Center for Strategic and International Studies

TRANSCRIPT

Event

"Missile Defense at 40"

The Industrial Base for Missile Defense

DATE

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FEATURING

Debbie Barnett
Vice President of Strategic Missile & Defense Systems, The Boeing Company

Lisa Brown
Vice President & PM for Next Generation Interceptor, Northrop Grumman Corporation

Tay Fitzgerald
President of Strategic Missile Defense, Raytheon Missiles & Defense

Miriam Marwick
Senior Vice President, Federal, Emerging Technologies, Palantir Technologies

Paige Rumberg
Director for Missile Defense, Government Affairs, Lockheed Martin Corporation

Marcus Weisgerber
Global Business Editor, Defense One

Transcript By
Superior Transcriptions LLC
www.superiortranscriptions.com

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Marcus Weisgerber: All right. Good afternoon, everyone, and welcome to what is the last panel of the day. Our panel is called the Industrial Base for Missile Defense. We have a great group assembled for you today and I want to thank CSIS and the Reagan Institute for holding this event.

I'm Marcus Weisgerber. I'm with Defense One. I write about the intersection of business and national security.

So real quick, I'm going to introduce each of our panelists. I'm then going to ask each of them to speak for four to five minutes and give introductory remarks. We'll then have a moderated discussion for 20-ish minutes or so and then we'll take some audience questions and questions from our viewers online.

So with that, let's go down the line. We have Miriam Marwick, senior vice president of federal emerging technologies with Palantir Technologies. Miriam, thanks for coming.

Then we have Debbie Barnett, vice president of strategic missile and defense systems with Boeing. Thank you for coming.

Tay Fitzgerald, president of strategic missile defense with Raytheon Missiles and Defense. Thank you.

And then we have – sorry, the list is not in order. We have Lisa Brown, vice president and program manager for the Next Generation Interceptor, Northrop Grumman. Thank you.

And last but not least, Paige Rumberg, director of missile defense for Lockheed Martin government affairs. Thank you.

All right. So why don't we just maybe go down the line and we'll start with Miriam, who just happens to be next to me.

Miriam Marwick: OK. Thank you.

So I'll start with some opening remarks.

Mr. Weisgerber: Please.

Dr. Marwick: I'll introduce myself. OK.

So, first of all, thank you for inviting me to participate and share some thoughts today. I joined Palantir Technologies, as Marcus pointed out, about two years ago. I, prior to that, was an analyst for the system evaluation division at the Institute for Defense Analyses for actually over a decade and

in that role I got to conduct several studies on missile defense and strategic deterrence as well as conduct some technical analyses of many of the systems in question that comprise our missile defense enterprise.

So I'd like to offer some observations. On this panel, obviously, we have some pretty formidable companies represented here. I wanted to give the perspective of a software company as a former electrical engineer and analyst of weapon systems and what my perspective is from my perch at an advanced commercial software company.

So three observations that I wanted to share. First is that even our most exquisite and impressive capabilities with respect to missile defense are as effective as the ability of those who operate those systems to actually effectively deploy them in the time of crisis and the time of conflict, and so when we define the requirements for our missile defense systems we tend to stack them up against the threat, against very specific targets that they're meant to defeat, and in doing so we sometimes make assumptions about what the operator knows about the entire scenario or the crisis at hand or all of the intelligence that supports our understanding of the conflict at that time, that individual who – and decision maker or that part of the operational community who is under that threat at that time has to make the decision.

So the window of time to react during an event or conflict is incredibly limited and so we are always thinking about how software can improve our ability to react really quickly to – and really effectively to a specific threat.

So advanced software helps in a number of ways. First of all, it allows us to do the large-scale fusion and data integration, ensuring that the decision makers at that point of operating missile defense systems have all the information including intelligence information that's gathered left of launch and they have that at the moment of a launch.

Second, we understand that software can dynamically deploy a certain level of selective automation. So I can speak about AI a little bit later. But just straightforward automation often can reduce the cycle of decision making pretty significantly and that by itself changes the effectiveness of the actual weapon systems in question.

And, third, software creates a very connected battle space and a very holistic picture of everything that's going on and everything that needs to be considered when defeating a particular threat.

The second observation I'd like to make is that we're often very careful to design systems around specific missions, and an enduring challenge in

missile defense, from my perspective, continues to be how do we integrate all these capabilities together, as Vice Admiral Hill mentioned earlier.

What we really want out of our missile defense development is a collective system of systems, not a specific we can solve this with this but being able to bring everything together to address the overall threat to our national security.

So, if designed correctly, a software platform can maximize the modularity, the interoperability across various missile defense systems. It can fuse data from any number of sources and, therefore, the more sensors, the more sources, the better off we ultimately are but only if we have the right software that can handle that massive influx of information that we're trying to use.

I think this is where, you know, the ability to have companies, industry, be able to work together and collaborate on hardware and software advancement is where we will see the most significant change in the future.

And the third observation is that I have seen some resistance to the idea that AI or automation is a value or makes a contribution to the safety of operating missile defense systems and there is a thought that, perhaps, it could increase the risk of escalation.

Actually, what we have seen is that in the right hands, developed by the right people, the right experts, AI has the potential to really significantly reduce the risk of escalation and the reason I say this, AI automation, both of those, as a baseline principle we believe at Palantir that humans belong in the loop, that humans are at the center of decision making, and that AI or autonomous contributions don't take away the power of human decision makers but actually augment it significantly, make them much more effective at what they need to do.

And when time is of the essence actually is not the time to test the limits of the human decision maker. That's the time to empower them with the speediest and most aggressive influx of information and the ability to make powerful and timely decisions.

So I actually really believe that the future success of the missile defense enterprise depends on our determination to make investments in these areas and I believe that we have seen the indication that our adversaries understand this, they believe this, and that just makes it even more imperative for us to stay ahead of these challenges.

Mr. Weisgerber: Great. Thanks so much.

Debbie?

Debbie Barnett: Thank you, and I really appreciate the opportunity to be here today. It's really a passion to get to talk about missile defense.

So 25 years ago next month Boeing was awarded the national missile defense contract, which later got redesignated as GMD – the ground-based midcourse defense – which you've heard many times today is the only system that protects this country, our homeland, against long-range ballistic missiles.

So there's been, you know, a lot of changes and progress that's happened across that system over time, and it takes all of us. And it's interesting because I'm sitting here looking at everyone that is sitting to my left and we all play a role together somewhere under the umbrella of missile defense related to just, you know, innovation updates and all kinds of solutions it takes for this to be successful.

So Boeing leads the design, production, integration, test, operations, sustainment, you name it, under GMD. We've been part of that from day one with the government and the Missile Defense Agency. GMD is made up of over a hundred and eighty assets spanning 15 time zones. It's quite a complex system of systems.

It will – it's been operational for almost 19 years. That's a little bit later today – September, sorry. (Laughs.) And but just so much to be proud of. We've seen so many changes that have happened on that system.

But we also play roles in other elements inside of missile defense. We support Raytheon with working on the Standard Missile 3. Northrop Grumman is part of our team for ground systems and now also booster development, and we do the seeker work for Lockheed Martin on PAC 3. So just there's an entire bond between industry in what it takes to make up the entire umbrella called missile defense.

So I look forward to much more today and there's – missile defense is just, again, quite a passion. I personally have been on GMD for 19 years. I've watched everything from test bed to operations. So I look forward to the discussion.

Mr. Weisgerber: Great.

Tay, over to you.

Tay Fitzgerald: So I also appreciate the opportunity to be here. Like Debbie said, you know, this is kind of full circle for me personally. When I was a teenager I can

remember all the Star Wars mockery, right. So less than 10 years later I found myself as a bushy-eyed, you know, bright-eyed new engineer in this defense company and I was working on this stack of electronics called LEAP, which was the Lightweight Exoatmospheric Projectile designed to, you know, bullet on a bullet to knock a warhead out of space, which at the time didn't seem so impossible; really hard but, you know, not impossible.

I also had the opportunity to work on a program called HEDI, High Endoatmospheric Interceptor, a very similar mission, you know, but that was much further along at the time, not just hardware. But we were doing flight tests when I was a girl.

So come full circle. Now as I sit here I'm very proud to say both of those interceptors have worked their way into SM-3, which we know is deployed in ships around the world, both for us and the Japanese is that interceptor, and HEDI, like Debbie talked about, went on to become the GBI, the interceptor for GMD.

Now, again, 44 of those, you know, in the ground ready to defend the nation, God forbid if need be. But Raytheon's been a proud partner also since day one and I feel like I have tracked the progress of Raytheon and MDA along the way and also very proud to work with again, I think, everybody – Raytheon's also worked with Palantir – on this stage.

I think MDA and industry, you know, some days we compete. Some days we partner. But I think we're all very proud to be part of this noble mission and I would be remiss if I did not also call out as a year of celebration this year is the 75th anniversary of the Women's Armed Services Integration Act and, ironically and I think accidentally you're looking at an all-woman panel here in the defense industry.

So lots to celebrate on that point and, again, we're very proud to have – protect the men and the women in uniform today. So thank you for being here.

Mr. Weisgerber: Great. Thank you.

And Lisa?

Lisa Brown: Thank you very much, and thank you so much for having us here today. And as we took the stage it's not lost on me that in various points in my career I've had weekly tag-ups both with Debbie and with Tay.

So it's very clear as we work through and talk through probably a lot of existing and future programs within MDA that we work very closely together, and not just the MDA but the other service industries as well.

As I was putting together my thoughts on the plane on the way here about what I wanted to talk about and thought about the technology innovations over the 30 years of my career so far I realized that I wasn't working either at the beginning of SDI.

So as any good engineer would do I went back and did some – tried to do my homework to see maybe what I missed in those first 10 years and one of the first things that I saw is I know that we're all aware of the folks that said that the internet would never take off. The internet was not possible. It would not be embraced by the public. And, similarly, I found a ton of articles about how SDI was the dumbest thing we could possibly do and it would never work.

And knowing what I know now, I think that I would posit that it has been a success not only in fueling technology innovation but also in formulating a lot of the bonds that we see here today between industry, between different branches and services of warfighters, as well as the different military agencies.

When I – previously in previous years when I briefed why do we do what we do, why do we do missile defense, I would accumulate – I would have one chart that would accumulate, you know, the headlines over the last six to nine months of all the reasons why we do what we do. And, frankly, within the last 18 months, I don't need to look back that far to find relevant headlines. Frankly, it's only in a matter of weeks.

If you looked at what we as a country are doing to respond to these threats, I mean, things have changed so drastically in the last 18 months when it comes to the Chinese ramping up test and development, Russia's invasion of Ukraine and seeing what they were capable of bringing directly into theater now.

You look at our nonpeer threats and the amount of testing – I think Admiral Hill talked to it earlier today – and you say what are we as a nation doing about this, what are we as industry partners doing about this, and you look at the 2022 National Defense Strategy and number one is defending the homeland, and John Plumb – Honorable Mr. Plumb, who has talked through thought leadership with his agency as well as throughout the White House, has introduced some new phases of battle, as he calls them, that make a lot of sense.

And we are right now in the competitive phase, which means that while we're in peacetime but you see the rapid emerging of the threats and the technology, this is called the competitive phase. The crisis phase would be as that transitions from peace into conflict and then, finally, what we hope never comes is the conflict phase, which would be war.

We're in an era right now where the warfighters also cannot do what they do without bringing in space assets, and all of our companies up here have significant parts to play when it comes to the use and modernizing of those space assets, and within Northrop Grumman we think about our capabilities along the missile defense kill chain and what we would call, off the top of my head, so we've got modeling and simulation. We've got left of launch. We have threat identification and discrimination. We have command and control, fire control, as well as the final intercept and then post-intercept assessment and what that looks like.

Threat modeling and left of launch are our key capabilities, also from some of our other folks that we have here on the stage, and what we don't bring in a prime contract typically we will partner, as we talked about, to bring forward to the customer.

Some of the programs that we have along those lines, not just MDA programs, would include HBTSS, which you've heard a lot about today. NextGen Polar – we have satellite capabilities, and then the cadre of programs we have within MDA.

We have the technical lead position on C2BMC and then we prime the ground-based system and the fire control, and then we have a very robust solid rocket motor business, which is not only for GBIs but for strike weapons and anything from what warfighters call rockets that you can hug all the way up through Artemis.

So one of the other things that I just want to acknowledge before I close is, you know, we up here do a lot of things when it comes to the conflict phase and avoiding the conflict phase and what that means, but we, certainly, appreciate the thought leadership with the Reagan Institute and CSIS when it comes to also the non-conflict-oriented thought processes around diplomacy, allyship, combating misinformation, and the wealth of other ways that you go about thinking about how to handle missile defense without actually having to use missiles.

Mr. Weisgerber: Thank you.

Paige?

Paige Rumberg: Thank you, Marcus, and thanks to CSIS for hosting this discussion today.

I've only been with Lockheed Martin for about a year now but I've been in and around missile defense and the community for 20 years and most of that time as a Navy civilian where I had the honor and privilege of working in the

Aegis BMD program for a number of years, which really started my journey forward with Aegis and into working with Lockheed Martin.

Going back to my early days in building and delivering capability, the initial defensive operations for long-range surveillance and track from Aegis destroyers, pivoting that operationally proven capability and bringing it ashore to Romania and now to Poland and really carrying forward today with what we're bringing to Guam that's been a tremendous journey just to see the strength and value of the partnerships between the government labs, UARCs, FFRDCs, industry, and service staffs to really hone where we need to go with those requirements.

It's not lost on me, as I think back through all the great historical retrospective we had at the beginning of the day today, that I am very privileged to have walked the halls of Aegis BMD where the hand markups of President Reagan's SDI speech are hanging framed on the wall. It's a very humbling thing to have been a part of the history of delivering this capability.

And as we look into what the next 40 years of missile defense will bring, you know, I'm very encouraged by the rigor of the capability that everybody on this stage has a part in in bringing forward. I think the end users are bolstered by the quality of what we provide and the partnerships that we all have here in delivering a missile defense capability that's reliable, that's persistent, and that's going to be ready to defeat the next era of threats.

So thanks again, and I'm really looking forward to the discussion.

Mr. Weisgerber: Great.

Well, you know, I was not going to go here at the beginning but in listening to everybody talk about the wide breadth of experience that everyone has over the decades in missile defense, I figured maybe we'll just – usually at the end I'll talk about the workforce. Let's talk about the workforce right now and just kind of how are each of you doing in attracting new engineers, new talent, to work on these really complicated programs?

Myself, I think back – it's got to be five, six years ago – I was at Sandia Labs with Dave Goldfein, who was the Air Force chief at the time, and we were meeting at the Air Force Nuclear Weapons Center and we were talking about, you know, the future of nuclear recapitalization and, you know, they were literally talking about having to go to nursing homes to find engineers to get some historical perspective.

So I guess maybe we could just go down the line and everyone could talk a little bit about, you know, what each of their companies are doing to attract

that next generation of talent and to capture, maybe, some of the expertise that has been done from the generation before now.

You want to – we'll go right down the line. How about that?

Dr. Marwick: OK. I should have picked my seat more carefully. (Laughter.)

So, actually, I love this question because I feel like – you'll note our company leadership does not speak about this issue much because we don't face this as an issue. We have, for some reason – could be the fun environment of the workplace. I'm not sure. But we have a very strong appeal to young engineers and young, incredibly talented people who learn very quickly and who are very open to mentorship from the people who have worked in this field before them and they absorb very quickly.

I think that the question of attracting is only the first – it's like the phase zero of the problem. It's like, first, how do you get people to want to work in this to bring them in, and it's more than just luring them. It's also how are you cultivating the right environment for them to thrive and want to stay in it because, as I think the women on this stage have shown, the really important thing is to encourage people to want to stick with us because that's where the really great insight comes from is people who are immersed in it for an extended period of time and don't want to just bounce off to the next interesting and exciting opportunity, and that's really what we focus on a lot is cultivating the atmosphere once we bring in that talent to really encourage them to appreciate the mission and want to stick with it.

Mr. Weisgerber: Debbie?

Ms. Barnett: Yeah. For me, especially if I just focus it on the missile defense portion, it really is about the mission. When you try to – you know, you talk about a program you want people to work on but they'll never get to see it operate. Hopefully, they never get to see it operate. You know, NASA has a very different sale pitch. So that's a sale pitch that's a little bit harder. So it has to be about the mission.

You know, you think about a system that protects every single person that lives in the U.S., all 50 states. It's a pretty heavy load and it matters no matter what anyone does. I don't care if you're, you know, deep into the interceptor or you're working a piece of data in configuration management it doesn't matter. It all matters. And for – just about getting around that mission and understanding the importance of the job that we do every day because we can't afford the thought of losing a life.

Ms. Fitzgerald: And I'm going to echo both what Miriam and Debbie said. You know, a lot of the mission is what helps us with retention, which is as important if not

more important than attracting people, but the complexity of the mission. You know, young engineers, just like when I was that bushy-eyed or bushy-tailed bright-eyed engineer, you know, you want a difficult problem. You want a meaty problem. You want a problem that matters, right, and, again, strategic missile defense has that. It has all of that, the great mission, the complexity, the hard problem, the almost impossible problem that, you know, we can solve.

And, honestly, Marcus, I think the pandemic, while that did drive some strange behavior in the workforce, at least for us it was a blessing in disguise because I think historically defense has felt very much that, oh, everybody has to be here and everybody has to be in the building and everybody has to, you know, be in the government model.

I think we've learned we can work, you know, almost anywhere at the time and that's – at any time and I think that's opened the doors for recruitment for us and we're seeing a really positive change on that. So, again, double-edged sword of the pandemic but we've, I think, been able to use it to our advantage for recruitment.

Ms. Brown: So I was in a conversation here at CSIS a few weeks ago where we talked about the fact that by 2030 80 percent of the jobs are jobs that don't exist right now. So it's not only finding talent, it's finding innovative talent and folks that are looking forward because of how fast technology is evolving.

So it's hard. I mean, there is a – defense is at a cross section with a lot of the commercial industries, the Amazons, SpaceX, other companies, where we're recruiting the same pools of talent. And it's not just recruiting, it's also retaining that talent. So the mission is incredibly humbling within missile defense and that's definitely a mission that young engineers and experienced engineers as well can really get behind, but also fueling the diversity of thought that it's going to take to be innovative, to think forward to the problems that we're going to have within the next several decades and, again, recruiting from – away from some of the same companies that also have commercial opportunities as well.

Ms. Rumberg: So, you know, I think of this from the lens of a multigenerational workforce as well because all the large primes, we're all still servicing hardware that's been in service for decades. And so you can recruit the top engineering talent out of the best universities and you're going to have to teach them how to use something that doesn't look like that Tablet and that creates a mentoring challenge for all of our companies as well.

And I think as we look to sustain that sort of steady state of not just the newest generation, the incoming workforce, but to be able to retain our

talented workforce that's been with us for a long time it's that passing down of knowledge while we're innovating that's going to be crucial.

You know, additionally, the commercial end, I think, is also a very interesting aspect, one that we talk a lot about. But I'm also drawn by the fact that Lockheed Martin's got a very large percentage of its workforce that has served in the armed services as well. So that kind of becomes a recruiting means in and of itself for a number of roles.

So, certainly, a dynamic time from a workforce perspective. But I think the mission, echoing what the ladies have said, you know, that continues to drive us, especially when we look toward opportunities to bring those who've worn the uniform into the company and see how we can leverage their lessons learned and make that even more real for the rest of our workforce.

Mr. Weisgerber: All right. And then the other aspect of the industrial base right now in terms of health of – outside the workforce is the actual manufacturing and supply chains and whatnot.

We'll bounce around this time. How about that? We won't go down the line.

Well, you're not manufacturing, I guess, missiles. So we can start with Tay. How about that? (Laughter.)

Tay, how is Raytheon doing with manufacturing right now? I know I've talked to your CEO before about some rocket motor shortfalls. How are you guys managing through that and just are we seeing finally, alleviation, I guess, of what the last three years have brought us just in terms of just the global supply chain from COVID and pandemic –

Ms. Fitzgerald: Yeah. As I say, another gift from the pandemic, right.

Mr. Weisgerber: Yeah. Mmm hmm.

Ms. Fitzgerald: Yeah. So, you know, you've heard from our CEO. No secret, you know, that we've been struggling, you know, particularly on the rocket motor front. But, you know, I don't think that's unique. You know, that's a particularly troublesome case for us but it's definitely not unique.

Suppliers, you know, for everyone – everyone has gone through their local fill in the blank drugstore, fill in the blank grocery store, has seen it across the board. I think we've all had to deal with it. Not everybody has the imperative to protect the nation like we do.

So we've spent a lot of energy internally making sure that we send people, send resources, send expertise, to those suppliers to make sure that we can

get back on track and make sure that where it matters most we can get those supply chains active again, full capacity, full expertise, even staff if need be.

So we are seeing – turning that corner, I'm happy to say, and I – also putting a lot of expertise into recapitalizing internally, you know, to make sure once that supply chain gets flowing again as it should be we are equipped to do that and even more as the pull from across the world intensifies. Yeah, I think we are getting there, Marcus.

Mr. Weisgerber: OK. Anybody else have any insight they want to share on their supply chains or manufacturing? How about – does anybody have – maybe, Lisa, can you talk – NGI, completely new interceptor. Could you talk about how that's being designed maybe compared to in the past with the way interceptors were designed and how is Northrop doing things differently?

Ms. Brown: Sure. So because we're in an active competition I was told not to talk about NGI specifically but I'll talk in general about –

Mr. Weisgerber: You can talk about it generally. It's fine.

Ms. Brown: – some of the underpinnings of weapon systems programs.

So, first, I want to foot stomp something that Tay has said, which is that we also because of the pandemic have put a lot of resources on making sure that we mother and nurture along a lot of our suppliers to make sure that we're not affecting the overall mission.

One of the things that I think that missile defense in general is doing differently, and we've heard people talk about it on this panel as well, is talking about the capabilities that AI brings to the fight as well as digital transformation.

So one of the key five cornerstones of our company right now – for the last several years it's been on our CEO's top list – is digital transformation and the development of digital twins. I mean, one of the first things I heard about digital transformation was that in F-1 racing they no longer necessarily restrict track time for the teams. They restrict how much time you could spend actually doing the modeling of the race itself.

So similar, if you take that to our weapon systems and missile defense as well, the ability to, essentially, fly a missile without flying a missile is important to be able to not only assess what the threats are and the capabilities against those threats but also to find the inner workings and potentially look at the strengths and weaknesses of the systems themselves.

So I would – my answer would be digital transformation and the things that designing something from scratch now that wasn't capable decades ago.

Mr. Weisgerber: You brought it up and, Miriam, you brought it up, the role of AI, earlier. Why don't we pull on that thread a little bit?

Ms. Warwick: Can I first say something about –

Mr. Weisgerber: Oh, you want to – go for it.

Ms. Warwick: – digital twinning and what Lisa mentioned?

So people often think that supply chain doesn't apply to a software company. It really, really does but in a very different way. But I don't want to pull on that thread so much as a lot of what we have learned – so we are – we have a very large commercial business in addition to our defense business at Palantir and one of the things that we're seeing, which is exciting, is how the Defense Industrial Base is starting to take its learnings from the way commercial industry appreciates how important it is to do that digital transformation and to really understand your supply chain before it's a problem, right.

So, COVID, obviously, accelerated everybody. My kids love to use the word supply chain now. (Laughter.) Didn't think that was going to be part of their vocabulary at this age. But it's changed our thinking.

But when it comes to this kind of complex manufacturing that you have to do it's a really important thing and it's – our customers on the commercial side have understood that for a while and we're now starting to see when we partner with companies on the defense side of the business as well how urgent that's become, and these are some of the most complex systems in the whole world with some of the most bespoke parts integrated into them, and we can't afford from, you know, the perspective of our national security to not pay very close attention to the digital implication of all of that.

And what we've seen is that it's not just about protecting the development of those things but there's often tremendous acceleration of the ability to produce these things on a much more efficient and assured production line when you employ the right types of tools. And now to the AI question.

Mr. Weisgerber: So let's pivot right to the AI question. Where should – you know, what is the role of AI in missile defense? Where could it help make those decisions earlier and how quickly can it help, or how much more time, essentially, can it give you?

Dr. Marwick: OK. So there are – and I think someone brought up the kill chain earlier – there are going to be fundamental points across the kill chain where we need a human decision maker. But there are a lot of places where we currently have humans making decisions and trying to discriminate massive quantities of information where a machine can do a better job.

So what I think is the most powerful thing that we can be doing in our design of AI is, first of all, not make it about the quantity but about the quality of where we apply it. So, of course, we tend to evaluate our ability to compete with our adversaries in this field of, like, how much money is being spent, how many, many, many different types of AI are being developed.

But it's not that. It's really the sophisticated and intelligent application of AI to how it augments the human in that loop, right. So we say, like, the human is in the loop but the human is actually the core of how we apply AI to the mission, and what we see is that significantly empowered operators, when they are given AI that is allowing them to process information, much more information and much more quickly than they could possibly be consuming that on their own and it does not in any way increase the risk from the operators' perspective because it is empowering them significantly to be able to make informed and timely decisions.

Mr. Weisgerber: Are you seeing resistance within just the military at all about using AI at all? You know, we hear from – we hear –

Dr. Marwick: The military is not one person. (Laughs.)

Mr. Weigerber: Well, right. Well, we hear from leadership this desire to include AI and machine learning in everything, essentially.

But as we go through the layers from everything from acquisition requirements folks to the operators themselves, I guess, what is the comfort level? And if anybody else has a good example of this, too, please chime in. What is the comfort level they have to using AI both, I guess, if you could put it on current systems, if it's there already, or in the future?

Dr. Marwick: So I think there's a lot that is – there's automation and then there's AI, right, and so those aren't necessarily interchangeable. But when you look at – from a leader's perspective, if you set it up as pursuing this increases the risk and not pursuing this is a safer option, then I think anybody in a military leadership position is going to opt for the lower risk, right. There are lives at stake. There's no room for error. This is really serious.

But if you start demonstrating it this is all about taking this from the theoretical and into implementing real technology up front and then not asking them to just believe in the future but showing them what can be done

now. Then you start to be able to show them a very different calculus and that is don't pursue this and you might actually be subjecting yourself to increased risk and when you change that calculus then you see people start to warm up to the idea.

But, again, we're all about proving capability and not asking people to trust that in five years from now or 10 years from now this is going to add value.

Ms. Fitzgerald: And, Marcus, if you don't mind, I want to jump in –

Mr. Weisgerber: Please.

Ms. Fitzgerald: – you know, because Raytheon, obviously, does a lot of work. Again, we have the GBI. We have other effectors, you know, that are very heavy in the discrimination domain. You know, a lot of algorithm, a lot, a lot, a lot of data, a lot of processing, right, and I would tell you that the customer is absolutely embracing what Miriam is describing as help me get through this massive amount of data that we have, especially when you start talking data coming from satellites, data coming from multiple resources, as Vice Admiral Hill was talking about earlier in the integration problem.

So I think – and Miriam also made a point I want to hammer home. There's AI. There's automation, which we're bringing into our factories and, again, the customers are embracing that with glee, right. And then there's machine learning, which is a whole other animal, right. Three very distinct things.

I think when we start talking about getting AI in the loop relative to real-time decisions that are going to be life and death I think that's where there is rightfully resistance or trepidation, right, as opposed to technologies that, you know, certainly, again, in our domain in Raytheon with discrimination we're seeing, again, open arms for other types of use of AI, machine learning, and automation. So I think we're maybe further along than the perception might be with the customer.

Ms. Rumberg: I'll jump in on that, too.

So when it comes to tactical decision superiority, I would say that there is a real hunger in the operational community for ways to better parse large amounts of data. Whether you're trying to build a common operational picture from a lot of sensors, sort through things very quickly, that speed that's going to be required for the threats that are coming, the rate densities that we're expecting, you cannot expect even the best trained operator to be able to keep pace with that fight.

So adoption of AI and automation, absolutely critical. I think the end user absolutely believes that. I think they're looking to industry to find ways to

make adoption and uptake of that capability faster and easier in the immediate near term because, let's be honest, they're all, you know, ending their day looking at a cell phone that has a lot of capability in it and not all of our operational systems are as user friendly as what has been, really, engineered for the mass market.

So we – I think the onus is on us to really try to drive that perspective into our program offices and double down on that operational feedback that says we could do better and we should.

Ms. Brown: I want to tag onto that, too.

So, again, from our perspective, we haven't seen resistance to AI. But one other critical part of that is as we talk about potentially a raid scenario or times where there's just such a large amount of data that a soldier is trying to take in and decide what the action is going to be, one of the things that General VanHerck – I've heard him say it several times – is give me the most amount of time to make a decision, and that's one of the things that, frankly, talking about how to use decision-making aids has been embraced by the end user.

Mr. Weisgerber: So I want to talk about S&T a little bit. You know, back during the SDI S&T funding was really critically important. Thoughts on S&T funding overall now? We've listened to Admiral Hill talk about, you know, ambitious goals for the future. I've seen – I didn't see the beginning but I don't think he had a chart but he had a chart a few weeks ago that he showed, I believe, during his budget rollout or during the speech he gave, just kind of how we've gone from ballistic missile defense and what is, essentially, one specific mission there to, you know, being able to defend against a host of different things – cruise missiles, hypersonic missiles, et cetera.

Is S&T funding where it needs to be and what are some areas where S&T funding could be – where you'd like to see greater investment or where your company is making investment in S&T in a specific technology?

Ms. Brown: I'll take the first hack at it.

So when I talked about the different pieces of the missile defense kill chain one of the things that we do is that we typically find a lot of adoption within each of those lanes with a given agency and what we have found is that, perhaps, the best use of our own discretionary is looking at the gaps between those individual lanes where you start integrating different capabilities so it brings a larger capability to the overall whole.

So I guess my personal perspective is that I think we have found a lot of goodness at S&T in the individual lanes and we tend to knit things together through our own investment. It makes sense.

Ms. Rumberg: I'll take that, too. So crossing the valley of death, right. So we've all experienced some flavor of that with S&T.

We have to continue to innovate because the adversary is going to continue to innovate , and finding the right mechanism to push capability out quickly, whether it's through some form of accelerated acquisition or through technical demonstrations that can get us to maturation of S&T and finding that landing pad faster, absolutely important.

But I don't think we should lose sight of what we could still do to get latent inherent capability out of the systems that we have today while we invest in S&T and do basic and applied research. It's all got to happen in parallel, and I think sometimes we lose sight of you have advanced threats coming but you have latent capability that could be optimized to go after that threat and if you only keep your eye on the S&T investment you lose opportunity to get something out there tomorrow instead of five to 10 years from now.

Ms. Fitzgerald: And that's – oh, I'm sorry, Debbie. Go ahead, please.

Ms. Barnett: Oh, because I completely agree. We have to be able to grow and make better what's there today, and the same as Lisa said. I mean, most all of your large industry partners are making investments for things in the future. But it's all about, you know, moving with the speed of relevancy or it really doesn't matter if we're not able to do that.

And when you think about the current – and I'll go back to GMD, and Admiral Hill talked a little bit about it – and that's the SLEP program. And that's making the GBIs we have better, you know, more reliable, and they'll be able to last for longer years at a higher level of reliability while NGI is making its way through the development phase.

So you can't forget today and only focus on tomorrow. Completely agree.

Mr. Weisgerber: I'm going to grab one from, I think, probably a viewer because I don't see Mark Selinger in the room. But he asked, is additive manufacturing or 3D printing being used in missile defense? If so, how, and do you expect that use to grow in the coming years?

Ms. Fitzgerald: Absolutely, and prototype development, right, it's one of the – you know, speed of relevance is one of the things we deploy regularly just to test out concepts quickly and I think we have a lot of great lessons learned, you

know, all the way from fitment to more complex answers that we're getting relative to our early designs.

My personal experience is there's actually a little more resistance to that even than AI in the end user. You know, I think we've got a ways to go to prove that we can do – use additive manufacturing as a true production capability.

Mr. Weisgerber: So I was going to ask you right there, so you said prototyping. I guess, where are the barriers for actually doing this? Because you got to imagine that a technology like this if – you know, if the rubber meets the road and you need to – I mean, as we're seeing with munitions as a whole right now with Ukraine you need to move fast. You need to use other methods to do so.

So where are the barriers to that?

Ms. Fitzgerald: I don't want to hog it. I will tell you, you know, personal opinion, quality, understanding the quality. The lifetime service of whatever is being made, I think, is one of our biggest barriers, just proving that. I think we all accept it but proving it is a whole different ballgame.

Ms. Rumberg: I'd say it's not just about speed. Sometimes it's about weight budgets. So there are parts, certainly, that Lockheed Martin is using additive manufacturing to save weight and when you've got a space weight and power constraint inside of a complex system there are applications for additive manufacturing that can really save you a lot on the weight budget.

So, you know, from a prototyping perspective, absolutely. It's, you know, speed to a part, speed to a component. But there are plenty of applications for it in operational systems as well and I think getting a widespread adoption of that you're not far into the future for seeing that. I think it's extremely near term.

Ms. Brown: And I'm going to tag onto that, too.

So other than just actual hardware that uses additive manufacturing, I think all of us on our manufacturing lines – I can't think of a single manufacturing line we don't use additive manufacturing on when it comes to maintenance and reliability of the machines themselves as well as set up of the machines, all of those things.

So I would think that – I just want to get across we probably use it more than most people are likely aware whether it makes its way into the actual delivered hardware or not.

Mr. Weisgerber: Can anyone talk about left-of-launch efforts that they're working on? I know we heard that come up. I know it – you know, it seems like one of those things that we've heard along with, you know, lasers for 40 years, and we do have another – we have a question about lasers that we'll go to next.

But can anybody talk about any left of launch, you know, whether it's, I guess, jamming or something else that I'm thinking about? Or is this all, like, super classified stuff? Yes?

Dr. Marwick: Yes, it's super classified. (Laughter.)

Ms. Brown: That gets classified very quickly.

Dr. Marwick: But I think – I mean, I can say that additive manufacturing you got me on that one.

Mr. Weisgerber: OK.

Dr. Marwick: From the perspective of left of launch, I mean, I really think that's all software, to a certain degree, and that is being able to really understand what is important to know at the point of launch and how do you really access that information when it counts.

So left of launch can be everything having to do with cyber electronic warfare, as you mentioned, all of the intelligence data that's out there and being able to figure out how it has any bearing on the decision making that the operator needs to make in that very short window of time after launch.

And I think – so left of launch is definitely an emphasis that we have been investing in and it impacts not just missile defense but all JADC2 and all of those domains as well.

Ms. Brown: Yeah. I'll quote General VanHerck one more time, which is I've heard him say, let's not leave data on the floor. So we collect a lot of data. Let's make sure we're looking at the right data, filtering through that data, and using it if it's indicating the imminency of a threat.

Mr. Weisgerber: So I'll go to the laser question next. I feel like – I've been doing this 17, almost 18 years and lasers were just around the corner then. I feel like lasers are just around the corner now, although, I guess, there are some small unmanned system like a small drone laser technology that's being used.

But in terms of lasers for missile defense how far away are we?

Ms. Rumberg: We're putting Preble to sea with Helios in 2023. So, I mean, we're assessing the lethality for missile defense purposes in addition to its program of record

capabilities for counter ISR, counter UAS, counter FAKVIAC. So there's real technology there.

I would say it's not a technology problem as much as it's a scaling and getting the cost where we need it to be for rapid proliferation of capability across the services and in multiple domains, and I would also put out the operational acceptance and overcoming the hurdles of not just maintenance on some pretty exquisite hardware but understanding the safety constraints that – or policy limitations that the Joint Staff has to approve packages on just to get it adopted and into the field.

So there's a lot of learning going on right now, not just operational learning but staff and policy learning, frankly, on the adoption of directed energy.

Ms. Fitzgerald: Yeah. I think Paige is absolutely right. We have some systems, you know, more targeted at this point, no pun intended, at international communities, right, for ground-based systems, you know, not so much missile defense. But you got to start somewhere and those are actually being fielded today.

But, again, a lot of policy issues, a lot of legal concerns that we're still working through, and I also always like to talk in terms of directed energy, not just lasers, but a lot of conversation, too, about high-powered microwave and a lot of advances in that direction. There are going to be very similar policy type challenges that we'll have to work through over the upcoming years.

Mr. Weisgerber: All right. So since we kind of started with workforce I feel we'll end with workforce. This is from Jake.

Similar to the first question that was asked, what are the major workforce challenges you see in responding to changing requirements in a timely manner? What can DOD do to enable industry responsiveness?

Ms. Rumberg: Responsiveness to requirements, I think, you know, there's a two-way street with some of the digital transformation that Lisa mentioned, and adoption of model-based system engineering is something that our younger workforce kind of comes in with plug and play with almost a predisposition to put MBSE into practice.

Now we got to work on the customer side as well to make sure that as we start doing digital reviews of our capabilities that there's an understanding of how to make that efficient and effective so that it's not just a buzzword or somebody, you know, checking the box to say, I've met my digital transformation goals, but that we're actually implementing it and that the workforce is seeing the benefit to doing that. I think they really go hand in hand for me.

Ms. Barnett: If I could add to the – maybe to the front part of that is that there has to be collaboration on front to make sure that what the requirements are are understood the same way on both sides so that we get started as quickly as possible and we're not ending up pivoting because maybe it wasn't as intended or just a misunderstanding.

So I think that collaboration on day one is critical.

Ms. Brown: I'm going to go back to something also that was just said, which is that the workforce is very excited about digital transformation, DevSecOps, agile development. I think that that is a lot easier on new start programs than it is on legacy programs.

So one of the things that, perhaps – and I'm lucky that the agencies that I work with are doing a nice job of embracing the advantages of digital, but on legacy type programs trying to figure out where that makes sense and then describe through the agencies the benefits that that offers.

I know we have some really good examples on – BSC is an example of places where we have employed techniques to decrease the number of people that it actually took for programming, as an example.

But I think that maybe a harder look on legacy programs to see how maybe we can interject those capabilities instead of just new start programs.

Ms. Fitzgerald: Go.

Ms. Barnett: No, your turn. (Laughter.)

Ms. Fitgerald: I was just going to say I think a lot of us have had really good – you know, I know for sure at Raytheon I know some of the folks we've worked with have had really good modeling and sim capability for a long time. I think the thing that's changing now that's helping a lot, again, with the new workforce and with the government being able to hit the "I believe" button on some of our requirements' trades is being able to integrate those models, integrate them with each other and integrate them with the government, you know, so that our customers can see firsthand, yes, this is a true result, a true performance analysis that we're getting so that we can do that common understanding of requirements and make those trades way up front. Sorry, Debbie.

Ms. Barnett: No, you're good.

I was just going to augment what Lisa said because GMD is a prime example of picking particular areas to start that digital engineering and we've done that. But then with MDAs, you know, going to the GMD futures with the

multiple contract, that entire future of GMD is going to be on a digital engineering platform.

So at least from an MDA perspective they've completely embraced that kind of thinking and the advantages that it brings end to end across the threads, point to point, because the amount of interfaces that that system has is pretty tremendous. So that whole new technology back to the workforce is exciting for bringing people on board.

Mr. Weisgerber: All right. Well, we're right at 2:00. So I believe we're the last session of the day. Tom, do you have any closing remarks? You're good?

So on behalf of Tom and CSIS and the Reagan Institute, thanks so much for joining us today. We hope you all have a great weekend. (Applause.)

And thank you to everybody.

(END)