Center for Strategic and International Studies

# Unpacking Impact

# "Wes Kremer: "Lack of Adequate STEM Education is a National Security Threat""

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FEATURING:
**Wes Kremer,**
*President of Raytheon Missiles & Defense, a business of Raytheon Technologies*

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**H. Andrew Schwartz,**
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| Navin Thukkaram: | Welcome to Unpacking impact, a podcast that explores how rapid digital transformation shapes economics culture, jobs policy, and of course, you. Each episode, we speak with thought leaders that are playing and changing the game at the highest levels. |
| | Today, we are joined by Wes Kramer, president of Raytheon missiles and defense. As president, Wes leads over 30,000 employees globally, and is responsible for a broad portfolio of air and missile defense systems. Previously, Wes served in the US Air Force as a weapons systems officer, flying more than 90 combat sorties in Iraq and Bosnia. We discuss the impact of digital transformation on the defense industry, COVID-19, and the importance of improved education for the future of STEM. I'm Naveen Thukkaram. |
| H. Andrew Schwartz: | I'm Andrew Schwartz |
| Navin Thukkaram: | Let's begin. |
| | Well, Wes, thanks so much for being on the podcast. Couldn't be happier to have you on Unpacking Impact today. So, let's just kick it off and try to set the stage. You know, your business is working to transform inside and out. Can you talk about the digital transformation journey, what that means, and sort of the impact of these new transformational tools and what that impact is on the defense industry? |
| Wes Kremer: | Glad to be with you today. And, you know, I think that digital transformation or digital technologies is one of the most interesting things that's happening, and you know, this isn't completely new, certainly we've had digital models who do a lot of simulations and this is something that's been going on for many years. But what we've seen most recently is a real acceleration, not only in the technology, but also in the pull function from our DOD customers. Is that because of the threat that we face, especially from places like China, we really have to go faster. And the defense acquisition processes has not been known as being the fastest process on the planet, and now we have a real drive-in kind of breadth that is forcing all of industry along with DOD to really look at ways to not only streamline contracting mechanisms and stuff, but for the actual product development, to be able to go faster. And I think that's the underpinnings of what really digital brand or digital transformation is all about. |
| Navin Thukkaram: | What's the impact of being able to go faster? Is it primarily a reduction of cost, or is it an ability to get the technology out to market faster that could |

impact a certain outcome?

Wes Kremer:     Yeah, its actually both. And in some ways, if you do something faster by definition, it's going to be cheaper or have us all a faster development cycle. But you know, if we look at the early parts of development, if you can eliminate cycles of learning, so if we can go all the way down to the very basic levels of design, you know, many things that in the past the circuit card or an ACX circuit, you had to go through multiple iterations of a design to get something that would actually work. But what we're seeing is the fidelity of the tools, the design tools is so much better now, and we can actually, you know, do a first pass success. We also have the ability with things like machine learning and artificial intelligence to link those models together. And what's really exciting is that when you combine that with additive manufacturing or 3D printing, as it's sometimes referred to is, you know, if the concept then now is that you could design something totally in a virtual environment, you could essentially model it in an operationally representative scenario, and then you could essentially hit print and print something and you could meanwhile, be testing it in a virtual environment. And, you know, when you look at how long these timelines take on DOD programs, there's an incredible opportunity here to go faster.

The second part of that is the ability to do what we call PPI, preplan product improvements. And so, you think about, you know, I heard the example the other day of a rocket motor, is it it's typically about a 10 year cycle to make a modification or to qualify a new rocket motor. You know, what, if we could make modifications in just a year or two or a fraction of that time and to continually upgrade capabilities in actual hardware, not just software. And those are the kinds of things that make it exciting, but also make it incredibly relevant to our customers around the world.

Navin Thukkaram:     Can you tell a little bit about how artificial intelligence machine learning is impacting some of the things you just mentioned? Maybe you gave us a little case study on somewhere that AI is particularly impactful for your business or a particular product.

Wes Kremer:     You know, one of the products that we build, it asked to be able to pick out a, you know, tell the difference between like a wheeled vehicle and a track vehicle and be able to do that through the weather. And so, we used artificial intelligence and machine learning for this to, you know, fly many different trajectories against various target sets and essentially create a learning algorithm so that it can operate on the fly and it can respond to a dynamic environment and be able to, you know, go exactly with what the pilot asks it to do. So, you know, that's just a simple example of how we're applying the technology to what we do.

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| H. Andrew Schwartz: | Wes, can I ask you, you know, digital transformation, isn't really a new concept. What in your view is the big change here? What's, what's essentially new and is it sustainable? |
| Wes Kremer: | Actually, I, I think it's more than sustainable. I think what's really new is that on so many different fronts, um, the fidelity of these models is getting much better. I mean, you know, we look at like what we call the FTM 44 mission here a few months ago where we shot down an ICBM with an SM 328 missile. If you went and looked at the modeling of that, you would see that essentially the flight trajectory and everything came out exactly on line with what we had predicted in the models. And so that means the fidelity is just getting so much better. You don't have to do tens or hundreds of tests. You can just do a couple of tests to kind of anchor your model. |
| | So, one is the fidelity of the models, the other thing, and I think this has been a big transformation that's been driven a lot by artificial intelligence and machine learning is the concept of being able to take disparate data and essentially rationalize it and learn from it, right. We used to think that everything had to be in a relational database and then it all had to be formatted to be able to do that. What the artificial intelligence algorithms have done is allowed us to be able to take data from all different formats, from all different types of databases and essentially make sense out of that data and be able to use it. So now, if you apply that to our industry and to defense, what that allows you to do is now to connect models together. So, we can connect a mechanical model to a thermal model, to a performance model, to a cost model, right? And when you start doing all of those things together, that's really the power of this. And I think we're just scratching the surface. All of those things that I just talked about, you know, are actually going to get better and they're going to get better at an exponential rate. And that's what we're seeing. |
| H. Andrew Schwartz: | So, this brings me to my next question, because what you just did is exactly what we're trying to do in this show is unpack impact and understand some of these new technologies. And Naveens smiling because, you know, this is, this is, this was Naveen's vision when we actually started this podcast. So, thank you for that really interesting answer. I want to ask you, you know, if you're on the cutting edge, what kind of impact does this have on the policy-making process? And what is it, you know, where, where are you seeing that? |
| Wes Kremer: | Yeah, so I think Andrew, here's one of the areas that will be very interesting in the defense industry, as we see is, you know, for decades, the concept has been man in the loop, right? We never deploy lethal force without having a man in the loop, somebody to push that fire button, make that final decision. And what we're seeing is we're moving to something called man |

on the loop where, you know, you kind of set the conditions and when those conditions occur, you know, it happens at the speed of light decisions are made and they're pre-programmed. And what we're eventually looking at is would we ever get to a, of not having a person in the loop? And now when you think about that from a policy perspective, again, that's not something that I'm going to decide, or the defense industry is going to decide. I mean, these are things that are really, you know, national security and policy issues that will be set by DOD, Congress, and, you know, maybe even international standards on things like that. So, the technology is going to force us to address policy questions like that.

H. Andrew Schwartz:

And is that going to be addressed in Congress? Will it be addressed at DOD, a little bit of both? How, how is that going to work? Because I mean, you really are in a new frontier here. And, you know, we, we do know that it's hard for policymakers sometimes to keep up with the innovations that are going on in the private sector. And this is another reason why Naveen and I wanted to do the show is because, you know, all of this technology, all of this innovation is having an impact on how policymakers react and deal with these things. So how do you see that equation for you guys?

Wes Kremer:

Well, I think we can draw, Andrew, a real parallel here to what's going on in cyberspace right now. Right. We've got the cyber issues, we've got cyber-attacks and, you know, it's a fundamental thing at, at what point does a cyber-attack become an active or at what point do you retaliate and do you retaliate in kind, or do you retaliate with, uh, a bigger force kind of thing? So, I think we see a lot of parallels in that. You know, I, I don't know what the answer to that question is. I think it's kind of all of what you said. I think that Congress will play a role in that the Department of Defense will play a role in that, you know, there may even be standards along the lines of, you know, of how warfare has governed, like the Geneva convention, right? So, I think there's, this is an area that's very interesting, it's a lot to be explored. It was interesting. One of our customers put it to me this way, so that Wes, you know, I think the job of industry is to come up with what's possible. And then, you know, the using community, the politicians and the war fighters are going to have to then decide what to implement. Um, so I think that's what we're looking at is what's in the realm of the possible? And how do we actually bring that to a point and find that middle ground, or find that what's acceptable because, you know, speed becomes the essence of that battlefield advantage, right? It's that the ODA loop, right? The decision who makes the decision fastest, and it's always going to come down to now, it's not about the human it's about the machines and the computers and the processing power to be able to take huge amounts of data, transform that into information, to make split-second intelligent decisions that eventually could be life and death kinds of decisions.

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| Navin Thukkaram: | Yeah, and Wes you bring up some very interesting points that we'll probably be wrestling with for at least another decade, because you've seen how hard it is for regulars, just to regulate who's responsible in a self-driving car accident. Now we're talking about warfare, this is exponentially more important as we understand, and has all sorts of diplomatic implications. |
| H. Andrew Schwartz: | That's a really good point. |
| Wes Kremer: | Yeah. And one interesting thing on that is I remember, you know, there was a program back in kind of the mid-nineties that was called the UCAV, unmanned combat air vehicle. And at that point in time, we were talking about, would we ever arm an unmanned vehicle? Well, you know, we're, we're well past that now, right? And so, these things are natural evolution of technology and as technology advances, then that forces policy to update, to figure out how to manage that technology and how to use an employee. So, I, you know, we can draw a lot of parallels here, but I think what we're talking about, and kind of unpacking today is, you know, what do we see in the future what's coming next? |
| Navin Thukkaram: | It's really interesting. And I wanted to save this question for the end, Andrew, cause, you know, I wanted to ask it, which is, you know, we're living in an interesting time where reality and science fiction are one and you know, we've all seen the Terminator. We've all seen a lot of fun science fiction movies, but now we're at the point where a lot of that stuff or some of those things are possible. What do you say to folks that that might say, hey, this is the dystopian future that we're all hoping to avoid? And how do you regulate artificial intelligence, whether it's self-regulated within the companies or regulated by the government so we don't have a dystopian future where the machinery and the weaponry are making decisions that we may not agree with it. |
| Wes Kremer: | You know, that's a really tough one. |
| Navin Thukkaram: | A really tough one. I understand that. |
| Wes Kremer: | A really tough one, but I, I do think there are some important guideposts here, right? Is that we still have to look at doing things that are morally and ethically, right. And, and I think that, you know, there's values and in companies and whether it's a defense company or a technology company, and, you know, we talk a lot about ethics and business, and you know, there's a lot of courses now in college and ethics in software ethics and artificial intelligence. I mean, that's a topic that is becoming to the forefront. And I think the great thing is, is that, you know, we're taking this on early its |

college courses are, are young, brilliant engineers that are taking those courses while they're there. And they're thinking about that as they're being, given their education and what I think we have to make sure we stay in touch with that, you know, you know, at the end of the day, you have to be able to say that, you know, we do what's morally and ethically, right.

**H. Andrew Schwartz:** Speaking of what's right. You know, I wanted to ask you a question about, what's been the impact of the pandemic on, you know, Raytheon Technologies and on the defense industry in your view as a whole?

**H. Andrew Schwartz:** Yeah. On one hand, it's been an incredibly challenging year, right? We literally went from overnight from, you know, 180,000 employees coming in, working every day to overnight 50% of those work from home. And that's pretty much what we've been operating at about 50% of our employees between factories, classified work, things that can't be done at home have been operating. I think that what we've learned from this is that, you know, we probably don't need to do as much travel as we did in the past. There are a lot of things that we can use technology, you know, we can do inspections and parts virtually. We don't have to fly somebody to a vendor to go accept parts. We've learned that a lot of meetings can be done virtually.

**H. Andrew Schwartz:** I want to stop you there for a second. So, you can actually inspect parts that go into sensitive systems virtually?

**Wes Kremer:** Sure, sure. Yeah. You know, say a mechanical part, right? You can put it against the template and compare it. We can look at test results. And I think that, you know, Andrew, you bring up a really good point here because when we talk about digital technology and design, one of the biggest changes is going to be how industry and government interact right now. We do, you know, a waterfall or cascading kind of effect work. We do all this design work and then we create thousands of PowerPoint slides and a hardware representation. And then we test it, and we go prove it. Right. But in a digital environment, the proof is the model itself. And so, it's going to have to be more collaborative, right? We're going to have to be every single day. We have an agreed upon model. And I'll give you an example of one of our programs today. We actually, the design updates to the software, uh, from our vendors are compiled every single night. And then this weapon flies 6 million miles every single night in a virtual environment. And it's evaluated for survivability other parameters and in the morning, um, not only our engineers, but our government customers have full access to that same data. And the idea here in a digital environment is that it's not your artifact. It isn't a bunch of PowerPoint slides and a bunch of test results. Your artifact is the series of models from the cost model to the performance

model, to the mechanical model that all of those together that's the deliverable. And so, when you think about that, that starts to become a little bit mind-bending of how that's going to change, how we contract, how we sell something off and how our customers buy.

**H. Andrew Schwartz:**

So, Wes, you've just told us something truly revolutionary. It seems like with this technology, the defense industry and the defense community might be moving a little bit away from PowerPoint slides? Is that actually true?

**Wes Kremer:**

You know? Absolutely. And one of the things that I'm trying to get, let's give you an example from my staff meetings, is I'm trying to get away from PowerPoint slides and say, when I look at the health of my organization and how we're performing, I just want to see the real time dashboards of quality of productivity of backlog, of, you know, bill of materials, uh, status. I want to see the real time data on that, not a PowerPoint presentation of summarized data. And so, we're trying to drive that in our company to get away from PowerPoint. And let's look at real time data, let's look at trend lines and let's focus on those things.

**Navin Thukkaram:**

It's interesting to hear about how you guys are dealing with the pandemic and using cutting edge technology to deal with people not working in the office anymore. I'm curious specifically within defense, because defense is a very broad word or other areas, what industries and sectors do you think are going to benefit from the new normal that we're in right now and what areas do you think might lag?

**Wes Kremer:**

Actually, I'll start with the latter first, the area that I worry about almost the most on lagging is the contracting. Right? We often see that at the end of the day, we can talk about all these things, but at the end of the day, we sign a contract, and we adhere to the terms of that contract. And so, I think what has to change is the contracting mechanisms of how we do this, because you think about all the things that are, we call CDLIs, a contract deliverable line item, you know, those are all written around that waterfall technique of the PowerPoint slides of the test results of all the things that we just said are going to go away in a digital design environment. And so, getting wrapped around that, I mean, we already went through this once with, you know, software engineering or Dev Sec Ops, right?

We went from the standard waterfall of, you know, do one build of a software. I test that, I deliver the results. I do build two kinds of thing to this iterative or continuous build. And one of the biggest challenges we have in that was getting the contracts written around a new method of doing software development of the Dev Sec Ops. And now you're kind of doing that on steroids. You're taking the entire development process quality,

right? We're not going to inspect quality in the, and this becomes very true when you talk about additive manufacturing, of when you 3d print a complex part, you can't inspect quality in, at the end, you have integrated features that are completely internal, that may even be hard to x-ray or anything else. So, you actually have to make sure that you have incredible process control of the actual, you know, laser that's taking the power and building it into, you know, whatever that part is. And so, you think about how this affects every single aspect of what we do. And somewhere there used to be a contract line item that said how we were going to do that and what the deliverable was. And those are all going to get upended in order for us to truly take advantage of everything that digital design has to offer.

H. Andrew Schwartz:

Wes, I wanted to ask you, you know, your business, your industry has traditionally been about a couple core things. One is, you know, high technology, high quality, great solutions. Another has been, you know, a lot of your businesses based on relationships and building and sustaining those relationships. How are you addressing COVID and vaccinations in your efforts to bring people back to the office? Or are you offering flexible work arrangements? What's that going to be like for Raytheon?

Wes Kremer:

Great question. And I think this is another area where we've really learned during the pandemic is that we've learned that we as an employer need to be more flexible. We need to offer people more ways to work from home. You know, some jobs obviously don't have a choice, but there are a lot of things where people can work from home. We are looking at more of a hybrid model of where certainly we will have kind of, I'll say three groups, you know, we'll have the people that come in every day, the people that largely work remote, maybe come in once in a while, and then we'll have that group in the middle that comes in on some regular schedule a couple of days a week. But think about what this offers us in terms of, you know, of, of being able to streamline our infrastructure, right.

I can have two organizations that essentially share the same office space and they just deconflict which days of the week they come in. So, we think that, you know, this can offer, you know, in the neighborhood of a 20% reduction in our overall office space. And when you start thinking about what that means to be able to lower our rates, to make us more affordable, to lower the price of things. So, I think there's a lot of things that we're learning out of this that are positive. I also think of flexible work schedules. You know, one of the examples I use is that, you know, in working from home, we had a lot of, you know, parents or single parents that were homeschooling and doing all of that. And so, you know, literally we would see that they're logging onto the network or making phone calls to Europe or something, you know, really early in the morning, they kind of, you know, I have to spend time with the kids during the day and then making

calls to Asia and do an email late in the evening.

Well, if I ask somebody to sign up to a schedule like that, that would be, you know, that would be a lot to ask. I probably wouldn't get many volunteers, but yet that becomes for that person, having the flexibility to be able to do that, allow those people to do what they needed to do for their family and still be in their job. And at the end of the day, if the body of work gets done, you know, should I care so much about where they're sitting and that it's happening between the hours of eight and five. And so, I think there's a lot of learning that really came out of this stuff, certainly for our company, and I would suspect a lot had the same experience.

Navin Thukkaram: Wes, I wanted to switch gears just for a second and ask a question that speaks not to only your experience in the defense industry, but actually as a veteran of the United States Air Force. First off, thanks for your service. I understand that you serve both in Iraq and in Bosnia putting that hat on or that flight suit on as the analogy may be. How does that person's job change today relative to when you were serving in the theater of war? Like, what are they dealing with? What, what kind of information are they seeing on their screens or in their ears to help them make better decisions, whether it be from AI or things happening automatically. Now give us a sense of what that's like. Cause I think that's a very unique perspective that you bring to the table.

Wes Kremer: Absolutely. And it's probably best told by something that just happened here a couple of years ago. In Raytheon, we, we sponsor a trophy called the Raytheon trophy and it's the, it goes to the top fighter squadron in the Air Force every year. So, the Air Force selects that. And then we sponsor the trophy, and I had the opportunity a couple of years ago to go travel to a squadron. And it was a, it was an F15E squadron. So, the, the plane that I flew and present this award, and we were there for a couple of days. And I have to tell you that, you know, talking to them, young men and women who wear the flight suit today, and to give you an idea of how old I am, you know, one of the pilots there was, uh, you know, I flew with his father, so you know, definitely made me feel old. But what I really, what struck me is, you know, how much that plane cause I'm very familiar with that has changed and how much more information and data is being presented to that air crew.

And not only that, the complexity of the environment in which they operate and, you know, for example, the rules of engaged of, you know, our men and women do everything they can, including calling off missions and stuff. If they think, there's a chance of collateral damage or or hurting civilians. And, um, I think that, you know, it's absolutely incredible what they do. And, and I'm an admiration of all of our war fighters out there that are operating in an incredibly complex environment that is just saturated with data and

information. And oh, by the way, it's also being watched, everything's being recorded, there's a predator or something overhead taking video of that. And then, you know, people are reviewing that after the fact. And so, what would impress me most is just the sheer amount of data, but the end, the professionalism of, of every single one.

**H. Andrew Schwartz:** And now according to 60 minutes, some of your former colleagues in the Air Force are dealing with UFO's or UAPs or whatever they call them. And that must be something that the defense industry is thinking about too.

**Wes Kremer:** Yeah. You know, I don't know. I honestly, haven't spent a lot of time thinking about that and I don't have any experience with that. I kind of find it kind of fascinating, but it, I guess, interesting to see how this unfolds.

**H. Andrew Schwartz:** Yeah. I thought it was interesting too. Switching gears, a little bit, you know, what are some of the industries do you think are going to really come out and what sectors are going to come out of the reopening in the global economy and really succeed in what are some of the ones that you think, you know, may lag?

**Wes Kremer:** Yeah well, the one I wouldn't want to be in is commercial real estate, for sure. And truly, I mean, I think that, you know, uh, companies are re-evaluating areas on that. I think that, you know, clearly the technology kinds of things, the capability to deliver things remotely, you know, one thing we talked about, um, was, you know, our ability to inspect things or to accept things remotely, we have a system that essentially is the two-way communication, right? It's a pair of glasses that you can wear, and you can see what the other person is saying, and you can transmit stuff to them. So, you can virtually be there. And whether that's to go inspect a part at one of our suppliers, or whether it's to, you know, with a field technician at one of our deployed locations around the world, instead of having to send an engineer or subject matter expert, we can, you know, have them virtually be there with the technician that's onsite and offer their expertise to conduct a repair, to do a test, to troubleshoot or diagnose something. I mean, those kinds of things. I think that that speed the way in which we deliver technology around the world are going to be the, the companies that will emerge stronger from this.

**H. Andrew Schwartz:** What about STEM? STEM skills are essential in your line of work. And how do you see the importance of stem education and especially in its national security implications?

**Wes Kremer:** Yeah, you know Andrew, this is something I think about every day and we as a company make STEM, one of our number one priorities. Right now, in

Raytheon Technologies, we have 60,000 engineers and just, you know, feeding that pipeline alone. And we're just one company and everything is becoming more technical. You know, we used to think that we had competition from other defense contractors for our technical talent, but we lose talent to Google, to Amazon, to, you know, Microsoft and companies like that. I mean, the ability of companies to attract the best and brightest talent is also a discriminator in this environment that we're in today. We're, we're all looking for the best and brightest. And I tell you that when I talk to young kids, the number one thing I is go, you know, if you have any entrance in science, technology, engineering, or math, stick it out, go to college, get a degree in STEM, but I'll give you an interesting statistic that I think is, is something that we have to address as a nation is that in most states, the high school curriculum only requires three years of math. And most kids take that freshman, sophomore, junior year. And I can tell you for a fact, it doesn't matter how smart you are. If you take a year off of taking math and then go into college and want to start with calculus or an engineering program, you're going to be behind and it's going to be discouraging. And so, um, there are some states that have started to change this, but I'll tell you, one of the things I advocate for is I think it should be the curriculum in every state is that you're required to take four years of math and it doesn't have to be calculus, but if you take four years of math, at least you're going to be in a position that when you go to college, if you want to get a technical degree, you won't be in a remedial class and you won't be starting there saying I can't graduate in four years because I'm behind on that, so I think there's simple things like that, that we can do.

One of our biggest programs is we take engineers and volunteer in the local communities. And we do rocketry contests. We do building Galileo, telescopes, you know, anything to get kids interested in math. And what, you know, data shows us is that where kids lose interest is in junior high. So, you have to go address this at the middle school level. You have to get middle school students interested in science and technology and understanding that that's the way our world is headed. And you know that that's a way for job security and financial security is to get involved in the science, technology, engineering, and math curriculum.

**Navin Thukkaram:** Well Andrew maybe we can help the world a bit and connect a west with our, our previous guest Dean Cayman. They can go fix STEM together.

**H. Andrew Schwartz:** Absolutely be a great one, two punch.

**Wes Kremer:** You know, it's, it's, it's a tough one too, right? Because every kid in the country has an iPhone and relies on technology for what they do. But yet the number of people going into, into the STEM career fields is going down.

And I think the other area we really have to target is are underrepresented populations getting more diversity into STEM? I mean, it truly is the way of

the future and anything that we can do to get underrepresented populations and to get more diversity into the STEM curriculums will absolutely serve bonuses many years down the road. That's the way we view it. It's not just about recruiting people for Raytheon. It's about, this is a national security issue in our country is that we need to continue to encourage kids from all backgrounds to study and to go into the STEM curriculum.

**Navin Thukkaram:** Wes, could you elaborate that a little bit further in terms of, I think you made such a great point with, which is that falling behind in STEM education is a national security issue. Can you just flesh that out for us a little bit?

**Wes Kremer:** Well, I think it's kind of it kind of summarizes all the things we've talked about on this podcast, right? Is we talked about whether it's artificial intelligence or digital design is that every aspect of my business is becoming more digital every single day? And I'm facing competition from not just, you know, defense contractors, but from all industries. And so when we think about that and we look at it and bring it up to the national level, I mean, we are in a, you know, a power struggle or a competition here, especially with something, someone like China and it's on all fronts, it's on economic, it's on military, and it's certainly on technology and, you know, the direction that we're headed and, and our numbers of, of kids that go into STEM curriculums and the output of the engineers, some scientists and technologists is not where we need it to be. Emerging fields like cyber technology, right, we're just now getting curriculums around cyber technology. There's areas like that, that we, you know, I do believe it is a national security issue that we have to get more people involved in this, or we will be outpaced by other countries.

**H. Andrew Schwartz:** Wes, we like to close by asking our guests, you know, if there's anything that gives them optimism for the future. And I think you've given us a lot to think about in this podcast, but specifically, you know, is there something that gives you optimism going forward?

**Wes Kremer:** Yeah. You know, there's actually a lot of things that give me optimism, but I think the one thing that we always know is that I think our future is bright. When I, you know, nothing gives me more energy than to go out and get briefed by one of our young engineers is I'm always impressed. Um, despite the challenges we talked about about numbers in STEM, I have to say that the quality of the students that we see coming out of engineering schools today is absolutely phenomenal. And what these kids do is amazing. In fact, you know, my son just graduated from college with a degree in electrical engineering on Sunday and what he does and what he knows already compared to when I got my degree, it's absolutely amazing. And his

willingness to take on challenge, you know, our, our kids nowadays in the video game era, they're, they're fearless, right? They're willing to try anything because they just hit reset and they're not, they're not intimidated by anything. And I think those are the things that give me optimism, and it's going to be so critical as we move forward on this journey of digital engineering.

H. Andrew Schwartz:

Well, congratulations to your son, congratulations to you. Good to know that we're going to have another engineer in our society, working for us for the United States and all of its different industries and possibilities that he can get into. So thank you for this terrific podcast Wes, we really appreciate it. And I know our listeners are going to be a lot smarter for hearing your insights.

Wes Kremer:

Thank you for your time today. This was a great conversation.

Navin Thukkaram:

Thanks a lot Wes.

(END)