THE HENRY FORD

COLLECTING INNOVATION TODAY

TRANSCRIPT OF A VIDEO ORAL HISTORY

INTERVIEW WITH

ELON MUSK

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SPACEX,

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BARRY HURD:

03:00:45;26 "We feel like we're standing in the future [here]" Is that the way you still feel when you come here? What's going on here?

ELON MUSK:

03:01:00;22 Well, it is easy to get somewhat blasé about a rocket factory if you're here every day. But it's true what you're saying. I mean, this really is a rocket factory. And you're walking around and that's a rocket engine. And that's a stage that's going to go to orbit. And that's a space craft that's gonna carry people to the space station. And these are, actually, pretty remarkable things. But I have to remind myself of that from time to time because as I walk around, all I tend to see are how we're gonna fix that. We gotta improve this. We gotta change that design. So I have to sort of bring myself back, think about the big picture and remind myself that this is, actually, pretty cool, unusual stuff.

BARRY HURD:

03:01:41;16 When you first got the vision for this, however that happened, were you more enthusiastic about an idea or a business?

ELON MUSK:

03:01:50;11 The reason I'm doing Space EX is not due to some childhood epiphany or because I think this is the highest return on your investment [or] a way to spend money. I think starting a rocket company is an unusual thing to do and pretty risky. But I'm a big believer in us becoming a space exploring civilization and, ultimately, extending life beyond earth. When I was in college I tried to think what are the really big problems that face the world, that, which will most affect the future of humanity?

03:02:26;24 And the three that I thought were the most important were the Internet, transition to a sustainable energy economy, and third was space exploration, in particular, making life multi-planetary. And I didn't really think I'd have anything to do with the third one because that seemed like the

process of governments, largely or entirely.

03:02:53;19 And I wasn't sure how I could get involved in sustainable energy, although, that was the path that I originally started on. That's what originally brought me to Silicon Valley: to do a PhD at Stanford in energy storage technologies for electric vehicles.

BARRY HURD:

03:03:09;27 The story is that after two days you left.

ELON MUSK:

03:03:12;10 Yeah, that's right.

BARRY HURD:

03:03:12;29 Tell me about that. That's kind of funny how did that [happen]? Just two days?

ELON MUSK:

03:03:15;18 Well, I didn't even go to classes, actually. It was two days into the quarter. And I was sort of forced to choose. You know, it's either start the grad program or, you know, do my Internet company.

BARRY HURD:

03:03:31;10 Tell me a little bit about that? You're ready to go to Stanford and this other idea from the Internet starts up. Now, how did that happen?

ELON MUSK:

03:03:38;16 Well, remember how I said that when I was just towards the end of my undergrad, I was thinking that the Internet would be something that would really fundamentally change the world and change humanity forever in a very significant way. It seemed to me like humanity was acquiring a nervous system.

03:03:57;28 And, you know, previously, you had people that were sort of isolated cells, if you will, that with the communications mechanisms were weak. And there's really no way that any one cell had access to all the information of the collective consciousness. You know, you'd have to go to libraries here and there and talk to people and that sort of thing. But the way it is today, if you could be in the jungles of Congo and have a satellite link to the Internet and AC, have access to essentially the entire knowledge of

humanity. I mean, that's pretty intense. I mean, that's a huge, huge difference.

BARRY HURD

03:04:38;02 When was this?

ELON MUSK:

03:04:39;01 I think '94.

BARRY HURD:

03:04:39;22 '94.

ELON MUSK:

03:04:41;01 Yeah.

BARRY HURD:

03:04:41;26 Okay, and so that's when you started concentrating then on the Internet as the first of these three ideas?

ELON MUSK:

03:04:46;11 Yeah, so then in '95, I mean, I'd been on the Internet for a few years before that because, you know, since I've been in the physics arena and the sciences people were using the Internet for many years, as early as the '70s, they were using the Internet. But it was very difficult to use. It was text based. It was very difficult to get access to it.

You had to be either in the government or in some academic institution. But once it became clear that the Internet was going to be widespread, that everyone would have access to it, that's when it occurred to me that this is really gonna fundamentally change humanity. And that became clear around about the '94 timeframe.

BARRY HURD:

03:05:28;04 Are you a programmer?

ELON MUSK:

03:05:30;22 I taught myself how to program computers when I was a kid. And bought my first computer when I was ten and sold my first commercial program when I was 12.

BARRY HURD:

03:05:41;16 Not bad.

ELON MUSK:

03:05:42;11 Yeah, made a lot of money for a little kid.

BARRY HURD:

03:05:45;09 So take me from your programming to [what led to] Papal. But you programmed, was it Xcom, maybe I don't have the story right? How did that all come about?

ELON MUSK:

03:05:59;12 Right, right. Well, I had a company before that which was called Zip Two, which people wouldn't generally have heard of. But it did things like maps and directions and yellow pages. And it, also, did e-mail, accounting, personalization. But really that software was provided to the major media companies like the *New York Times*, Hearst, and Knight Rider to power their websites. And it had a much more functional Experience for the user.

03:06:29;23 So my first company was not a consumer company. It was primarily providing Internet software to media companies to enable them to go online. But then the second company, PayPal, started off, originally, as EX.com. And then about a year after that the company merged with another company called Confinity. And both Confinity and EX had started from very different places.

03:07:00;22 EX had started off as a financial services company. The idea was to aggregate all of your financial services seamlessly in one place and make it really easy to use so

you don't have to go to multiple financial institutions to take care of your mortgage, your credit cards, your banking relationship, insurance, mutual funds. You can just go in one location. And we had a feature which was the ability to e-mail money to anyone in the system.

BARRY HURD:

03:07:25;10 Was that the real sort of big headline?

ELON MUSK:

03:07:28;14 Well, it was very easy to implement in the beginning. It gets harder to implement over time as you are forced to minimize the fraud in a system. But the initial implementation of e-mail payments is very [easy], it's really trivial. But anyhow, we had that as a feature.

03:07:45;23 And whenever we demonstrated the system to people, they wouldn't get excited about the aggregation of financial services. But they got really wowed by the fact that you could e-mail to somebody. And we were, like, "Wow, okay, that's the easy part." But we started focusing on that. Just let folks in on the e-mail payments part of it

and then Confinity came in from a different area. They started off as a Palm Pilot cryptography program and then developed an application with that cryptography which was to be able to beam money tokens by the infrared port of a Palm Pilot. So you remember back in the day [that] Palm Pilots didn't have any connectivity, really? But they had the infrared ports. They could beam little things back and forth.

03:08:28;16 So you could beam money between Palm Pilots. And then they also had a website which was called PayPal where you would reconcile those payments. So you had your tokens and your Palm Pilot. You plug into your [port] and then you'd log onto the PayPal website and that's how the beamed money tokens were transferred.

03:08:48;03 And then they added a feature. "Oh, well, let's just allow people to just use the website without using the Palm Pilot." And so we sort of converged to the same business model. And then in early 2000 about a year after both

companies were formed and only a few months after we launched our respective websites we merged the companies, with EX.com acquiring Confinity. And initially, the company was known as EX.com. And then we used PayPal as the consumer brand. And then about a year after the merger, we changed the company's name from EX.com to PayPal to match the name of the product.

BARRY HURD:

03:09:27;05 So if you were to go back and say what was the big innovation about PayPal that really made it catch on and rise to the top, what would it be?

ELON MUSK:

03:09:36;00 This gets complicated. But I'll [try].

BARRY HURD:

03:09:39;13 I have a high school education.

ELON MUSK:

03:09:40;05 There's a number of factors because PayPal was not the first to do e-mail payments. So you have to say, "Well, why did it succeed where others did not?" There was a company that was acquired by Amazon, started by Danny

Shader, I forget what it was called. But it was, also, an e-mail payments company. There was a company called Billpoint that was acquired by EBay which did e-mail payments.

03:10:07;03 So how is it that PayPal was able to beat all of them? And in particular, how was it able to beat Billpoint when Billpoint was EBay's in-house service. Very few people understand why. There's a couple of things [which made it succeed].

03:10:26;00 First of all, if you look at the online economics of the system, we figured out a way to authenticate bank accounts. So normally it's really hard to authenticate bank accounts from the standpoint of pulling money from someone's bank account 'cause you can give us a bank account number.

03:10:44;22 But how do we know it's you, right? The Federal Reserve has no authentication system that works for pulling money from people's accounts. But we came up with an idea for

authenticating by making two small deposits in somebody's bank account which effectively made it a four digit pin. So only the person who had that bank account could tell what the four digit pin was because of those two little tiny deposits.

BARRY HURD:

03:11:12;19 The authentication process that…

ELON MUSK:

03:11:14;14 We figured out how to authenticate a bank account without anyone even seeing you.

BARRY HURD:

03:11:19;21 And that's a breakthrough, right?

ELON MUSK:

03:11:21;26 That was one of the fundamental breakthroughs. There were many.

BARRY HURD:

03:11:24;03 Well, just tell me one more; that's pretty big right there.

ELON MUSK:

03:11:26;26 That's a very big one. And the reason it's very big is

because when you send money from one person to another, if you send it using a credit card you have a very high fee associated with that. But if you send it using an electronic check it only costs a few cents. Plus, the electronic check is very likely to be fraudulent but whereas credit cards, there's a huge amount of fraud associated with credit cards. So with the credit card system, your effective cost, including fraud, is probably about three and a half percent of the transaction. But the effective costs of the electronic check are maybe a quarter of a percent.

BARRY HURD:

03:12:06;14 So there's a big economic comparison there that makes sense, yeah.

ELON MUSK:

03:12:09;25 Yeah, absolutely.

BARRY HURD:

03:12:11;01 So you had a better authentication and a better business model.

ELON MUSK:

03:12:13;09 We figured out how to authenticate bank accounts. We've

also introduced features that encourage people to keep money in their PayPal account, which no one else did. So we had a debit card, a MasterCard debit card that could access your PayPal account. So you could buy stuff at a restaurant and it just directly came out of your PayPal account. So you don't need to transfer it to a bank to use it in everyday life. You could, also, get cash from an ATM. In fact, I have a card. I have one of the first cards ever. In fact, I have the first card ever.

BARRY HURD:

03:12:41;15 This is the first card?

ELON MUSK:

03:12:41;24 I had, actually, the very first card, but, I lost it. And then I had to get it replaced.

BARRY HURD:

03:12:51;27 So tell me, again, what this is.

ELON MUSK:

03:12:53;23 Well, I had the first debit card attached to the PayPal system. And what this [is]…

BARRY HURD:

03:13:00;20 Is that it?

ELON MUSK:

03:13:01;00 Yeah, it's a MasterCard debit card. But it's a very important bridge to the material world, because not everything can be paid for online. You wanna go to a restaurant or you wanna get cash out of an ATM, you need this bridge to the regular world. But by having that card and by, also, instituting a money market account so you could earn interest on money in your PayPal account, meant you didn't need to transfer it to your bank. Now, you could leave the money in your PayPal account. Now, if you send money to someone, it just comes out of your PayPal account. Well, that's even cheaper than an electronic check.

03:13:33;28 So, you know, if a credit card costs, say, three and a half percent, an electronic check costs a quarter percent an internal PayPal transfer costs maybe .01 percent, [essentially] nothing. So as the percentage of electronic check transfers and internal PayPal transfers increased over time, it meant that our effective fees, the fees that

PayPal needed to charge to make money were much less than any other competing system. So we could undercut everyone including EBay's own service.

BARRY HURD:

03:14:10;28 Now, you know, that kind of bridges this question I was gonna ask you. I mean, when you look at [your] private rocket ship company and you look at NASA, what do you do differently here that is obviously gonna give you an advantage over how our government would approach doing space colonization and travel?

ELON MUSK:

03:14:23;16 Sure, and by the way, on the PayPal stuff, I just touched on a subset of things.

BARRY HURD:

03:14:28;29 If I had more time I'd ask you to go through more. I don't have time, though.

ELON MUSK:

03:14:30;01 Exactly, that's why… I can write a treatise on the thing.

BARRY HURD:

03:14:32;25 Well, we'll come back sometime and we'll go over the rest

of it.

ELON MUSK:

03:14:36;05 I mean, there are many nuances to the thing. I think it's worth noting that when somebody has a breakthrough innovation, it is rarely one little thing. Very rarely, is it one little thing. It's usually a whole bunch of things that collectively amount to a huge innovation. But the problem is, because it's hard to convey a complicated thing to people, the innovator or the innovator's PR department will say, "Oh, such and such is the reason why it's better," just a little catch phrase. You know, like what is it with EBay? [Something]like, Pam wanted to do beanie babies or something. I mean, really that's not the basis for EBay. But that was, like, the PR department.

ELON MUSK:

03:15:18;19 The Pez dispenser, that's right. I'm, like…

BARRY HURD:

03:15:20;16 And that's not even for a story, is it?

ELON MUSK:

03:15:22;04 So, anyway, yeah, it's, like, something the PR department

made up. So really, its innovation is a collection of complex things that are usually difficult to convey so there is some sound byte that's given. You know, why is Southwest Airlines the most popular airline in the whole business? It's not just because they use 737s. Okay, I mean, if it was that easy, everyone could do it, anyway.

BARRY HURD:

03:15:49;26 Also that part about the people who are doing this they're all thinking in a different way. And it's traditional to come up with these breakthroughs. Tell me a little bit about how that works. Don't you have to have a vision that's different and try to execute something that maybe people are against?

ELON MUSK:

03:16:13;08 Sorry, can you repeat the question?

BARRY HURD:

03:16:13;17 Yeah, I'm saying, in order to do these breakthroughs, all these different things, you said it's a combination of a lot of things. But you have to think differently about what?

ELON MUSK:

03:16:20;17 Yeah, you do have to think differently. Absolutely.

BARRY HURD:

03:16:22;14 So tell me about that process. How do you train yourself to think differently and surround yourself with people that do that as well? Or maybe you don't do that. I mean, how do you get into an organization?

ELON MUSK:

03:16:40;12 I think, generally, their {other people's} thinking process is too bound by convention or analogy to prior experiences. So it's very rare that people try to think of something on a first principles basis. They'll say, "We'll do that because it's always been done that way." Or they'll not do it because, "Well, nobody has ever done that. So it must not be good." But that's just a ridiculous way to think.

03:17:10;01 I mean, you have to build up the reasoning from the ground up from first principles as in the phrase that's used in physics. So you look at the fundamentals and construct your reasoning from that and then see if you have a

conclusion that works or doesn't work. And it may or may not be different from what people have done in the past. It's harder to think that way, though. Sorry.

BARRY HURD:

03:17:33;29 Why is it so hard to think that way? And how have you managed to? I mean, obviously, you've thought the other way. How have you broken that path?

ELON MUSK:

03:17:47;16 I don't know. I've just always thought that way, I suppose. I mean, I would always think about something and whether that thing was really true or not. Could something else be true or is there a better conclusion that one could draw that's more probable? I don't know. I was doing that when I was in elementary school. And I would just question things. Or, maybe, it's sort of built-in [to our nature] to question things.

BARRY HURD:

03:18:14;28 I wanna go back to [the] nuts and bolts and PayPal. Tell me about how Bill…

ELON MUSK:

03:18:17;14 It would infuriate my parents, by the way.

BARRY HURD:

03:18:18;25 I'm sorry, say that again.

ELON MUSK:

03:18:19;17 It would infuriate my parents.

BARRY HURD:

03:18:21;09 That you would think differently about things, or, what?

ELON MUSK:

03:18:24;02 That I wouldn't just believe them when they said something 'cause I'd ask them why. And then I'd consider whether that response made sense given everything else I knew.

BARRY HURD:

03:18:32;00 Now, you have, what, five kids? Are any of them doing that back to you?

ELON MUSK:

03:18:35;12 Yes. Well, one of them in particular just asks "why" a lot. He's a master of the chained “why.”

BARRY HURD:

03:18:41;26 So that whole thing about, you know, you're gonna get

where you are to drive you nuts, right, did they tell you that? "We hope you get a kid just like you?"

ELON MUSK:

03:18:48;17 Yeah well, you know, inheritability of traits is much greater than I thought. I mean, I'd assume that in the nature versus nurture, there's much more nurture. But having had five kids, I think its much more nature. I mean, what are you? You're hardware and software, right?

03:19:10;19 So the difference between one person and the next must either be a hardware difference or a software difference. And why are kids that may have the exact same background or same school, same everything, get those widely different capabilities. Yet, they have the same input experiences. Well, then it must be the hardware that's different.

BARRY HURD:

03:19:30;12 Yep, take me back to PayPal how you built that up, sold it off, and then started going to these other businesses. I'm just trying to get some connective part of the story, now.

ELON MUSK:

03:19:40;26 Sure, well, so I built up Zip Two, the first company. I sold that to Compaq for about $300 million. And then I wanted to still do another company on the Internet. And that's what I thought: "Well, where is there still room for a lot of innovation on the Internet?"

03:19:56;22 And that's how I chose the financial services sector because money is just an entry in a database. And it's low bandwidth. You don't need any big infrastructure upgrade on the Internet to make it work. And so it seemed like there must be room for innovation.

03:20:08;22 And that's how I decided to do something in the financial services arena even though I really had, essentially, almost no background in financial services except for an internship at a bank. And anyways, then PayPal went public. We sold PayPal to EBay for about a billion and a half.

03:20:26;23 And then I wanted to do something different, something

outside of the Internet arena. I was a little burnt out on the Internet, having been immersed in it and spending every day of my life on it for a long time. And that's where I thought: "Well, you know, I've got a bit of capital.

03:20:42;18 "Let me see if I can do something in the space arena." And I initially started out with this idea: "Well, let me do a small philanthropic mission that will generate public interest." And so I gathered from engineers, from the space business, and started to learn more and more about what it took to do space missions.

03:21:00;03 And, but I came to the conclusion that really the problem, the reason why we weren't making more advancements in space was not that there wasn't enough public will. I think there's, actually, plenty of public will for space exploration particularly in the United States which is a nation of explorers. And I came to the conclusion that really there was a fundamental problem with space transportation.

03:21:21;15 And if the space transportation costs hundreds of millions

of dollars and billions of dollars and people don't think there's a way of doing it that doesn't bankrupt us, they're not gonna want to do it. So we've gotta figure out a way to do it that's affordable and workable and reliable. And that's why I started Space EX, it's really to try to make a huge difference, at least, in order of magnitude of more difference in the cost of space transportation and in the magnitudes of the capability of space transportation because we need very big rockets if we're going to, you know, make life multi-planetary.

BARRY HURD:

03:21:58;04 So the vision here is the movement of people to planets? Or is it just to supply a space station for awhile and see what happens?

ELON MUSK:

03:22:05;09 Well definitely, the long time vision is to help make life multi-planetary. So really these are all steps along the way to doing that. So we're starting off with a small rocket capable of putting half-ton satellites into orbit. We're about to do our third launch which will carry an air

force satellite and two small NASA satellites in about a month. And then we've got our big rocket under development, the Falcon Nine, which will, actually, be the most capable rocket in the world or at least, the Falcon Nine Heavy, which is a larger variant of it with two side boosters, will be the most capable rocket in the world.

03:22:42;04 And we, also, have our Dragon Space Craft. And then a couple years ago, we won the contract to design, build and operate the successor to the space shuttle which retires in 2010. So we will be taking supplies to the space station, [and] returning them to earth.

03:22:57;00 And then NASA has an option to add manned capability to our system, you know, to pay us to do [human] transport as well which we think they will exercise. And we're, actually, designing the whole system with people in mind from the beginning. So it's really a relatively small difference from one to the next.

BARRY HURD:

03:23:18;00 And to most people, I mean, we're coming and we're looking at this and we're thinking NASA. Compare and contrast the NASA approach and your approach at Space EX a little for me so we see the difference.

ELON MUSK:

03:23:29;09 Sure, well, it's important to appreciate that the actual hardware construction is done by semi- private companies. I mean, Boeing and Lockheed are the two biggest contractors to NASA. So when you see a rocket getting launched it is either a Boeing or a Rocky, Lockheed Rocket, typically.

03:23:46;29 NASA does not build the rockets. But NASA will contract with the aerospace companies, the big company contractors to develop and build these rockets. And that's typically done in a cost plus manner, where there's just a big fee, or there's a fee, or a total contract value and then Boeing and Lockheed will earn a fee that is a percentage of that contract value.

03:24:13;20 And if that cost increases, then they earn more. So actually it's not a very good incentive scheme because they're incented [sic] to make it more costly. And that's one of the problems that plague the cost of space exploration. You know, one of the big differences we're aiming for here is full reusability.

03:24:34;01 No one has ever developed a fully developed, a fully reusable orbital transportation system. That will be a really, really big breakthrough if we can do it. It's a very tough problem. You know the Soviet Union tried to solve [it]. The United States government tried to solve [it] and spent tens of billions of dollars collectively trying to do that and did not succeed. So it's a tough problem. We're gonna try to do it though with Falcon Nine.

BARRY HURD:

03:24:59;24 What's your plan if we go on two, four, six, eight years of what's gonna happen, like, next year or the year after? What are the benchmarks you're trying to achieve here at Space EX?

ELON MUSK:

03:25:11;10 Well, on launching Falcon One we are going to be launching Falcon Nine sometime next year. We expect it to have the rocket at Cape Canaveral around the end of [this] year and launch sometime next year. And that'll carry both heavy satellites over ten-tons to orbit as well as transport our Dragon Space Craft, deliver it to orbit so it can go to the space station and be re-supplied. So two years from now, we expect to have launched our big rocket, demonstrated, and re-supplied the space station. Four years from now, I think we will demonstrate manned transport. And six years from now, and we'll have our heavy lift launch vehicle operating.

BARRY HURD:

03:25:59;20 When are we going to Mars?

ELON MUSK:

03:26:02;16 When are we going to Mars?

BARRY HURD:

03:26:05;04 Are you going to Mars?

ELON MUSK:

03:26:05;22 There's a lot of variability around that prediction.

BARRY HURD:

03:26:08;05 Is that sort of in the back of your mind somewhere?

ELON MUSK:

03:26:10;22 Yeah, absolutely.

BARRY HURD:

03:26:11;12 Tell me just a little bit about why you wanna do that.

ELON MUSK:

03:26:15;16 Well, first of all, it's not that I, personally, wanna go to Mars. It's just that, as I said, I think it's extremely important that life become multi-planetary. And so you might say well, why do I think it's important? You know, aren't there lots of important things [happening] on earth that should be addressed?

03:26:31;12 And certainly there are. And it's not that it's important to the exclusion of all other things. Just that it makes sense to spend a small amount of our resources on doing this. And the reason it's important, is if you go to the nature of importance itself, how do you decide that anything is

important? Well, the lens of history is a good way to filter more versus less important things.

03:26:52;22 And as you zoom out further and further the really important stuff stays and the less important stuff goes away. Now, let's say you zoom out really far and look at the entire history of earth or history of life itself. What are the most important elements in the history of life itself?

03:27:13;15 Forget about parochial concerns of humanity. What would any species, any intelligent species say: "Oh, those were really important items?" Well, there's, obviously, single celled [life], multi cellular life, plants and animals, the animals you know, [sea-creatures] going out of the ocean onto land, having mammals, consciousness, [and] this [is] part of maybe ten or so big ones on that list.

03:27:42;13 And on that list, you, also, fit the extension of life to multiple planets for the first time. It will be, at least, as important as life going from the oceans to land and

arguably more important because life could [move] gradually from the oceans to land and if it got a little uncomfortable on the beach, you can hop back in the ocean. But [to] go extending life to another planet is a huge quantum leap.

03:28:05;22 You have to go hundreds of millions of miles across extremely hostile environment to a planet which is completely unlike anything you've evolved to live on. And that's just really an extremely difficult problem. In fact, I think it's an impossible problem without the advent of consciousness. So consciousness is a necessary precursor for that.

BARRY HURD:

03:28:29;28 It's almost like part of a grandness. [Do] you think there is some kind of destiny involved in this? Or is it just physics?

ELON MUSK:

03:28:38;25 Well, I do. Do I think that there's some sort of master intelligence architecting all of this stuff? I think probably not because then you have to say: "Where does the

master intelligence come from?" So it sort of begs the question. So I think really you can explain this with the fundamental laws of physics. You know its complex phenomenon from simple elements.

BARRY HURD:

03:29:07;21 Let me jump back and ask you. So you wanted this thing with the Space X, let's become multi- planetary. But you, also, got involved in the alternate energy [thing] [with] the electric car. I'm thinking, I guess you got one parked out front they're telling me.

ELON MUSK:

03:29:18;18 Yeah.

BARRY HURD:

04:00:51;01 Tell us a little bit about Tesla, how that started, and what your goals are for that.

ELON MUSK:

04:00:55;18 Sure, well, Tesla started with a lunch that I had with J.B. Straubel and Harold Rosen. Harold Rosen is somebody who's actually very famous in the space arena and also in the electric car arena. So that actually was what ended up

being the bridge from rockets to electric cars. Although I, as I mentioned earlier, had a long standing interest in electric cars because that's what I originally came out to California to do grad studies in.

04:01:24;09 So , I had lunch with J.B. and Harold and J.B. mentioned this company, AC Propulsion, which had this car called the TZero which was a kit car with lithium ion batteries that had a 0 to 60 mph and, 250 mile range. So I was, like, "Yeah, wow, that sounds great." And that sounds about right because if you go from nickel metal hydride to lithium ion, you about double the energy density. And the EV1 which was the nickel metal hydride car had had about a 120 mile range. So if you double the energy density, you're gonna get a 40 mile range or thereabouts.

04:01:55;14 So I got a test drive of the TZero, and I said, "Wow! This is really great. I tried to encourage AC Propulsion to go into production with the TZero or productize it essentially. But they weren't inclined to do that. They're sort of more

of an inventor type shop. They don't like to make product. So and I tried to get them to even make one for me, and they wouldn't make one for me.

04:02:21;23 Anyway, but they did end up introducing me to three guys, Martin Eberhart, Mark Topning, and Ian Wright, who were interested in productizing the TZero. So I funded the company and worked with those three guys to develop the Tesla Roadster. And the design ended up being an iteration primarily between myself, J.B. Staubel, the guy I'd had lunch with who joined Tesla right after I funded it, and Martin Eberhart.

BARRY HURD:

04:02:57;21 What are some of the things that we, the average person would look for in models, like sports car models and a medium price; the price will come down eventually? Anybody will be able to get an electric car like Tesla or?

ELON MUSK:

04:03:06;28 Yeah, with the Tesla Roadster, with the sports car, it's a two-seater sports car, very high performance. It says

super car performance. In fact, it'll beat any Ferrari or Aston Martin in acceleration. And it has more than twice the energy efficiency of a Prius. The fully-computer well-to-wheel efficiency taking a gallon of oil and converting that to generate electricity, taking transmission losses and charging losses into account, counting how many miles you get, and taking that gallon of oil and refining it to gasoline and seeing how many miles you get, that's how you get the well-to-wheel efficiency.

04:03:39;08 And the Roadster is more than twice as good as a Prius. But it's $100,000. And the reason is because new technology takes time to optimize. We're working on a model two which is a luxury sports sedan, four-door five-passenger, quite roomy, and that'll go for about half the price. And then we've got additional products in the queue which will drop that price by half again and get us to about a $30,000 car.

BARRY HURD:

04:04:09;23 Let me jump over to the-- is it Solar City.

ELON MUSK:

04:04:12;14 Solar City, yeah.

BARRY HURD:

04:04:14;00 Tell me a little bit about that, how that started, what that's doing, and how innovation plays a role in that company.

ELON MUSK:

04:04:18;12 Sure. With Solar City the idea there is to help solve the production side of electricity. So it's all well and good if you've got electric cars. But how do you produce the electricity? So that's why I wanted to do Solar City.

04:04:35;28 And there I have to give a lot of credit to Lyndon Rive and Peter Rive who are actually my cousins. But they're the guys making it happen. And although I contributed to the initial idea, that's really just a small part of the equation. As Edison said, "It's one percent inspiration, 99 percent perspiration." And they've just done a phenomenal job on executing that company and making solar power affordable. And also it's innovation on so many levels because there's the insulation and the construction of the

solar power.

04:05:13;04 But then you've also have to say, “Well, how do you make it so that people don't have to outlay a bunch of money?” Because solar power is very much a cost of capital type of business 'cause once you've paid for it, there's no fuel. So it's really how do you reduce the cost of capital for buying the thing in the first place. And they've come up with some very innovative financial tools working with Morgan Stanley. They set up a $300 million fund that allows people to establish solar power with no money down. So I mean how do you like this proposition? You put no money down, and your electricity bill goes down?

BARRY HURD:

04:05:48;06 What's not to like?

ELON MUSK:

04:05:49;00 What's not to like? Exactly. So they're growing like gang busters.

BARRY HURD:

04:05:52;05 Elon, let me ask you a question. You've got three

companies going, at least five kids that you know about, right? That's the joke. What's a typical day like? How do you juggle all this and keep it going?

ELON MUSK:

04:06:03;04 It's a little intense. Actually, I'm trying to throttle back because particularly the triplets are starting to gain consciousness. They're, you know, almost two. And well, before kids gain consciousness, they don't really know if you're there or not. I mean they know that people are there. They recognize familiar faces, but they don't know, and they don't have expectations that Dad will be home at a certain time. The twins do. They're four.

BARRY HURD:

04:06:27;04 You have triplets and twins?

ELON MUSK:

04:06:27;27 Yeah, all boys. So I definitely have to scale down my work activity within…I think I've got no more than a year.

BARRY HURD:

04:06:37;16 But you spend, I mean between these three big things going on now, is most of it here at SpaceX or is it, I mean

where do you do your work day, where are you putting [in] most of the time I guess?

ELON MUSK:

04:06:47;20 It does vary. So I mean right now I'm probably 60/40, or 60 percent SpaceX, 40 percent Tesla. Well, actually probably, 60 percent SpaceX, 35 percent Tesla, and five percent Solar City and everything else. So most of my time is really split primarily between SpaceX and Solar City. Long term I'd like to reduce the total number of hours worked and to be roughly 25 percent Solar City, sorry, 25 percent Tesla, maybe…

BARRY HURD:

04:07:24;08 Change the ratio?

ELON MUSK:

04:07:22;07 Yeah, change the ratio to be a little more weighted in favor of SpaceX 'cause I wasn't expecting to spend so much time with Tesla. And then also just to reduce the total number of hours so I have more time to spend with my kids.

BARRY HURD:

04:07:35;24 [With] all three of these endeavors there's a commonality

of this innovation in putting the people together and the teams and seeing things in a different way. Tell me a little bit more about the philosophy of how you make that all work, how you attract the people, and how you manage it. You talk about the first principles of physics. Do you actually apply the principles of physics to your philosophical thinking of how to do this? Or, take me into that realm.

ELON MUSK:

04:08:00;18 Well, what does the phrase “reason from first principles” mean in physics? It means that you go to the very basic laws of physics, the things to which we believe to be extremely well demonstrated. In other words, the reason they call it a law is that no one has ever demonstrated an exception to that, ever. That's how it qualifies as being a law.

04:08:26;28 But even then, laws can be broken where you can find some corner case in a very unusual circumstance that will break it. And that's the transition from Newtonian to

Einsteinian mechanics. Newtonian mechanics are actually extremely predictive of reality except as you approach the speed of light. Since, you know, back in the day with their primitive instruments, they couldn't detect these tiny little differences. So you know Newtonian mechanics appeared to predict everything perfectly.

04:08:59;23 But you take these very fundamental laws and you say, "Now let's use those as the ingredients from which we will construct a conclusion, a theory. 'Cause we know that base is sound, and we, so, therefore, if we're able to combine those elements in a way that's cogent, that conclusion will be sound. That's what I mean by reason and conclusive first principles. And I think that general approach can be taken in many fields.

BARRY HURD:

04:09:28;01 And how do you translate that to getting the right people to think that way, to these breakthrough ways of thinking of these innovations that go on?

ELON MUSK:

04:09:38;19 Well, getting the right people is extremely important. And I actually interview everyone at SpaceX personally. And we're a 500 person company. So that's a lot of interviews.

BARRY HURD:

04:09:51;14 What do you look for in someone?

ELON MUSK:

04:09:53;23 What do I look for? It depends on the task. You know, it's different, and I'm not necessarily looking for someone who has brilliant analytical ability if their job is going to be assembling hardware. But I think, generally, I look for a positive attitude and are they easy to work with, are people gonna like working with them? It's very important to like the people you work with, otherwise life [and] your job is gonna be quite miserable. And, in fact, we have a (CLEARS THROAT) a strict "no-assholes policy" at SpaceX. And we fire people if they are. I mean, we give them a little bit of warning. But if they continue to be an asshole, then they're fired.

BARRY HURD:

04:10:35;28 That's innovative, right?

ELON MUSK:

04:10:36;29 Yeah. Because you know, if your boss is an awful person, you're gonna hate coming to work.

BARRY HURD:

04:10:45;26 Yeah, you said something earlier about how, I forgot exactly the term, but how the United States is a great place to innovate.

ELON MUSK:

04:10:49;19 Yeah.

BARRY HURD:

04:10:49;12 Tell me a little bit. I know you must be really pro-American for innovation. Tell me how the way the U.S. has set up works that advantage for people like you.

ELON MUSK:

04:10:59;19 Well, I think the United States is more open to new ideas than any country in the world. And I think becomes somewhat of a self-fulfilling prophecy in that because the United States is open to new ideas, it attracted people

from around the world who had new ideas. And so it becomes, you know, so now it's filled with people who like new ideas. And who aren't bound by history.

04:11:29;04 You know, a lot of the countries that have been around for a long time are really trapped in their own history. And the United States is also a great melting pot of different cultures and ideas and thoughts and it's a country which tends to encourage success, where you sort of see someone that did extremely well, and generally, the reaction of the United States is good for that person.

04:11:52;10 In most [other] countries, it may shock people in the United States. In most [other] countries, that's not the reaction. People tend to think, "Oh, that person did well because they screwed somebody else." Or they try to rise beyond their station [and] that was really inappropriate of them to be nouveau riche, to use a French word. And Australia, for example, which is arguably similar to the United States in a lot of ways, but they tend to not, they

tend to try to knock down people that have risen too high. They're called the tall-poppy syndrome. You know, tall poppies get shot. So I think that's really a good thing about the United States.

BARRY HURD:

04:12:36;25 Tell me a little bit about what you think about people. [Do] you think ordinary people can change the world if they're given the right resources? Or, like you started out, you're basically an ordinary guy, but you're changing the world in a way, aren't ya?

ELON MUSK:

04:12:48;26 Well, you have to look at it, what's the definition of an ordinary person? I probably wasn't that ordinary. But my lack of ordinariness did not manifest itself until later in life. Or wasn't all that obvious. But I think people can choose to be not ordinary. You know, they can choose to not necessarily conform to the conventions that were taught to them by their parents. So, yes, I think it's possible for ordinary people to choose to be extraordinary.

BARRY HURD:

04:13:23;07 Now, let me ask you. Did you have mentors? Or was it your parents that were your inspiration, [or] an older brother? I mean what sort of drove you from that standpoint from looking up [to someone], [and] was there anybody you looked up to?

ELON MUSK:

04:13:36;09 Well I think on like Wikipedia it says that I was inspired by my father in terms of technology. This is actually not true. I think that needs to be corrected. He's somewhat of a Luddite actually in many respects, and particularly computers. He didn't wanna buy a computer and refused to use computers and said they would never amount to anything.

04:13:55;16 So I actually had to buy a computer with saved up [money]; I saved up my allowance. And he did contribute a bit after I saved up my allowance. But he initially refused to buy a computer for me. But he was an engineer, an electrical and mechanical engineer. So I was

exposed to technical subjects when I was growing up. It's just that he wasn't much of a technologist. As far as role models, I think there's obviously somebody, the obvious role models. I think Edison was certainly a role model probably one of the biggest role models.

BARRY HURD:

04:14:32;02 Did you study Edison's life?

ELON MUSK:

04:14:33;16 Yeah, I read books about him, absolutely. And it's an interesting contrast like Edison versus Tesla. The car company is called Tesla. And the reason it's called Tesla is because we use an AC induction motor, which is an architecture that Tesla developed. And the guy probably deserves a little more play than he gets in current society.

04:14:52;16 But on balance, I'm a bigger fan of Edison than Tesla because Edison brought his stuff to market and made those inventions accessible to the world, whereas Tesla didn't really do that. So he would certainly be a big one. And you know, I think the great technologists--Steve Jobs

at Apple, Bill Gates. I actually thought Disney was a pretty good innovator. I like Disney, yeah.

BARRY HURD:

04:15:30;06 Well, I mean you're gonna be in that role or you already are. How do you inspire people? I mean do you, what do you do to inspire people around here?

ELON MUSK:

04:15:36;17 What do I do to inspire people? Well, I try to make it a really fun place to work, really enjoyable. And I talk about the grand vision of SpaceX, where we wanna go, what we wanna do; we wanna take people to orbit and beyond. We ultimately want to be the company that makes a difference in extension of life beyond earth, which is one of the most important things that life itself could achieve. And so sort of you construct this great Holy Grail potential in the future. You have to stay grounded in the short term. 'Cause if you don't do things that pay the bills you're not gonna achieve the ultimate long-term objective. But it's nice to have that sort of Holy Grail long term potential out there as inspiration for coming to work.

BARRY HURD:

04:16:32;08 Yeah, I mean you're motivated obviously to make money. But and you wanna make money. But are you motivated beyond just profit motive and racking up dollars?

ELON MUSK:

04:16:41;13 Yeah, no, I'm a volunteer. I mean I don't need the money. There's nothing [I want to buy]. It's not like I'm sitting here saying, "I wish I could buy such and such a thing." I could buy it. I get paid minimum wage. Actually, I don't even get overtime. So but not being motivated, personally, by money is not the same as saying that I think SpaceX shouldn't make money. In fact, it's very important that SpaceX is profitable, or we'll not be able to earn the money necessary to continue future developments because the company's at a scale right now where I can't afford to just personally fund it and not get any [return], and we don't generate any revenue. We have to sort of earn our keep 'cause we're a pretty big company right now.

BARRY HURD:

04:17:23;00 So you gotta be financially healthy.

ELON MUSK:

04:17:24;12 Right, so SpaceX has to be financially healthy in that the cost of what we produce has to be less than the price that we charge people, or we'll all go into the ground.

BARRY HURD:

04:17:37;26 What qualities do you think it takes to create the stuff that makes innovative thinking happen?

BARRY HURD:

04:17:39;02 What qualities do you think it takes to create innovative thinking? What's some of the stuff that makes innovative thinking happen?

ELON MUSK:

04:17:45;00 Some stuff that [makes innovative thinking happen?] Okay. What makes innovative thinking happen? Well, I think it's really a mindset. You have to decide. We're going to try to do things differently. Well, provided that they're better. You shouldn't do things differently just because they're different. They need to be different or

better. But I think you have to sort of decide. Let's think beyond the normal stuff and have an environment where that sort of thinking in encouraged and rewarded and where it's okay to fail as well. Because when you try new things, you try this idea, that idea. Well, a large number of them are not gonna work, and that has to be okay. If every time somebody comes up with an idea it has to be successful, you're not gonna get people coming up with ideas.

BARRY HURD:

04:18:28;13 Do you think a lot of people in companies make mistakes and discourage people from being innovative? I mean if you were to give a message to people who wanna be an innovator and maybe come up with [new ideas], and maybe you're one of their inspirations, what would you tell the people, the young kids now who are thinking of creating the future?

ELON MUSK:

04:18:49;08 Could you say that again”

BARRY HURD:

04:18:49;22 I said, what would you tell young people who are starting out now who wanna help create the future, wanna be innovative?

ELON MUSK:

04:18:54;22 Yeah.

BARRY HURD:

04:18:55;04 What sort of things should they be thinking about or doing? And [what is] your message to the next generation that's coming up?

ELON MUSK:

04:19:01;14 Well, it's like the Nike slogan. You know, just do it. Just showing up is half the battle. You gotta try hard to do it, and don't be afraid of failure. You also need to be rooted in reality. It's easy to get high on your own supply. It's as Scar Face said, “you've gotta not be afraid to innovate”, but also don't delude yourself into thinking something's working when it's not, or you're gonna get fixated on a bad solution.

04:19:43;01 Yeah, and I think also just don't be afraid of new arenas. You know, you can get a book. You can learn something and experiment with your hands and just make it happen. Find a way or make a way to get something done. I don't know if that's helpful.

04:19:57;28

BARRY HURD:

04:20:13;11 Is there anything about Henry Ford's life that you studied or paid attention to that [might have influenced you]?

ELON MUSK:

04:20:16;00 Oh, well, yeah, absolutely.

04:20:17;09

ELON MUSK:

04:20:21;29 Yeah, actually there's a lot of things about Ford that I think are really interesting. He's often associated, obviously, with the moving production line. That was a big innovation. But Ford was just the kinda guy that when something was in the way, he just found a way around it. He just got it done. He was also big on vertical integration, which I actually think is good. In [the] modern

world, people have started to think that vertical integration is bad. I think Ford was right that you do wanna be vertically integrated. Not to a silly degree, but you do wanna be vertically integrated.

04:21:02;15 I think it's good to combine engineering and production. So have development and production close together because when you try to make something there's a big leap between making that first prototype and actually making it, manufacturing it in large quantity with good quality. It's really hard to make that leap. And for some reason people decide, “oh, they're gonna do engineering here and do the manufacturing on the other side of the world.” And I think that actually ends up being, often being pretty inefficient. I like that combination of engineering and production.

04:21:43;26 What else is there? You know, Ford, at least in the beginning of his career, I think he got a little too high on his own supply later in his career, or Ford would have

remained the largest car company in the world. But at least the beginning of his career, he actually was really focused on what the customer wanted. What the customer needed. And sometimes the customer doesn't actually know what they need. But he really figured it out. Like, if we can make this car really affordable, reliable, something that finally [someone] can depend on their livelihood for, man, that's really gonna make a difference in people's lives. And he just really got focused on that.

04:22:25;06 Now, over time, he should have decided, okay, sometimes people want a color that's not black. And so he should provide that to them. But at least in the beginning of his career, he just had tremendous insight into what would really make a difference as a product.

BARRY HURD:

04:22:39;18 And a final question. When this capsule behind you is ready, you goin' up?

ELON MUSK:

04:22:45;11 I will eventually go to space, yes.

BARRY HURD:

04:22:47;25 So that's part of a serious plan?

04:22:50;13

ELON MUSK:

04:22:54;28 I do wanna go to space and eventually it would be really cool if I could go to Mars. That would be super awesome. But this is not about me getting to space, it's really about enabling others to get to space. It's about enabling the extension of life beyond earth. So I'd like to go in the first one. Actually, if I didn't have all these [projects], so much depending on me, I would, actually.

04:23:19;28 You know, early in life, I did lots of risky things when I didn't have that much that was depending on me. Now I have to be more cautious about risky things. But eventually I will definitely go up.