Heather Penney:

Good afternoon, ladies and gentlemen, and welcome to our session focused on spectrum warfare. I'm Heather Penney, a Senior Fellow at the Mitchell Institute for Aerospace Studies. Thank you for being here today. But if you look around, look at how unpopulated the room is. It's not just because it's Wednesday afternoon at the end of the conference. I mean, when I had my quantum panel on Monday, we were packed and it was standing room only. So it's really indicative of how important it is that we understand spectrum warfare, electronic warfare, because this is not Vietnam era, your granddaddy style of EW. So to get on with the today's discussion about spectrum warfare, I'm pleased to introduce our panelists. First, Brigadier General Richard Face Goodman, Commander of the 57th Wing, Nellis Air Force Base. Woo. There we go. General Goodman provides advanced training to the next generation of warfighters for the high-end fight. He's an experienced F-15E and F-16 pilot and a former Weapons School instructor. Next, we have Colonel Joshua "Mule" Koslov, Commander of the 350th Spectrum Warfare Wing.

Brig. Gen. Richard Goodman:

Okay, y'all are going to have to clap for Josh as well. Colonel Koslov commands the 350th Spectrum Warfare Wing, the DAF's only spectrum warfare focused wing, which enhances the Air Force's electromagnetic spectrum readiness through rapid programming, target waveform development and assessment. So he's an EC-130H Compass Call EVO and former Weapons School instructor as well. And finally, now y'all better clap, we are glad to be joined by Mr. Josh Niedzwiecki, Vice President and General Manager of Electronic Combat Solutions for BAE Systems. He manages the development of advanced electronic warfare technologies that deliver the next generation electronic combat support, protection and advanced capabilities, as well as electronic combat solutions product portfolio.

So thank you all again for joining us and for being here today. We are going to skip opening remarks, because I know the conversation, the dialogue is really where we get that rich interaction and hear the things that we want to hear. So to open up the conversation, gentlemen, it's difficult to talk about electronic warfare and spectrum warfare for a number of reasons. I mean, one, as I alluded to earlier, the Air Force lost a lot of its corporate knowledge when we retired the EF-111. Second, the EW is difficult to understand and usually highly classified, so we can't talk about it. EW is also, from a pointy nose perspective, often thought about as an automatic function that just magically happens when I hit the button.

And finally, we don't routinely operate and train with electronic warfare. But as I said, today's EW is very different from past generations. So gentlemen, how should today's warfighters think about the why of electronic warfare? In other words, how do we define the value proposition of spectrum warfare?

Thanks, Lucky. I'll start with an introduction, even though you said not to.

Heather Penney:

Go for it.

Brig. Gen. Richard Goodman:

Well, it's an honor. So thanks to AFA and Air & Space Conference for allowing us to discuss this very important topic, which we have talked around, and near, and about throughout the last three days, but to dedicate this space and time is a testament to the fact that you're all here on Wednesday afternoon is a testament to that as well. I can guarantee you that I'm barely in the top four smartest people on the stage in terms of spectrum warfare. But I could also guarantee you that within the 57th Wing we have

some of the smartest, and best, and the brightest young Airmen, men and women, who are head-on attacking this issue.

In the 57th Wing as you described, the mission is to train the next generation of warfighters for the high-end fight, the Air Force, the Joint Force, and allies and partners. And so it's through that lens that I show up today talking specifically about the advanced training. And in that high-end fight specifically and necessarily we're talking about the electromagnetic spectrum, or EMS. It is undoubtedly going to be a part of that environment that we experience when we go to fight the next potential fight. Not as a button that we push and it magically happens, not as an aftermarket bolt-on capability, but as the decisive terrain that we talked about. And that gets to the why of the question.

You've heard General Kelly. I'm sure anyone that's here has heard him say essentially that, "If we lose the war in the spectrum, we're going to lose the war and we're going to lose it quickly." And that's essentially the why that we're driving at. We could put a lot of pieces of iron in the sky and that matters, the types of iron, and the types of people, and the types of weapons that we're employing. But if we don't win the war in the spectrum, then those things are going to matter a lot less. And so that's what gets me up in the morning. That's what we're getting after as we continue to push the electromagnetic spectrum to the center point of everything that we're doing in the 57th Wing, and I look forward to talking more. Thank you.

Heather Penney:

Thank you. Colonel Koslov.

Col. Joshua Koslov:

Thank you for the opportunity. And I will do just a couple quick intros. First, it's awesome that AFA and the Mitchell Institute allow us to have this opportunity to talk about the spectrum. General Lauderback, thank you for being here today. And then thank you to everybody else in the audience for being here as well. It's an honor for me to sit on a panel with my fellow warfare center wing commander and longtime peer, mentor and friend, General Goodman. And then to all of our folks in industry that are here, it's really great to sit with Mr. Niedzwiecki. But I wanted to say, I think you guys are all critical members and stakeholders of our wing and our wing's success. And so I'm really excited to be able to sit here with him and talk about some of these panels and some of these questions that we're going to answer.

Where I want to go with that question is really just a mindset function. And so we've heard General Brown talk about, "We need to change our mindset, because EW is going to be decisive in our future wars and it's going to meet and obtaining Joint Force commanders' objectives." So what does that mean? You have to unpack that a little bit. And so the purpose of EW is to break killwebs. In the future, in the digitized world, in the spectrum, all of our platforms are going to be running mission data and software that is trying to link together in order to close killchains. We have to be able to break those killchains to create information advantage for our commanders in order to kill faster.

And so our mindset has to be that we use the spectrum to kill faster, not protect things. We protect things by killing things because the more things we kill, the less things that could hurt us. And so that's the mindset that I want to try to talk about here first. And then the second piece about that is just there's some characteristics of the environment that are changing. The need for speed and agility in the spectrum have never been higher. We have to quickly get data from the edge into the hands of the capability providers, and we have to be agile enough to be able to push that capability back into our weapon systems so warfighters can execute their missions. And to the loudest part of the audience, the crows of the Spectrum Warfare Wing, thank you for being here today.

Joshua Niedzwiecki:

Hey, thanks everybody. Josh Niedzwiedki here from BAE Systems. So building on what you just said, Colonel Koslov, defeating the killwebs, you mentioned Heather, Vietnam. Electronic warfare in the Vietnam era was a radar warning receiver on something like a Wild Weasel. And now you're going to use tactics to evade those SA2s and stay alive. Draw them out and use your platform. Today we're in a world where everything is a one versus many fight. Every platform is stove piped. Every platform has to defeat every possible threat out there in its requirement space.

When we look at the future fight and the complexity of the threat environment, the density of the integrated air defense networks that China has and the layered effects that they have, both passive and active, it requires that many-versus-many mindset. And that's where Mule talked about going offensive in the spectrum. We have to stop thinking about my platform alone and unafraid, has to defeat every possible threat out there, and more about how do I defeat those killwebs in a collaborative, networked approach across all of the assets in the inventory.

Heather Penney:

Josh and Mule, I really liked what you said about using electronic warfare to attack the adversary's killwebs. But I think it's also important to understand it's not just about the killwebs. It's also really about degrading, disrupting, creating doubt in the adversary's OODA loop as well. So General Goodman, I'd like to go back to you regarding how we actually train to this. We're in an era where the scale and the scope of the modern spectrum warfare vastly exceeds what we can do to train to that on a physical range.

And obviously, we have to be concerned about open-air collection by adversaries. So we're very conscientious to not show what our capabilities might be. And so we're having to turn to things like virtual constructive environments to provide that full spectrum training. So I'd like to ask you, how far along are we in that? And can you also speak to how that will impact other large force employment exercises like Red Flag and Northern Edge and so forth?

Brig. Gen. Richard Goodman:

You hit the nail on the head. Well, we're playing catch-up in capabilities, in integration across the FAA on what we can and can't do, both in onboarding capabilities and then turning on those capabilities. However, there's a lot of really important reasons why we need to continue the live fly scenarios. And frankly, there's a lot of things that we can continue to do on places like the Nevada Test and Training Range. And so in those areas where we can improve and onboard those capabilities and practice those techniques, tactics and procedures, we're going to keep doing that as we onboard those capabilities.

However, as you alluded to, there's just limitations that we need to address. Some of those are going to be the training range on the NTTR, the capabilities that are emitting. But we're going to continue to create the scenarios and the environments in which we can maximize those reps and sets. But also, there are limitations. And a number of reasons why we wouldn't want to do some of those things a little bit could be related to conceal-reveal, OPSEC, things we wouldn't want to release in war reserve modes, switches and techniques that we don't want to turn on in front of the enemy, whether it's over the NTTR or out over the warning areas off the coast of Colorado, or sorry, California. Or it's just the capabilities and the waveforms themselves.

And so we could talk about this more in a bit. But increasingly driving advanced training into the synthetic arena, both in terms of the geographic range capabilities as well as the techniques that we want to employ there.

Heather Penney:

And that's crucially important for two reasons. One is cease buzzer. For a lot of our major weapon systems in that contested spectrum environment, whether or not they're being jammed themselves or they are doing the jamming, learning how to operate within that contested environment is important for safety of flight. We have to do it to learn how to do it safely. And the other piece is hitting that I believe button. If we never get our warfighters to actually operate with these capabilities, the I believe is really going to be a challenge to get there. And the last thing we want is to place warfighters in that position when there's actually a hot war.

So this actually will get, Josh, to you. I'd like to toss this over to you regarding modeling and simulation. I have a hypothesis that as we begin to continue to develop these electronic warfare capabilities even further, it's going to go beyond just simply attacking the adversaries killchain. If we integrate electronic warfare in all that we do, it will also change our own TTPs and how we maneuver. But that's going to require us to validate this in a simulation environment and then use a valid simulation environment to then develop those TTPs. So Josh, could you speak a little bit to modeling and simulation?

Joshua Niedzwiecki:

Sure. I think there's a couple key areas that are important related to modeling and sim. One is just technique and EW capability development first. So before you even get to the TTPs, the fact that the threat is evolving so fast, our typical acquisition cycle has a list of threats that are fixed, that we've got intel on for years. And we're building to that understanding of the current threat. And today, that's not how our adversary is operating. That pace is so fast. We as a nation have to get better at not just testing to what we know, but anticipating what we might see in the battle space. And that's where I think modeling and sim, as well as extensive-range testing, are super important to increase that rep rate of design, test, iterate.

I think the other piece of this is because EW is so hard to comprehend sometimes when we're doing technique development and TTPs, the complexity of the radar threats used to have just, "What does it do to my signature? I've got EW, so my signature gets reduced by a certain amount. And I can do some scenario modeling to see how far I can get platforms in the threat ring." Now, the threats are so complex that you really need to have that in your scenario modeling and so we can start training with EW. We've got a system like F-15 EPAWSS. We can't just think of that as a fourth gen platform outside the ring, but how does the EW reduce the weapon engagement zone and allow us to take more risk, that has to be built into the modeling and simulation so that we can train to that as well.

Heather Penney:

Mule, do you want to pile on?

Col. Joshua Koslov:

Yeah, I think from an operator's perspective, the modeling sim community, and again, I really appreciate being able to work with Mr. Niedzwiecki on this question because there's two sides of it. And so from the operator's side of it, we actually have to make sure that the modeling and sim pieces of machinery that we buy are representative of the environment and they use real data. And that we run our real war reserve modes and our real files against that virtual environment to make sure that we actually see how that environment's going to go. And so if you take back to what Mr. Niedzwiecki talked about with that many-on-many and that approach that we take with every asset's got to beat every threat, the money's not there. The capacity's not there.

And so what we have to do is integrated tactics that allow us to understand what weapons are going to get through. And so when we talk about killing and breaking killwebs, what we have to be able to train to is being able to break down the wall of threats that are posing our blue forces and saving the number of weapons it takes to get to the target. That's what we have to do in the Straits of Taiwan. And so that's what everything should be focused on when we're modeling sim. It has to be based on physics-based EW real threats. And then we have to rapidly be able to take information from the edge, bring it back to the capability developers and providers, and edit when red votes with their war reserve modes. And then get it back out to the warfighter again as quickly as we can, because that's how we're going to win.

And that's the value proposition of EW. There's not going to be more planes. The planes are the most important thing. The weapons are the most important thing, that people are expendable. And so we have to make sure that the capability we put into the systems is the best possible every single time they go to the merge.

Heather Penney:

So let's go a little bit off script here, because I'd like to build on something that, Mule, both you and Josh had brought up. And that is, what happens when we encounter the war reserve modes of the adversary? What happens when they modify their capabilities? Because with electronic warfare and software, we can have rapid reprogramming not just on our side but their side as well. So how do we collect that? What's the process for rapidly adapting to that and responding to that? What do we need to do?

Col. Joshua Koslov:

I'll jump in on there.

Joshua Niedzwiecki:

Go for it.

Col. Joshua Koslov:

So hey, that's why they built us. So the Air Force did the MSO security strategy. They said, "We're too slow." As I said of the Spectrum Warfare Wing, we have three key missions, rapid reprogramming, target waveform development, and then assessment, which basically means readiness in order to meet the missions that the work tasked to based on our doc statements. There's five ways we're going to be able to get after that rapid reprogramming piece. The first way is crowdsource flight data. So all of those platforms that are bringing back war reserve modes have to be able to get information back to the reprogramming centers, or to the common operating picture, or somewhere where engineers could get their hands on that data to understand what's happened in the environment.

So that means we need the multilevel security data architecture in order to house the terabytes of data that are going to come back from the edge so that we can be able to rapidly respond. What that also requires is a transport layer. So electromagnetic battle management has to be a real thing tied to ABMS and is able to provide all of our platforms. This is the information we need in order to do our job. Then you need, and I'm looking forward to talking with Josh, Mr. Niedzwiecki about this one. There's a buzzword out there called cognitive EW. And I'll fight you. We'll talk about it.

But really, I'll be honest with you, cognitive EW, people have this imaginary thought that there's going to be boxes on the edge that are sensing, IDing, and making decisions in order to support the JFC's objectives. That will happen, but not in the time span that we're talking about here. And so what you actually need are the AIML algorithms in order to carve through all that data as quickly as you can to do

threat change detection, et cetera, give the engineers the information they need in order to make the changes that are required. And then you need to be able to assess that and then shoot that back out to the edge as quickly as possible.

And so that's how you get to rapid reprogramming. And that's where the partnership with industry is so important, because I know that Mr. Niedzwiecki has got a lot to say on this topic.

Joshua Niedzwiecki:

Sure. So building off that, Colonel Koslov, from an industry standpoint, then it's about how do we mechanize our EW kit to support that objective? EPAWSS is one system we just were testing on the F-15s up in Alaska during Northern Edge earlier this year. And one of the things that we focused on was looking at how well we can support, mechanically, rapid reprogramming. And so there were some scenarios when we were out there. There were some threats that were in the environment that were not in our database as known threats. The team was able to affect those threats with some level of performance by just using the system as is.

But the ability to take the data after a sortie off the jet, understand it, analyze it, reprogram a mission data file, and in the next day completely crush that threat, helps prove that use case that you can physically do that rapid reprogramming. And hugely valuable. Instead of taking months to validate a new technique, how do we get good at doing that in the matter of minutes and hours? And then the nirvana certainly is eventually with whatever information you have on your platform, you're making those adjustments automatically. But even just going to that real-time flight line reprogramming, hugely valuable from a mission perspective.

Col. Joshua Koslov:

Just two more pile ons if you let me. 100% shacks on all those points. The two other pieces that are critical to this are that EPAWSS data has to be able to go into weapons that are inside the B-1 also. That's the future that we have to build. So to the operators out there, those are the requirements and those are the things you need to be thinking about when you're going to your web text and your TRBs. And then also industry, when I talk about collecting all that crowdsource flight data, I want you to know that I know that the engineers at Eglin are going to develop cool capability. You guys are going to do it faster. And so I want to make that data available to industry, to academia, to help us develop target capability faster because that's what we're going to need. It's going to be an all-hands effort.

Brig. Gen. Richard Goodman:

I'll just pile onto the two pile ons. And that is, and this will be a challenge and I'm talking directly to the people in OCPs and flight suits in the room is the mindset that Mule alluded to before. We'll provide the training sandboxes, plural, in which to accomplish the rapid reprogramming sets and reps. But I need you to care more. I need us to care more. So this is a cultural piece specifically. And I'll use F-35 as an example, but it applies to F-15. It applies to F-16. I've used it. It applies to anything that propagates a waveform, anything that receives a waveform, which is pretty much everything that's going to play in the spectrum. And so from an F-35 perspective, I certainly care about the blue lines, and I care about your red lines, and I kind of care about your break turns.

But what I really care about is your spectrum fluency. And by that what I mean is in terms of your plan, your brief, your execution and debrief, what did you bring to the fight that day? And at what point did the aircraft sense that ambiguous signal? At what point did the operator understand that there's an ambiguous signal? What is the structures in place in order to execute that data pathway that Mule talked about? And when you land, what did you do with that data? How did you debrief that data? And

if we just talk about who turned better and who shot who, then we're missing the boat altogether. So we are laser-focused on accomplishing a cultural revolution in the spectrum in terms of training from our warfighters.

Heather Penney:

So then how do we better integrate spectrum warfare as a capability that we proactively employ and integrate into our operational concept? I mean, I anticipate that as we get better modeling and simulation, we understand how our spectrum warfare impacts and degrades red capabilities. We also learn how we can use it for blue capabilities above and beyond just self-protect. How do we get there? How do we get there to allow us to change TTPs, develop new operational concepts? And then also, how do we make that happen, that planning?

Col. Joshua Koslov:

I'm going to be a little flippant with you. We have to finish doing the stuff that we said we were going to do in the MSO superiority strategy. Number one, we have to follow the AFIs that are in all of our weapon systems that tell us what we're supposed to do, what our spectrum knowledge should be. We have to demand to General Goodman and his team that when I show up at Red Flag, I want a high-end spectrum threat. We have to demand to the Weapons School that our graduates are knowledgeable on the spectrum and can fight in that space. And we have to build the organizations in the warfighting commands where the spectrum is built into the O plans. In our warfighting CNAFs today, there are not offices that do spectrum things. We've got to work on fixing that part of the problem set.

And then finally, as the spectrum warfare wing commander to all the folks in OCPs and flight suits, we need to develop your profession. And we're working hard on that. It's not just the rated guys, but the 62s, the 63s, 15 alphas, 14 ends, all the enlisted career fields that go into this. We have to figure out a way to break our stovepipe platform-centric development of people in this space into developing true MSO warriors that are fluent in the language and could sit on a staff or they could be on the flight line and be just as effective.

Joshua Niedzwiecki:

Just to build on that, from an industry standpoint, I think a big piece of that is educating our warfighters. What is the art of the possible? What's the art of the possible technologically today and tomorrow? And one of my favorite things, not just because it's in Hawaii, is go down to PACAF and really, really understand those mission scenarios and help have those riffs around, "Hey, when we look at EW, here's the capability that you have on the shelf today and what it could do to completely change mission functions."

There are certain things that us and other industry players are doing right now that provide completely new mission functions for platforms because of that capability development. And I think educating our warfighters and our war planners on what the art of the possible is and what's already on the shelf to be able to be employed is super important in that discussion.

Brig. Gen. Richard Goodman:

Just one more piece on that, and this is very specific to the 57th Wing in what we provide in those spaces. So someone is art of the possible in terms of courses that we offered, like a reinvigorated electronic warfare operations course, or EWOK, which is a revamped fighter electronic combat or RPA electronic combat. As a proud graduate of FECOC and RECOC, we are putting the emphasis back on. We are emphasizing and we will emphasize those in selection processes to get after the culture piece that I

talked about before. And then providing up to those 300 weapons officers and advanced instructor graduates every year back into the workforce that brings that expertise and that culture that we talked about.

Heather Penney:

Got to admit, I'm a fan girl. I was an ECP back in the day. I went to FECOC and graduated from that. So speaking of art of the possible, let's go back to cognitive EW. I think it's important to be able to define what it is, because right now, I feel like we're treating cognitive EW like its pixie dust. Just like a lot of other advanced technologies like AI, and Quantum, and all of that, it's just going to magically fix things. But it actually has a specific reference. And so I'd like to just have a definitional terms of reference moment here. We define what is it, how would it be used, and where are we in that? It's not today's panacea.

Col. Joshua Koslov:

Really good question, because there's not a DOD definition. So in the Spectrum Warfare Wing, it could mean lots of different things. And so what I'll tell you is it exists. As a Compass Call guy, there's cognitive EW capabilities that are fielded out of that airplane today. They've been there since 2017. So it can exist, but it's very small. What I think of it as, and what we think about it as in the wing, is a container that can sense, locate and ID, and make rules-based decisions based off of what the JFC has told us we're going to do with that system today. That's what I think it is. That's not written down in the DOD any more anywhere, but that's what I think it is.

I think it's a worthy goal. But I do think that there's a lot of steps that we need to help industry on to get to be able to deliver something like that. Because I would think that Mr. Niedzwiecki, I don't want to put words in his mouth, so it's a pop quiz, I apologize, but I bet he would say, "DOD, tell me what you think it is so I can help you build this thing." And so I think that that's probably where he's at. Now, if we are going to live in a massive, data-centric environment, we need AIML tools that can make us carve through that environment faster. We need that. We need to figure this out. And so that's what I'll offer to start off, and I'd love to hear what Josh has to say.

Joshua Niedzwiecki:

Sure. So to build on that as an EW system provider, where we spend a lot of our time thinking about cognitive EW is very close to the sensor. And when you look at a mission data file-driven EW system that is the standard for today, you've got threats that are defined by very static parameters, what their frequency is, what their pulse repetition interval is, et cetera. Those are all the things used to detect an ID and track those threats. And in this environment where everything is software-defined, the threats are agile, pulse-to-pulse. So from our perspective, cognitive EW is the technologies that you need to be able to characterize and understand that environment that may not have been in your mission data file, those unknown threats, those agile threats to be able to counter them.

There are times where you've got a much simpler technique that you want to implement against things you don't know, and it has some level of effectiveness. But the cognition part comes when you observe how effective you are with that technique. And as the system starts to adapt into those new techniques, learning that so that next time you encounter that characteristic, you've already got queued up what a better answer is. And so when we think about cognitive EW, that's how we look at it from an industry standpoint.

Col. Joshua Koslov:

I think to just drive home one more point, what's going to make the industry's job easier to develop those capabilities for us in the DOD is to give them our data, the real data that we have. And to partner with them in order to make this capability possible. But what that means is we need a place where we put all of our data in the first place. And we can actually have accessible, curated data that is useful to capability development.

Heather Penney:

So Josh, building off of this, and thank you both for that discussion on cognitive EW, Josh, how do the spectrum warfare solutions increasingly depend on software, not just hardware?

Joshua Niedzwiecki:

So great question. I think the future of EW has two components. You still need very advanced electronics. The threat is moving in the spectrum low and high, and you need high sensitivity, radio frequency transceivers, electro-optical sensors. But where the real magic is going to happen in the future and is happening now is in software, those very advanced techniques, those tailored cocktails to go after nuances in the radars, not just put noise on their scopes. But you really have to get into their decision logic. And so that requires more advanced techniques. All of that means software-defined systems are critical.

The good news is most of the systems that the Air Force has today on their platforms are already software-defined. So one of the things we're looking at as an industry player is in addition to positioning for the advanced systems, the next generation platforms, the next generation systems, how do I take advantage of the existing install base that the Air Force has already purchased and procured and leverage those software-defined systems to do new advanced mission functions? And so that's a big focus for us right now.

Heather Penney:

How does open architecture impact that? So how does that change how we develop and then field additional capabilities?

Joshua Niedzwiecki:

Sure. So I'll use Compass Call as an example. The current Compass Call system is now software-defined and open architecture. And what that means is we are able to ingest not just BAE systems techniques, but techniques developed by a range of industry players into that platform and immediately have an effect. Today, I think we have over 19 different techniques that are built from a range of industry partners. And so software-defined, open architecture systems means everybody can play in that environment and that sandbox and you eliminate that vendor lock. So I think that's super important to the Air Force's future.

Heather Penney:

Let's do a pivot very quickly, because we spend a lot of time discussing the hardware and the technology, but let's talk about the people as well. The human capital is really important. We don't have a whole lot of old crows anymore. And Face, you had spoken a little earlier about the need for culture change. So what do we need to do to cultivate this generation and the next generation's electronic spectrum warfare talent?

Joshua Niedzwiecki:

So I'll go. So this is actually quite a passionate topic for me as an industry EW provider. Take a system like F-35, multi-decade long program, thousands of people employed building that system. The fraction of them that really have to be electronic warfare experts is quite small. You could go through your whole career doing requirements development, testing evaluation, and not have to be an EW SME. Given the pace of the threat, that's a big concern for us.

So one of the things we do is we put a lot of emphasis in the science and technology community. We do a lot of work with agencies like DARPA, where our new scientists who really understand the latest tech are focused on mission problems. And we marry them up with our mission experts to not just build the next GenTech, but really understand the mission gap and use that new technology to try to accelerate that advance. And so I think that's super important for us across the board.

The other thing on talent is the traditional program design cycle is we have a series of requirements. We do PDR, CDR, build test, and then we have a milestone event at the end where we figure out if the system worked or not. We have to get much better at doing agile development and getting in testing early, failing fast and learning. When I look at our employee base, the smartest EW experts are the ones that are sitting at the range every month doing exactly that. So I think we need to get better as an industrial base doing that more.

Col. Joshua Koslov:

I'll just hop in with three quick ones, because we're getting short. The first one is the MSO world has to take a page out of the Space Force and the intel communities book and deliberately manage a functional profession. That includes many a FSEs. Have to do that or we're just not going to have enough experts. Right now, as we divest platforms, the number of rated EWOs is declining. So just as the importance of the spectrum is increasing, the guys who are tactical warfighting experts in it is decreasing.

The second thing is for the platforms that aren't traditionally EW platforms, to the commanders out in the room, we have to reinvigorate the processes and the AFIs that make you accountable for your EW readiness. And we have to assess you on that in a better way. Part of that's my job, but part of that is my other commander's jobs. And the third piece of that, because I'm glad you're an ECP, is there's not a standard ECP format for the United States Air Force. Each of our major MDSs has their own series that has different requirements for what it takes to be an ECP. We've got to fix little things like that which will have instant impacts. Thank you.

Heather Penney:

Thank you. So we're getting close. We'll have a lightning round. When it comes to fielding a dominant electronic warfare capability, it's an absolute imperative. It's time to stop admiring the problem, looking at it, studying at it. We need to do something about it. So let's go down the line. Gentlemen, what are the next steps?

Brig. Gen. Richard Goodman:

From my perspective, I know there's a lot of sides to this elephant, and I'll tell you, we got to get the advanced synthetic environment correct and robust, incorporating new platforms rapidly, as well as getting the environment right. In specific terms, what I'm talking about is from the Nellis perspective is the Virtual Test and Training Center, the JSE, joint synthetic environment. I'll tell you right now, the Weapons School goes off campus and operates somewhere between 30 and 40 high-end integration VUL periods in a single week what would've happened over a course of about a three days for a single VUL. And all of that happens in the synthetic environment.

I can imagine a day in which all of that occurs on the campus in the Virtual Test and Training Center, for either Red Flag or Weapons School or both. And then you get that maximized opportunity for both live fly and synthetic training.

Col. Joshua Koslov:

Four keywords, people. Talked about that already. Tools, across the spectrum we need the tools in order to do our job and the processes by which we execute those tools, which means resources. We are talking about it still. Pay for it. So we need to continue to develop the Spectrum Warfare Wing to be able to execute the rapid reprogramming mission that I talked about, the target waveform development and the assessment, which is all based on that core of moving data quickly in order to respond to somebody else who's moving data quickly, because we have to kill their killwebs.

Joshua Niedzwiecki:

So for me, 2027 is right around the corner, and that's a very scary time. We think of it as capability, capacity, and speed. Those three things are what we need to win that fight. Speed is critical. There is a tremendous amount of electronic warfare capability in development now. We have to get good at hitting the accelerator button and taking some risks and getting that out there faster, at the same time, we're investing in those future platforms that protect us in the longterm.

Heather Penney:

Yes, that DevSecOps cycle can allow us to take a little bit more risk to field meaningful capability and learn quickly. And Mule, thank you very much for saying that we need resources, because the only way that the warfighter is going to get inside that first island-chain, execute their mission successfully and come home safely is if we have spectrum dominance.

Thank you all for joining us here today. Electronic warfare will be an essential element of shaping the battle space, disrupting each step and link in the adversary's OODA loop and killwebs, supporting kinetic operations and providing independent combat effects in the battle space. We must aggressively pursue the development of electronic warfare and electronic warriors if we are serious about prevailing in a highly-contested environment against a peer threat. Please join me again in thanking the panelists. Don't forget to visit the Mitchell booth. Sign up for our webinars, for our podcasts. And have a great aerospace power kind of a day. Thank you.