

Sue Nelson

Hello, I'm Sue Nelson and welcome to the Create the Future podcast, brought to you by the Queen Elizabeth Prize for Engineering. Celebrating engineering visionaries and inspiring creative minds.

[Music]

Linda Zhang was born in China, and arrived in the United States with her parents as a child. She went on to study electrical engineering, and later in her career, an MBA and Master's in Computer Engineering at the University of Michigan. Her engineering career began though, when she joined the Ford College Graduate Programme, a two-to-three-year series of job assignments at the Ford Motor Company, whose headquarters are also in Michigan, in a Detroit suburb. This is where the first mass produced car, the Model T Ford was made in 1908. And over a century later, Linda made another piece of automotive history as chief engineer of the team that electrified Ford's F-150 Lightning pickup truck, which launched earlier this year. Linda joins us today from the Engineers Future of Cars event, a partnership between the Royal Commission of 1851 and the BBC. And she began by describing the electric F-150.

Linda Zhang

The F-150 Lightning is a full-size pickup truck. It's five passengers, and it has a five-and-a-half-foot box in the back for whatever the customer wants to throw into it. This truck is very popular in the US, it generates \$42 billion of annual revenue. And there's about 17 million units of these out on the road as of 2020.

Sue Nelson

Was the decision to electrify it welcomed?

Linda Zhang

Yes, definitely. I mean, I think Ford strategy is really around bringing electrification to customers and helping them transition in a way where we are electrifying our most iconic vehicles, whether it's the Mustang with the Mach-E, transit with E-Transit for commercial customers, and now F-150. Those are all very iconic brands that our customers know and understand. And I think with that, it really helps the transition to EV with Ford more planning \$50 billion of investment in EVs globally, through 2026. And I think it's really important to be able to do that with iconic brands that customers recognise.

Sue Nelson

And so how do you go about electrifying a vehicle like this huge pickup truck?

Linda Zhang

Giving our customers that capability of being able to do whatever it is that they currently use their truck for not just the transportation to get from A to B, but also the ability to go off roading going, you know, from A to B any route, they choose to using it for work using it for whatever it is that they currently use it for. Towing trailers and all of that. So I think that was the first element is make sure that we can be durable, and that we can stand behind are built for tough shield for F series. But in addition to that, really giving the customer more than what they bargained for, right? Whenever you create a new product, it's really important to give our customers more because otherwise why would they ever go there? So you know, the thought here was an and solution, right, giving them what they know traditionally with trucks, but also adding to it and giving them even more things that they wouldn't even know or expect from the truck. For example, we now actually are able to backup when a power outage comes and backup the home for multiple days. Four days easily.

Sue Nelson

And how long was that engineering development process?

Linda Zhang

The development on this truck started about four years ago. So we've gotten pretty quick from concept all the way to a product. And that's something that I'm very proud of the team for.

Sue Nelson

And for you what was the most challenging aspect of the changes to the vehicle in terms of its engineering or design in order to electrify it?

Linda Zhang

EVs today, or in the past haven't been known as a tough and durable vehicle, it's often known as you know, more of a eco vehicle. So kind of having to work through a lot of that, and mythbusting on an electric truck can be just as tough and in many cases tougher. And I think it was probably our biggest challenge at the very beginning of the programme really trying to bust that myth in a way. And we did that with a really interesting train tow video where we towed a train that weighed more than 1 million pounds, and it was a double decker 10 freight cars. And I think it really went a long ways in terms of showing people that an electric truck can be tough and can do work.

Sue Nelson

Was there anything that you had to sacrifice when doing that conversion to electric in terms of performance or power?

Linda Zhang

Absolutely not. With an electric, you actually get fantastic power and performance. And that's one of the things that we really were trying to educate in a way with that video with the train on demonstration. And what's great about an electric vehicle is the fact that it has near instant torque, instead of the transmission and the engine, you know, which with this older technology of having to switch gears and get up to a high amount of torque to be able to pull with an electric with the battery and the e-motor, you get to that torque near instantly. I mean, it is absolutely fantastic.

Sue Nelson

And did you have to do anything to the design or that the chassis at all? Or was it simply I say simply, obviously, I'm using that word rather loosely, a replacement of an engine for an electric one.

Linda Zhang

Oh, no, definitely not a direct replacement, we had to engineer the entire chassis quite differently. First off, we the vehicle weight is a bit more. So with that we had to ensure that the chassis was up gauged to be able to sustain the weight. And in addition to that, with the e-motors with dual motors giving this truck four by four all the time, that architecture really lent us to re-evaluate the suspension system. And we ended up with a rear independent suspension in the back of this vehicle, which is really an all new for any truck application of full size. And it actually ended up being a really, really great architectural change for us.

Sue Nelson

What sort of range does the truck have?

Linda Zhang

The extended range goes 320 miles on a full charge. Which to be honest with you, unless I'm going on a large trip, I've never had issues with charging, because I never go more than 320 miles in a trip, for a day.

Sue Nelson

That's pretty impressive. And where are other car firms worldwide in the process? Because it sometimes feels as though we're slow globally on the uptake.

Linda Zhang

Well, I can't speak for other firms. But I know that you know, charging in a way is a infrastructure issue. And I think with more people adopting EVs, I think that infrastructure will increase. And with a lot of what, you know, we're seeing most automakers are using compatible charging, so that you can, you know, charge different vehicles at the same chargers. It is definitely a very important piece of the EV adoption. And it's something that we need to work together across the industry on.

Sue Nelson

And when did you first become interested in the electrification of cars?

Linda Zhang

Well for me, I'm an electrical engineer, so I always loved electricity, probably more than mechanical engineering, ever since college. So I am so excited about an electric vehicle being out there. And I think even at Ford, when I joined Ford, there were several assignments that I had taken, that were really around what would it take to get electrification off the ground, from a strategy perspective, from an infrastructure perspective, from a technology perspective, right, all those different things that contribute to the adoption of a new technology. So I've been very excited looking at EVs for quite a while in my career.

Sue Nelson

As you said, you said did electrical engineering, what was it that made you join Ford?

Linda Zhang

Yeah, I mean, for me, I fell in love with the car when I was eight years old, when I moved to America, got off the plane, it was the first car ride I took. And it was, in a way, very emotional for me because it was basically taking me to a new world. And I think that has been something that I've carried my entire life in a way, since I've moved to America. And my father worked for Ford. So for me, I had seen how great of a company that Ford was, I knew we were very advanced, he actually worked in the research labs. So I knew some of the things that you know, Ford was looking at. I was just excited about automotive. But at the same time, I could see a place where I could use my electrical engineering skills, and really do something from a career perspective. And that's why I joined Ford is it's just a fantastic company. And Ford's been really great to me, in terms of helping me learn different aspects, whether it's professionally, or whether it's, you know, going back to school and getting a Master's degree in engineering or my MBA to try to understand the business side of that.

Sue Nelson

You went to the University of Michigan, and there's an amazing, as you will know, museum near Detroit, the Ford Museum, which is one of my favourites. Do you find the fact that it's got such a history of the automobile there, was that somewhere that you had, you know, went to and thought, "wow, this is what I want to be a part of"?

Linda Zhang

Oh, absolutely. The Henry Ford Museum is fantastic. And you're right, it has such a great range. Whether it's the museum itself, or the Greenfield Village, with the old homes, I mean, walking in there makes me feel like I've, you know, entered the past in a way. And they actually run a really great summer camp too, where I used to send my kids when they were a little because it'd be a week-long camp, and each day was a different century.

And they learn how it was to do that. And I just thought, how fascinating, right. And then you also have the Factory of Tomorrow tour as well, which actually takes you to our truck plant, and shows you how, you know, like the manufacturing of an entire truck gets put together. So just such an array, and you're right, all the way, you know, reaching out to, you know, the 1920s in a way. Or even further than that, to try to see different pieces of the history all the way to advanced technologies that we're using in our plants today. It is got such a range. And it's a wonderful tour to go to.

Sue Nelson

Now, you mentioned that your father worked at Ford, did your mother have an influence in your engineering career as well at all?

Linda Zhang

Yes, absolutely. My mother is also an engineer, and she's actually an electrical engineer. So in a way.

Sue Nelson

Preordained wasn't it.

Linda Zhang

A little bit, I probably followed more in both of their footsteps, because I ended up being an electrical engineer, like my mother, but I worked in automotive, like my father. So I have a little bit of both of them from an influence perspective. And they are such an inspiration because they came to America with nothing. And when they were here, I was able to earn a Doctorate degree from my father, and then a Master's degree from my mother. So just while at the same time, you know, raising us, and me and my brother that that is and they're just fantastic. And they're a great influence for me, not just from a professional perspective, but also from a personal perspective, in terms of how to be a great parent and how to be a great person in general.

Sue Nelson

And what for you, has been, you've got, you know, many years ahead of an equally successful engineering career, but what for you has been part of your work that you just get up in the morning and just think "I love that". You know, how would you explain the appeal of engineering and working with electric vehicles to those that perhaps, you know, are not in the know?

Linda Zhang

Well, I think electric vehicles are really the future. So for me waking up every day and knowing that I have a way to influence that and a way for to build a better product, a great product and a set of services that our customers don't have today, and working to improve that, I think is something that definitely drives me. And not only that, as you think about engineering, it's really all about curiosity, right? Being able to look at something and be curious about how and why, and what and, you know, basically those type of questions, and then trying to make it even better. And that's what we do here every day at Ford is look at the product. And we try to make it better, every little bit trying to improve it over time, to make it even better with time. And I think that's what I would say is you know, for aspiring engineers out there, if you have a passion for technology, or how things work, or how to make something better, engineering is the right field for you. And we're always looking for great engineers in the automotive industry, particularly as we head through this EV revolution. And I would welcome any aspiring engineers to look at this field, because it is really a really great one as we look toward the future, and what we can do to make the world a better place.

Sue Nelson

And how do you see the future in terms of electric vehicles? Where are the areas where you think, “actually, I'm hoping that in 10 year's time, we'll be able to do this or that or improve this even further”?

Linda Zhang

I think some of it will be gradual. But I think the technology is definitely still improving in terms of energy density, trying to get more range. Also, charging speed is another one where if we can get the vehicle to be chargeable, as quickly, as you know, it takes right now to fill up gas, then really, we've taken all of the excuses in a way away, right. And I think the industry will head that way, as we get more pronounced with the technology in terms of energy density, trying to find different ways to use clean energy, but then also improving the charge capability and the charge time to be able to get even faster. I think if you do that, and together, we really make EVs the only option.

Sue Nelson

So how do you gradually change that mindset?

Linda Zhang

Right. I mean, to change and transition people's existing behaviours, right, you really would, would want to give them something to want to change for. So I kind of view it as, you can change their minds in terms of, you know, talking to them about how great the product is going through the total cost of ownership and the fact that it's a lot cheaper to operate and own an electric vehicle over the course of time versus a gas vehicle, you can talk about the lifecycle, sustainability of the product, and the fact that you know, EVs account in a total lifecycle is a 64% reduction in terms of emissions output. But I think to really get people to change behaviours, you also have to change hearts in a way, right? Give them something that they can be passionate about. In automotive, vehicle purchases are very emotional, and people, you know, need something that represent them in a way. So for us, that's why I think it was very important to make sure that we provide them this “and” solution that we talked about earlier, the fact that, you know, it's the truck that they count on today and this all new technology that gives them these added functionality that they never could get with a gas vehicle. And then really that experience to have been in EV, that quietness of not having the engine in the background, the fact that zero to 60 is of mid four seconds. I think that's what's going to help change hearts in a way, in addition to the minds, and I think you need both of those to be able to really move something as important as what people drive on a daily basis.

Sue Nelson

Are you already thinking of electrifying another vehicle now, or has that process started?

Linda Zhang

Yes, we were always looking at electrifying more, I think that's been announced a while back actually, that we're looking to one increase the capacity to meet that reservation and that customer demand. But in addition to that, you're right, very much so. We are also looking at taking the electric technology and being able to put it on other applications that would make sense for our customers.

Sue Nelson

Now, the Queen Elizabeth Prize for Engineering in 2022, was awarded for permanent magnets and the engineer who played an enormous role in increasing the magnets power and range of uses. Now, what are the types of magnets that are used in electric vehicles?

Linda Zhang

Yeah, so we do use the magnets for our three phase permanent magnet motors, there's definitely a lot that goes into the motor. And particularly for a truck motor, right, we need to make sure we have very strong magnets to ensure that we get the, you know, power need out of it.

Sue Nelson

So the magnets effectively, you know, they're one of the main elements of electric motors. And it's something that I think most many people just don't realise, I think.

Linda Zhang

Yes, magnets are what helps the motors turn and spin to generate that torque and power for the vehicle.

Sue Nelson

And for you, you know, you mentioned that your your child went on this fabulous camp at the Henry Ford Museum. Did you find during your career, particularly when you are studying and a bit younger, and before you got onto the Ford Graduate Programme, were there specific things that you did, be at an internship or a camp, that really helped fan the flames of your interest in engineering?

Linda Zhang

For me, I didn't have a lot of opportunities at camps, I think my kids have been able to grow up in a much different environment than I did. For me, my parents, you know, came to this country with not a lot of money. So I had to entertain myself, I guess, in a way during summers and such. But I think, you know, I grew up at Purdue University and having that academic environment around me the whole time actually was super helpful. I think, just by osmosis, I was seeing some of the things that was happening on campus and, and just learning from, you know, being in that environment. And the people I was with it, especially my friend group, we were all very curious kids, and we didn't have a lot of money. So, it was really all about what can we do with things that we have, and maybe tinkering with it to make things better. I think those are the things that kind of, I think back to and think, you know, I was definitely a little engineer, even as a eight year old child because that was something that I, you know, I just always tinkered with things and was always curious about how anything worked.

Sue Nelson

And is it true that your motto is be happy?

Linda Zhang

Yes.

Sue Nelson

Really?

Linda Zhang

I'm a pretty positive person. I think for me, it's you know it, whether it's what you do in a career or life in general, I think you have to go after what makes you happy. Otherwise, it's a, you know, it makes things feel a lot longer. Right. whereas if you're happy, I feel like time just flies by and I'm having a great time and why not?

Sue Nelson

Well it sounds as if electrical engineering has made you very happy indeed. Linda Zhang, thank you so much for joining me on the Create the Future podcast.

Linda Zhang

Thank you so much for having me.

Sue Nelson

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