to kind of open source expedition and we're hoping that we can - that the accolades can come from the amazing things that citizen scientists or artists or researchers or students or anybody wants to do with it. So as I said I am building kind of these sensors and they're based off of kind of open source microprocessor platforms and they send the data real time to the Web site. For this last one we put a - just a handful of sensors, kind of prototype versions up in different parts, but this next year's expedition deploying an entire mesh network across the Delta to gather the information that we need. But I want to talk a little bit about the expedition itself, because those 17 days were the greatest adventure I have ever been on in my entire life. I'm not sure if you got it from the video itself, but this was not an easy trek. This was pretty crazy. We were in boats, in little canoes like that surrounded by hippos and lions and elephants and crocodiles, without a gun or anything like that.

And so we had to be pretty careful and not only that, but we had to pull the boats over water for a number of days. Three days this last expedition it could be as much as nine days and there was only a handful of people in the world that know how to get to this really pristine area on land or on water and they were our guides for this expedition. During - while we're dragging that - the boats over the water, we were walking through things like this and there was one moment where I lifted my feet out of the water and I had nine leeches on my legs at once, which was pretty interesting, five on one leg and four on the other. But we got through all these reeds and all this papyrus and we got to the --- pretty much the most pristine area I've ever known in my - I've ever seen in my entire life. It was so much wildlife there. It felt like you were in the middle of a Disney movie, but you could see right here, this is just a front of a huge herd of elephant, there was around 50 elephants there, but also in that picture we have a crocodile, hippos, lechwe and birds and this was everywhere we looked. Just right after this picture, you see a piece of it in the video, but the elephants and the hippos basically gone into an attack on each other, which was pretty amazing just to see right in front of you, it was like you're watching a planet Earth documentary, but it was literally in front of you. And so I don't know how much you guys know about hippos, but they kill more people in Africa than anything - any other animal out there. They are horrible, they're scary. And we were charged by a number of them.

The thing that hippos do is - there was sounds of it in the video, but basically they start, they sit at you and look at you like this and they grunt and they make this noise, it's like, I mean, it's kind of a grunt and it's kind of like an old man laughing if you put both those together and then when they want to charge you they drop to the bottom of the water like onto the bottom of the channel and they run. So you see the head, you hear the grunting and then you see a wake moving towards you and you just have to kind of move as fast as you can possibly move. But the experiences we had with elephants were amazing too. This picture was taken, we were setting up camp one day and our expedition photographer James Kydd came over and he told me oh there is three adults and a baby right over there on the other side of the trees and so I walked over to this tree that I thought was kind of along the path where they would walk and I climbed up into the tree and I started taking pictures. Slowly one by one, each one of the elephants walked right pass me, it was one of the most amazing experiences I ever had in my entire life. I felt like nothing else in the world existed, except for me and these magnificent elephants. But the last one was a bull and he looked over at me and did kind of this aggressive behavior that they sometimes do where they lift their foot and they flap out their ears, and in that moment I went from feeling the most amazing experience I have ever felt to being most scared I've ever been in my entire life. I've never felt more small than sitting on that tree and that thing looking at me, but it obviously kind of thought I was not very interesting and just walked away. So the final lesson that I want to bring to this class is I want to say find your inspiration and that the world needs you. I think that all you guys can potentially find something that inspires you as much as kind of conservation and technology inspires me.

It's all out there for each and every one of you've just got to start looking and try things and so I basically plead you to go out there and put yourself out there and try and fail and pick yourself back up and keep on working on it. The world actually needs your help. We need you. So instead of thinking of entrepreneurship and engineering and innovation in terms of maybe building a better app that can filter things better than Instagram, I want you to think about the grand challenges that our planet is facing. And what you can do to kind of change those challenges, what you can do to start companies or start nonprofits that can really change the tide on where we are going, because we need you to do it. Maybe by doing it you can inspire the next generation of engineers and scientists that go off and change the world and maybe we won't leave this planet off as badly as it

seems like we're starting to put it. So thank you. Questions? So there is an implicit rat race in the corporate world where almost every single bit of energy is given into climbing this invisible ladder and that's the reason I guess you weren't able to attract a lot of other engineers in going to join in your efforts. How have you been able to manage to do so many amazing projects while working in the corporate world? So the question was there is kind of this rat race in the corporate world that basically is the reason why a lot of engineers didn't want to volunteer alongside me? And the question was how I was able to be able to do all this stuff while working in corporate America? And I guess, my only answer was that I found something that I was passionate and inspired by. And so I'm not going to lie, I work very long nights and weekends on things and sometimes it feels like I am doing two full-time jobs, but I'm in a position where I feel so inspired that sometimes it doesn't matter and then as you kind of work hard towards something, I mean, you see this in entrepreneurship, right, like entrepreneurs see this.

If you're working hard towards an idea, you have times where you feel like it's the greatest idea in the world and you have times where you feel like you're an idiot. And so it kind of goes through these waves and that's the same thing that happens when you're working on anything, especially things like this and you've just got to kind of convince yourself to work through it, work through the stressful times and keep on pushing and maybe eventually you can get there. While doing the project you showed us in Africa, how much would you say did you learn during your studies and how much did you learn like during the job? So the question was like in pertaining to the project in Africa, how much I learned when I was studying and how much I learned in my job? I learned it all on the job. So I'm an engineer and I know engineering principles and I've worked in industry as an engineer and I understand like kind of how to go about those problems. And I have learned a lot of that stuff from school, my Masters degree was in Systems engineering, so I have - I know how to look at things from a systems perspective and boil down the requirements and everything like that. So I use that in this stuff, but the technology itself, I mean, most of it I have kind of just learned from working with people or the Internet. We are - that's part of the whole - we're living in this amazing time, right? We have the opportunity to learn these things. And if you hang out around like maker spaces or anything like that, most of the people that are building interesting things in a lot of the maker spaces are not engineers, they're just random people who have figured out how to build something and they're buying hardware and doing it. With the drone technology that you mentioned or you showed us in that one video is there a plan - how do you plan to spread that? What's the - is there a model for selling that to entities, what do you - how do you see that growing and scaling in a perfect world? So the part that was already funded was to put together all the information around it, what the limitations are, like operations kind of lessons learned everything and through the expeditions and all that stuff is going to go on the SoarOcean website. So it's effectively going to be open for anybody who wants to use it and do anything with it.

Now what SoarOcean is going to do beyond that is probably work on creating some off the shelf drones for specific uses that they can do. I don't want to build my own drone. There is a billion companies doing that nowadays, but configuring it in the correct way and deploying it is something that there is a ton of interest in so. So do you plan on starting your own nonprofit or would you rather keep this as a volunteer experience? Yes, that's what Conservify is going to be. It's a nonprofit. It's going to eventually kind of - there is some things in work to move into doing that on a bigger scale. Shah, can you repeat the question? Oh, the question was am I going to start this as a non-profit or just do it on the volunteering side and I said that it is a non-profit and it's moving towards the kind of much bigger operations so that's the plan for 2015. More suggestions about stopping this illegal fishing problem across the planet? Yes, so the question was more suggestions about stopping the illegal fishing problem. So the number one thing I can tell you guys that you should do is download the SeafoodWatch app from Monterey Bay Aquarium and don't eat the things that are red on it. Like that's the easiest thing that you can do.

It's super easy to do. There's a lot of information, a lot of great books and documentaries that have been done on in it. I have - me personally I know so much about that kind of stuff, because I've been working in it so long that I'm the guy that nobody ever invites to sushi, but like you can do much less than that and still have a positive impact. There is this great push for seafood traceability and understanding where it came from, catch to plate basically and through using things like Seafood Watch you're reinforcing that, and asking - you can ask restaurants where they got their fish. A lot of times they don't know or they will tell you something that they think you want to hear, but if enough people do that then it can kind of be a bigger movement. So just to clear up something, is the drone thing supposed to happen regularly or are people supposed to do rounds to patrol? Yes. Well, so the question was about the drone thing and how it works operationally. So yes you can patrol with like a fixed wing that's got a longer range on it. It obviously it's going to be more nearer shore stuff right now, while the endurance are lower. And then quad copters would be more for like technical type evidence gathering.

So that's the model as of right now. What would you say is the ultimate impact or legacy you want to leave after your career is done or your work is done? So the question was what would I say like the ultimate legacy or impact that I want my career to have? The number one that's super easy, I want engineers to start thinking about problems outside of what school has told them are the only problems they can work on. I want interdisciplinary thinking between engineering and the rest of the world. I think that there is a great potential. There is a lot of people doing really stupid things now that if you just had someone who had a different perspective come in and say just check it out and look at how they're doing it, they might be able to save a lot of resources, change the things that they're doing and potentially change the world. I mean, I think that through doing that, through collaborating with each other, we can do quite a bit. So I'd love to inspire other engineers to do the same thing. That's

what I'd like to do. Oh and stop all the wildlife crime if I could do that, but you know that's a little difficult. How effective was your initiative for conservation? I'm sorry I can't hear.

How effective is the initiative for conservation? I mean it's been huge. There is not - I mean, there is tons of nonprofits that want to work on it. We have pilot projects that are working all over the place. There is - when I first started talking about this stuff, nobody was talking about technology and conservation. There was very few people, but they were looking at companies that already produce things and everything was overpriced and it didn't really work very well. Now it's, I mean, Google is looking at different ways that they can help and stuff. So I think it's been huge over the last couple of years, the changes that we've seen. So we will see how things go in the future, this stuff kind of takes a little while to kind of go through and make a difference. Can you talk a little bit about your failures? It seems that things came to place almost all the time to you, but then you said when you fail make sure to pick up yourself and move forward. So can you talk about your challenge? Yes, so the thing was to talk about my failures a little bit, because I think the way that maybe this sounded was that I haven't had a billion failures, which I failed more than anything else.

I had failed way, way, way more than I succeeded. I basically every time I tried something and it didn't work; I just kind of started again the next day to try over. So every single project you had there was just riddled with failure. I just didn't let it affect myself. So I don't want to - I mean, failures are part of this whole thing. This is the way that you move forward. You can't - nobody ever creates anything without failing before. And if you do, you're very lucky and I'd like to meet you. Okay, yes. Are you guys building predictive models based on when you catch illegal activity on the seas and using that to target your patrolling efforts a little bit more? Okay.

So the question was, are we looking at predictive models to help target the patrols and the enforcement and the answer is yes. That's part of what's going into when I mentioned MPA Guardian went away and it's going to be something bigger that's basically what it is. I'm also working with an individual that has done it for drone technology. So they did it to try and help find where like rhino poachers would be, so we can do similar things with illegal fishing, so yes. Once you find illegal fishing, what do you do about it? So the question is once you find someone is like illegally fishing, what do you do about it. That's a particularly loaded question. The first step is finding it, which we're not doing right now. So that's where my efforts are focused right currently. If you can gather enough objective evidence of what's going on and kind of prove to people other than it just being an arbitrary fishermen saying he saw this happening, then you could start to change the legislation around it and start to put pressure on the governments to do more about it. There is already some pressure being done, but we are like way early in the process.

We weren't documenting it well in the first place and so a lot of the projects that I worked on were focused much more on how you fix that problem first. Once you document it, then like how do you kind of make sure that that stuff sticks and enforcement gets strong enough to deter people from doing it. So typically the way that it would happen is if you could prove someone is doing it, then they would get arrested and their stuff would get confiscated, they would probably get fined or the boat would be destroyed, it depends. The laws differ from country to country, but there is - some countries are starting to collaborate and work together on this sort of thing. They have regional management organizations that are kind of addressing this sort of thing. But everything is different right now. The way every country does it is differently. If everyone did it like the U.S., it would be fine, that the U.S. has spy satellites and all sorts of stuff all over the place that we see and U.S. had just barely started to care very strongly about illegal fishing.

Obama had put out a proclamation about it this year, but before that they would basically be looking for like drug trafficking and things like that. And if they ended up finding someone doing some kind of a wildlife crime in the drug thing or human trafficking, then they would get them there. But a lot of my efforts are trying to see how to standardize that across the countries and especially if you can standardize it across the countries that don't have as much resources as like the U.S. and Canada and U.K. and people like that - countries like that, then you can raise the bar and change the way we do things.