“Advancements in Collaborative Combat Aircraft CONOPs”

Dr. Caitlin Lee:

All right. Hello, everyone. My name is Caitlin Lee. I lead the center for UAV and Autonomy Studies at the Mitchell Institute. We've got a great panel assembled here today to talk about the Air Force's Collaborative Combat Aircraft Program or CCA. As many of you know, this is a program to rapidly field large numbers of autonomous aircraft to team with manned aircraft, and I think this program really has the potential to be a game changer.

If you think about the history of the Air Force, ever since the beginning, the service along with the other joint forces, have sought to seek overmatch over our adversaries. We started out in the early fifties during the Cold War looking to get overmatch over Soviet conventional forces with nuclear weapons. That was our first offset. Then we moved into the seventies and eighties, still looking to get that edge over the Soviets, and we built up some pretty breathtaking capabilities in terms of precision guide ammunitions and stealth, and then we employed them with devastating effect in the Desert Storm.

Now I think the question we have today is what does the third offset actually look like? And I would offer to you, it probably looks like affordable mass. If we can actually build large numbers of relatively low cost CCA, we can begin to offset over 30 years of decline in our capability and capacity in the United States Air Force, and begin to build a combat credible force to deter Russia and most importantly China.

I don't think this is going to be easy. There's a lot of technical challenges ahead, and how do we actually team all of our wonderful Airmen with these unmanned systems? These are huge challenges that lay ahead and that's why I feel really proud and great to know that we have these gentlemen leading the charge and thinking about these problems every day. I think that's going to be really good for our nation and I'm so glad we have them here today.

So I want to introduce them all to you. So first we have Major General R Scott Jobe who leads plans requirements at Air Combat Command. We have Brigadier General Dale White who leads program executive office for fighters in advanced aircraft at Air Force Lifecycle Management Command. We have Mr. David Alexander, the president of General Atomics Aeronautical Systems, and we have Mr. Mike Benitez, who is director of product at Shield AI.

Thank you gentlemen for being here today. This is going to be a great panel. There's so much to cover with this DCA topic. It's so new, and so I'm going to offer that we'll just hop right into some questions and then we can come back and do some comments at the end, time permitting. So kick it off with General Jobe and General White. I'd like to ask you all about attrition.

So General Brown has said that a war with China could lead to combat losses on the order of World War II. We heard Secretary Kendall yesterday talk about fielding possibly up to 1,000 CCA or more. Could you tell us a little bit about the concept of building a CCA for affordable mass? What does that actually mean and what kind of trade-offs might we actually have to make to get there? Let's go with General Jobe and then General White.

Maj. Gen. R. Scott Jobe:

Okay. Thanks, Dr. Lee. So first of all, appreciate you putting this panel together, all the work that went behind the scenes to set it all up. So it's a great event for us, and appreciate all the rest of our panel members showing up this morning too, especially at 0730 hours on the last day of AFA, which is good. So as we embarked on this analysis of the capability gaps that we have looking at trying to provide mass to the battle space, there is going to be a lot of trade space that we work in and through.

I like to say affordable mass, because if we can get a price point that gets what Secretary Kendall talked about, maybe up to 1,000 air vehicles out there at a price point that gives us enough capability to provide effect on the battle space, it's really a game-changing kind of concept. It doesn't mean though that this is an attributable type of platform, and that's been a common misconception. This is about affordable mass.

So as we look through this, we've got to make sure that everyone keeps an eye on that. We're going to reuse these air vehicles, and that the decision for risk and the risk that we will take with these type of capabilities will be at the mission command or at the combined forces air component commander level. It'll be at the point in time when you're making a risk decision in combat, not at the industrial side of design, and not at the engineering level of detail. That is where a lot of trade space occurs when it comes to sensors, capabilities we'll put on it with weaponry and communications and other types of those capabilities and technologies, but not at the risk level. That's not at the mission command level.

That will be where that decision is made. So the affordable mass concept that in all of our analytics supported by multiple efforts across the Department of the Air Force partnered with other departments in the Department of Defense as well, specifically the Navy, show overwhelmingly that this provides us an overmatch capability and changes our loss exchange ratios dramatically in our favor. So that's I think my first volley at that question and I'll let General White pile in.

Brig. Gen. Dale R. White:

No, first of all, thanks as well, Dr. Lee, for putting this together and getting us all organized. This is really fantastic, and thanks for my industry partners being here and everyone getting up very early. And there was no coffee out there this morning, so it was a little rough walking through there. Hey, so first and foremost, I think when you talk overmatch, it's an effects based discussion and you have to really start right there.

And so General Jobe and I did a panel with you recently and we really kind of refocused a lot of folks on the idea of simply this, right? Affordability is only as good as a capability you can deliver. No matter how cheap it is, if it doesn't achieve the effect we need in the battle space, then it's not going to do what we need it to do.

So affordable mass has to be based on affordability and capability and we got to keep that in mind all the time, and that is going to drive that trade. I've talked to Secretary Kendall about this and I've said it to my leadership, General Richardson, to Secretary Hunter. We have to start thinking through the lens of lethality for the dollar, and we measure what lethality we can achieve and then we look at the affordability aspects of that and we make those trades.

The second piece, and I really want to double down on what General Jobe said, when we started this journey together some time ago, we always knew the decision space was at the mission planning level. We could not force decisions in design that limited the flexibility of the war fighter or the commander for him or her to make that decision at the beginning of any and each mission.

So we will continue to make design decisions and approaches just like that, knowing that we got to provide that flexibility, because that affordable mass, that's the challenge with it. You've got to unleash it, and we got to be able to build platforms and capabilities that allow us to have that flexibility for the commanders on the ground.

Dr. Caitlin Lee:

Got it. No, that makes a lot of sense. And just to dovetail on that discussion a little bit, I want to turn it over to Mr. Alexander. If anyone knows how to build lots of aircraft very quickly in wartime, it's this

man. So I'd like to, based on your experience with Predator and Reaper, can you tell us a little bit about the kinds of challenges we could expect to see if we want to ramp up the industrial base for CCA very quickly, and what we can do to plan for that prior to conflict?

David Alexander:

Thanks Caitlin, and thanks for that nice introduction. So it was really good to hear on the keynote from Secretary Kendall that we've heard a number of 1,000. I think that that went around the world twice within one minute, that number, but it's a key number to have, because if you think about what would be your peak rate, and let's just say we assume it's like 200 aircraft a year, and that's a considerable production rate.

So it's going to be really important that we can tap into the commercial market that already has production lines that are set up to support this program. The light business jet, so propulsion. We need to make sure that we've got a propulsion set up so either they can support that kind of rate or even better maybe have where the airframe can take two different suppliers for propulsion going forward.

So propulsion would be super key and getting into a mature product line will be key, because if you have to redesign engines, we all know that's billions of dollars that we can't afford to spend or wait for. I think the second big area would be the airframe and tooling up for that. So there's obviously the digital thread that everybody's talking about that, but get into net parts so it's enough investment in the tooling so that you're not having a lot of labor coming out the back end. So eliminate the touch labor.

So that's smart tools, additive manufacturing, thermoplastics. These kind of things will be in introduced. But again, I think the key here is to tap into the commercial market. There's a lot of capacity out there that can be used and can be used quickly. For systems, those I think there's pretty healthy production lines on that, and I think you could solve ramping up on that with a lot of long lead procurement, but it means you got to get your designs scored away from the beginning and know what you're buying.

But things like navigators and radios and data links and things like that, I think pretty straightforward is scale up on those. But again, you got to have the time. So long lead procurement would be good there. General atomics, we're very vertically integrated, so we actually build a lot of the avionics ourselves. So for supply chain at the component level, we use vendor managed inventory, VMI, and that allows us to hire a company that buys for everybody, and they're actually located inside our factory.

So we can buy at scale and we can avoid some of the issues you've seen here with supply chains on components like electrical components, connectors, wiring and such. Sensors and payloads, I think, are not a challenge right now. I think we're still in that definition stage, and maybe some of that'll come in phases on the program. So maybe that's something we're going to have to keep an eye on. But that will be a challenge depending on what sensors go with what platform, whether it's a shooter or just a sensor or just doing ISR on these CCAs.

And then from day one, I mean you got to have the facilities in place for open production and then classified production, so closed areas for production. And then from day one we're you're going to need dedicated airports, dedicated airspace and dedicated areas to perform qualification testing. We can't be waiting for those items when we're going out. So I think just quick in summary would be tap into the commercial space and use that capacity that's out there.

Dr. Caitlin Lee:

That's excellent. Thank you, Mr. Alexander. And it's a great point about the commercial sector coming into this space more, companies that may not have even been associated with defense traditionally

playing more of a role, especially on the artificial intelligence side, which is what we're going to need to build these aircraft that are going to team up with their manned counterparts.

So the next question I want to do is to kick over with Mr. Benitez over here, talk about autonomy a little bit. So can you tell us a little bit about Shield AI? How do you guys think about autonomy as it relates to collaborative combat aircraft? What's the art of the possible today with pairing and then what's the technological readiness? How long is it going to take us to get to a world where we see the swarms we see in science fiction? No pressure.

Mike Benitez:

Oh it's on now. Thanks. I'm the only one with the wired mic, which is why I'm the artificial intelligence company rep. I just want to point that out. Thanks for people who decided, I know there was a choice to make this morning. You can either sit here and listen to us or you could have gone to the NGAD conversation. So you're here. Thank you. I think this is going to be a better engagement personally. I'm biased. So yeah, back to the beginning, before I answer that, I just want to highlight, we talked about affordable mass. I think there's a word missing there, which is affordable, capable mass.

Dr. Caitlin Lee:

Yes, agree.

Mike Benitez:

Because we can have 1,000 drones and send them out, but if they're not capable, it really doesn't matter. And to get that capability at scale, you have to do something different. And that's where the conversation about autonomy starts to come into play. Because as you know, the unmanned remotely piloted fleet that we have today is certainly manpower intensive. It's not delivered on the promise of the past two and a half generations of promise. We're going to take the man out of the cockpit, we're going to save on manpower.

Turns out it's about 4X to 5X more people to operate unmanned aircraft today. And we can't do that with 1,000 CCAs. So how do we apply autonomy in the best use case possible? You asked about the state of autonomy. So to answer that, I'll give you an analogy. So let's talk about the state of AI. Who's heard of generative pretext training? Has anyone ever heard of that? Okay, there's a couple hands in there.

So here's what it is. It's you're going to use basically stack types of artificial intelligence, so some unsupervised learning, which is a type of machine learning, which basically takes a whole bunch of data, tries to make sense of it, and then it applies that through a couple other filters. There's supervised learning, which is another type of machine learning, and that basically applies some data labeling and then you apply some other stuff to it, some magic sauce, and at the end you're getting some generative AI. Okay?

And I tell you that to ask you the next question. Who's heard of ChatGPT? I just described what ChatGPT is. That is what the GPT stands for. It is generative pre-training transformer. So the history of ChatGPT, I think, draws a very, very clean parallel to the state of advancements of AI, because yes, it's text, there's some other stuff going on, but that is really, it marks with everything going on in the industry right now, whether it's autonomy or applying AI from new for air or generating pictures that are funny, it's all kind of advancing at the same rate.

It's a common tech baseline. And there's a few enablers for that we can talk about later. But if you go back to Open AI is the name of the company. So GPT, the first GPT came out in 2018, GPT1. That is when

Shield AI deployed AI into combat on a quad copter. So we have TL9 AI deployed in combat since 2018 when GPT, the first GPT was created. One year later, GPT2 came out. It was 10 times the size of GPT1.

Two years after that, GPT3 came out, it was 10 times the size of GPT2. It has 175 billion parameters. That was modified and then turned into a chat bot. And that's what you guys hear about ChatGPT. So 12 months ago, you probably never heard of GPT. Now everyone's heard of GPT. GPT4 will come out in about 12 months. It has one trillion parameters. That is how fast the state of artificial intelligence is advancing.

So we talk about the clips of TRL advancement and industry is putting a ton of money. Our company is putting billions of dollars into advancing this because we believe it's the right bet to make. And the reason is you go back to cost of attrition. Sorry kind of bouncing around. That's okay. Cost at attrition is you do campaign analysis. Some guy named John Void back in the eighties, he did air campaign analysis and some of it still rings true today, which is 1%.

1% attrition is what you can sustain to continue an air campaign without prohibitive interference. And those two words matter because prohibitive interference is literally the definition of air superiority. So if we want to gain and maintain air superiority, we have to have a force that can absorb attrition at or below a 1% level, but, and this is the but, this is where the CCAs come in, is that attrition kind of comprises a few things.

It's losses, it's imposition and then it's also reconstitution. So in World War II, the eighth Air Force, General Kelly, you're a big fan of history. So the eighth Air Force absorbed 10% attrition a month for 24 straight months. How were they able to do that? Well, it's because they were producing 1,000 bombers a month, so they had a reconstitution capacity.

And so when we talk about affordable mass at scale that's capable, you have to have not only the means to produce them, but the means to continually and rapidly produce them. So that's the part I wanted to answer from Dave, from General Thomas. As far as what we're doing and what we could do, we talk about man to man teaming. Secretary Kendall had some ratios. We've heard three to one, two to one, five to one. I could do this, I could do that.

That's not the problem. It's not a technology problem. What we have to do is we need to do the analysis to make sure we're solving the right problem. So what we don't want to do in five years from now is sit here on a panel and talk about the should would've, could haves. Man, there is what we can do from the industry. There's what we could do for policy potentially or budgeting. And then there's what we will end up doing or maybe doing. We'll see.

And so the analysis of that is extremely important. And when we back it up, we're on the third day of this panel. And the theme of this thing is [inaudible 00:18:28] deter fight win? We like to talk about winning. We like to talk about fighting to win. There's a lot of boost downstairs to talk about here are the things that help you fight the win or get you to the fight or sustain the fight. But I don't want to fight. I don't think anyone ultimately wants to go to war.

We want to prevent war and deterrence and how do you deter? And that gets in the conversation of what capabilities will I invest in with CCAs that induce or inject that fear, uncertainty and doubt calculus that can supercharge deterrents in the near term. And that's really what we're talking about with CCA's autonomy. Again, it's not a technology problem, there's a lot of stuff we can do with it. We just got to make sure that we pick the right problem and we resource it and finally execute.

Dr. Caitlin Lee:

Thanks Mike. A theme that I'm hearing from this panel is, yes, affordable mass, but it's got to be the right kind. You got to have the capability to, and it really is a balance, and I think that'll be especially

important when we think about deterrence in the Indo-Pacific Theater. So thanks for tying that together, Mike. General White, to pick up a little bit on the autonomy theme a little more, could you talk a bit about the Air Force's approach to how we integrate autonomy into CCA? How it will look in the beginning and what the sort of end state you ultimately envision might be?

Brig. Gen. Dale R. White:

Well, certainly. First I'll start by saying if ChatGPT were around when I was in college, I probably would've done a little better, for the record. Man, things have changed. So yeah, so I think first of all, in light of what Mike said, and he's adding words to phrases, so I think I'm going to do that as well. Can't be one-upped, right? I think when you think about autonomy, it's got to be mission trusted autonomy. It's missionizing trusted autonomy. That is what we have to do.

And it goes back to exactly what Mike said. We've got to bound the problem, because the technology is already there. It exists today. And in many cases I would submit to you that there are companies out there that have already started perfecting some of this delivering packages and things of that nature. So it is there. It's how we bound that problem. And I will tell you how we're going to do that.

We're going to have a space where we build autonomy off of a basic architecture, a common architecture. And why that's important is simply this. You used the term crawl, walk, run. I will tell you we've been crawling and almost standing for a while.

Dr. Caitlin Lee:

Good to hear.

Brig. Gen. Dale R. White:

I think that industry would-

Mike Benitez:

I agree.

Brig. Gen. Dale R. White:

Yeah, and I think I'll go one further. We've been flying this with Skyborg and many other platforms. We still have XQ58s flying down in Eglin right now today. So I think having that common architecture, building on top of that architecture, and why that is important, that walk and run piece, is because then you have to bring in things from a mission perspective that most people don't think about.

Interoperability, right, because we're not doing this just for us. We're doing this for a joint fight, our joint partners, our international partners, and so we have to have that common architecture. And so what the walk and run looks like is you take the autonomy that we have, you build it on top of a common architecture that is government owned. I think that's critically important. We need that common architecture because that way we can make this a platform-agnostic discussion, because if you build autonomy each time you filled the new platform, we've gone about this all wrong.

And then the next piece is, is I think, and Mike and I think you and I have had this conversation, there's also a culture aspect of this in the walk and run piece. And that culture aspect is simply this, and I couldn't say it as well as General Kelly said at the last AFA, we need to get this capability in the hands of the captains and we need to let them lead us through this and we need to iterate as a function of time.

So we bound the problem early, we know how to build the architecture piece. We have the technology, we get it in the hands of the captains, let it iterate early and continue to build upon that. And I think

where we're going to have a challenge, and I think this is where General Jobe and I spend some time, and I'll invite him to pile on here, is where you bound that problem.

What are those mission sets? How can we keep that problem low enough so that we can field something quickly and then we just continue to iterate. I don't want anyone to gloss over the trusted autonomy piece. Trust is key. Trust is going to be key. And so the only way to break down probably that part of that culture piece is again to get it in the hands of the captains early and let them iterate on it.

Dr. Caitlin Lee:

You want to pile on there, sir?

Maj. Gen. R. Scott Jobe:

Just a couple of comments. I think that as we've been on this journey for a couple of years for these combat collaborative aircraft, we're approaching this from a different perspective, and it gets after what General White talked about. We're going to get prototypes rapidly to the field, but we're also going to focus on that bounding condition problem. So we're going to focus on very specific mission sets. We're going to start with the air fight.

So we're going to go do air-to-air kind of capabilities. Then we're going to start working on surface targets, maritime and others. But we're going to be very focused and we're not going to take the very long developmental test, operational test approach to things. We're going to be very iterative. We're going to be really rapid and we're going to do that by going prototyping and we're going to iterate with both industry and the government side of things.

So we're going to bound the mission set closely, but then we're going to iterate rapidly through this, and we're going to do that at places like Nellis where you get unique capabilities with unique Airmen and Guardians that can only do the kinds of things that they know how to do. And that's how we're going to go fast.

Brig. Gen. Dale R. White:

And I'll add on it. I think that John Brown said yesterday, unleash the Airmen. That's where this is going to happen. And if I were an adversary and I was watching this panel right now, I would be concerned because it's not going to take us that long to figure this out. We've already come such a long way. And the mere fact that industry is sitting here with me saying, "Yeah, we've already kind of cracked the code on some of this," it's really just how we task organize and get after it. And we got a plan to do that knowing that we're going at it in a different way. I don't think, Caitlin, you've ever seen General Jobe and I not together talking about this.

Dr. Caitlin Lee:

Yeah, it's true.

Brig. Gen. Dale R. White:

Because we are that closely aligned on getting this done.

Dr. Caitlin Lee:

Awesome. And I want to build on the point that General Jobe you just made where part of this is really define your problem carefully and bound that mission set. Could you drill down a little for us, sir, on the

kinds of missions? When you look at air-to-air what do you actually see the CCA doing? What kind of payload sensors do they need? Are they missile trucks? Are they ISR? Where do we go first?

Maj. Gen. R. Scott Jobe:

Okay, so this is the big one. We're going to focus on offensive counter air first. Both sweep and escort missions. Doctrinal, nothing new there, but we're going to focus on that. But the unique thing that CCAs bring to the fight is the ability to do fire and maneuver in a different way. And you accept risk in a different way because you're going to have different tactics, techniques and procedures. Traditionally when we do air-to-air and we're walling up a four ship of fighters and we're going at the enemy, you're constrained by that mutual support. You're constrained by your formations.

With the combat collaborative aircraft, you're not necessarily constrained by that because you can make different risk decisions. As you enter a threat envelope, I can come in from a different axis or I can accept a different level of risk even though I'm in a threat envelope. So we're going to focus on that first. Certainly kinetic effects are going to be one of our high priorities.

So we will have weaponry that can reach out and touch the enemy and provide lethal effects, but it's not constrained by that only. It's also going to include sensor packages so we can sense the environment from an air moving target indicator kind of perspective. Multi spectrum is going to be part of the play as well. And then in the electromagnetic spectrum, that's also going to be capabilities.

If we built this architecture that General White talked about, we have the ability to now kind of plug and play, if you will, for what the mission needs and what the requirements of the day are. The behaviors of the autonomous capability that we have out there in the early days will be kind of fairly deliberate. It will be algorithmic, it won't be like having a human in an airplane flying it. It's not going to be that advanced, but it's going to provide us the capabilities we need.

We're going to be able to go to a cap, we're going to be able to orbit, we're going to be able to patrol an area, rooting, fuel calculations, all those kind of things, avoid areas where you don't want to go, go to areas where you do need to go. Those are going to be very deliberate processes and we're pretty confident in that. We've been looking at this for a very long time. We know the tech is there and we're focused on those mission sets, if that got after. I don't know if you had anything else you want?

Brig. Gen. Dale R. White:

No, I think you got it spot on. It's spending the time early on, because we don't have a technology problem like we've reiterated over and over again. And so the other part of this is in terms of coming at it differently, having industry with us every step of the way, that's a critical piece. This isn't one of those times where because of the challenges in trying to get the problem definition exactly right, this isn't a time where you go in into a vault somewhere, write a requirement that goes over to the acquisition community and then creates an RFP and then we send it out and we wait for a response.

It's not how we did it, and that's not how we're going to do it. This is an iterative journey with us and industry in the boat together rowing. And the reconstitution piece is critically important because I remind people often, right, it's not militaries that go to war, it's nations that go to war, and that reconstitution piece is going to be a critical part of that.

And so making sure we have that demand signal there and making sure industry is in that iterative circle with us all the time. And even talking about, hey, as we start bounding what the mission sets are, we've had those discussions about, "Well, did you think about this or did you think about this?" Because industry, they've got a lot of game here and they've been exercising that game quite a while in different

spaces. I mean billions and billions of dollars across multiple AI companies. I mean it's very clear that we have that piece cornered.

Maj. Gen. R. Scott Jobe:

Just one last point. As we're iterating with industry and working on attributes and requirements that are not isolated and stove piped, we also started this journey with logistics and sustainment right at the forefront of everything that we're doing, how we're organizing, how we plan to sustain the fight in the field so we can mission generate and provide that mass. This is a right from the beginning, we bake this in for how we're going to sustain this capability into the fight. So it's pretty critical that we highlight that.

Dr. Caitlin Lee:

That's awesome. It's great to hear you say that, sir. Just one clarifying point, you and General White kind of alluded to this, in the beginning you talked about the Airmen and mission planning and how giving them options is really important, creating flexibility for the Airmen. And then you also mentioned thinking about the counter air mission. Sure, you need all kinds of payloads and sensors potentially to do that. Is modularity or dis-aggregating these capabilities across larger numbers of CCAs part of the plan here or do you see any one CCA having organic capability all the time? So if you could describe how much modularity.

Brig. Gen. Dale R. White:

Yeah, I think from my perspective we've given this a lot of thought. The modularity piece is absolutely critical because look, one of the things that I think I've recently told the secretary and we had this conversation, we could easily overreach here and make this a 15 or 20-year development program. We're really good at that, right?

Dr. Caitlin Lee:

Yes.

Brig. Gen. Dale R. White:

And so we've given thoughtful approach to how we do this, making sure that, again, that flexibility for the commander, him or her on the ground at the time of mission planning is going to be key. And the only way we do that is have some form of modularity, because Gerald Jobe is right, we're not building with attritability as the focal point. That should still be something that the commander that she or should have on the ground to say, "Okay, this is going to be a little more risky. We're going to press this thing through and if it doesn't come back, I got it. So I'm probably not going to put this sensor on there, I'm probably not going to do." So again, it's that flexibility piece. So yeah, we do see that as a key component.

Dr. Caitlin Lee:

Got it, got it. Okay. All right. Well was this is one more for you two here. And this is about operational experimentation. So everyone on the panel panel has talked about how important it is to get these CCA out there quickly. And so could you talk to us a little bit about what we need to do to shake out the CCA technology, get it into the hands of Airmen? What does that actually look like? How soon can we do it? Where can we do it? What dot mill PF, kind of, if you could walk us through that, General Jobe and General White.

Maj. Gen. R. Scott Jobe:

Yeah, that's a great question. So we've been working on our concept of operations and concept of employment and how we plan on organized training and equip this capability. One of the best ways to figure out how to employ from a blue side of things, if you will, so having a CCA on our side is actually to go out and fight against one. So we're going to do both of those because there's five essential pillars of autonomous collaborative platforms that CCA is one of them.

So the combat collaborative aircraft is one of those pillars where we're going to go out and we're going to fight against these aircraft. So go take a Raptor, go fight against the CCA and then bring that CCA right back over onto the Raptor side as an example. F-35 is our cornerstone fighter. We know we're going to partner with F-35s in mass. This is how we're going to provide mass to the fight. It's the most prolific fighter we're going to have. It's highly capable.

And so we're going to go through those type of exercises. National airspace is going to be a challenge. So we're going to need help from a policy perspective across the inter-agency. But places like Nellis where we have restricted airspace, we know we're going to fly in areas like that early on as we kind of develop these tactics, techniques and procedures.

Brig. Gen. Dale R. White:

And I'll pile a little bit there. One example I will give you, and I saw General [inaudible 00:31:51] come in earlier, there's all kinds of aspects you have to address. I'll give you an example I think is really interesting, because I had not really thought of this until the team had come to me. So we have a couple of XQ58s down at Eglin, and one of the things we're doing is we're practicing on how you would exercise these on a range. So we're exercising the range to get ready for the type of tests we're going to do in this environment, understanding how these would operate.

So we're doing a lot of that right now. And so as we continue to go through the process that is prototyping and moving forward and things of that nature, we'll be pushing more and more capabilities out, get into the hands of the Airmens and have them help us steer the outcome here. And so we've got a good speed to ramp on how we're going to do that.

Dr. Caitlin Lee:

Awesome. Kind of building on that comment about needing that range space and needing to do this testing quickly and efficiently, I want to turn it over to Mr. Alexander and Mr. Benitez to talk a little bit about the industry perspective on what you guys actually need to go fast on developmental and operational testing. We'll start with Mr. Alexander.

David Alexander:

Yeah, so just springboarding off what you were saying, doing a lot of iteration and a lot of development of AI and autonomy, this requires a lot of revisions going forward. So you can't get hung up in a program that's going to have to go through an airworthiness panel every time you want to release a new set of autonomy or a new algorithm. So I think what we had on our Skyborg program with the MQ20 is to create an airworthiness kind of checkpoint from the autonomy engine so that you don't do dumb things basically.

And you can make it such that you don't have to go through a whole process, and if you get a red risk, you got to run up to the head of acquisition and get it signed off. These are the types of things you have got to avoid. One, not to lose your asset, but just to be able to move quick. So you need that firewall.

That firewall needs to say, "Nah, yeah, I hear what you just said, but I'm not going to do it, because we don't fly upside down yet." That kind of thing.

We don't fly over LAX. So that geofencing and flight envelope checking, those kind of things I think are something new. And that's what we've added the Skyborg. And it'll allow you to go quick, allow you to iterate and move quicker. But we cannot get hung up every time we want a new algorithm to run it through and their worthiness panel, it'll just slow us down way, way, way too much.

Dr. Caitlin Lee:

Got it. Mr. Benitez, you want to weigh in on this one?

Mike Benitez:

Sure. Well, we're a software company so we don't have airplanes, so that's a problem. So we are dependent on a vehicle to actually do live fly experimentation. And in the CCA, if we say that CCA is your group five UASs in this conversation, they may not be, but let's say they are, there's really only a few people in the United States who even have group five vehicles that can host autonomy to do experimentation. You can count them on one hand, that's it.

The X62, the Vista, the modified F-16, the Edwards, we flew on it in December. It's a great aircraft. There's only one in the whole world, one. So we're kind of a slave to that platform. As we move to the Valkyrie in a few months, we'll be flying autonomy on the Valkyrie down at Eglin as part of an Air Force program. That's great but there's only two of them. And in your launch and recovery reconstitution, we still have to flush out some of that to do what we call fly fix fly. So we want fly, iterate, fly again.

So we really have access problems to platforms, and to the point about dot mill PFP and logistics and how we bid this down, that's not our problem as a company, but what I can tell you is that without the aircraft in the hands of the captains live flying it, it's really just an academic exercise. You're not really actually getting data and testing hypothesis because you don't have anything to test it against.

So until we have different types of aircraft at different locations doing different things with different types of force compositions, it's like the lead wing concept. For years the Air Force experimented with different constructs and different locations doing different things to see what those attributes might look like. So that's where I think we're going to learn a lot.

I can tell you we've done a lot of live fly of AI over the years on a lot of different platforms. And I can tell you that going from an R and D program that does some stuff in simulation and putting something and taking it into the air and flying with a human internet is orders of magnitude difference in difficulty. There is a lot of learning that is going to happen across industry. We learn something every time. It's part of the process.

It's why we have flight tests, we have a test community, we don't just build it and give it to the operator. So I think that is going to be a really significant challenge. And the other part of that, just real quick then I'll hand it off, is that there's another step that autonomy actually injects into this entire process that everyone's kind of ignoring right now.

We can experiment, we can do operational experimentation, it's great, but we actually want to get something to the war fire. There is a process that that autonomy has to go through that is extremely nascent. And so it's an internal validation verification process that AI companies do with their autonomy product. But there also has to be an independent validation verification, and that is a OSD requirement.

There is actually no requirements written for that, by the way. It's just a requirement that we do it. So there's not really a cross-functional team stood up or someone that we've actually spoken to in the Air

Force, an OSD that can clearly articulate what a V and V process for autonomy for CCAs looks like. And that is going to be a huge problem.

Brig. Gen. Dale R. White:

So I want to pile onto that real quick for a second, because you said something that was important. I joked earlier about how long it takes us to do development. It's obviously much, much less than that, but there's a point here about development piece I think that we need to bring out, and you just said it, Mike. We have to fail forward here. We don't want to go into an extended development pattern. Our EMD programs can be five to 70 years, whatever the number is. But in this particular case, it's that iteration piece, it's the idea of failing forward.

I think that is going to be a critical part of this process. And I think that you guys have already done a lot of that work. Some of the other companies I've worked with have seen, they've had the challenges, they've had the mistakes and so forth. If we learn how to fail forward, capture that and then immediately continue to move forward, what that allows us to do is trade off iteration for extended development timelines. There is a time and place for lengthy developments. I think this is one where iteration is going to be the one that's going to serve us well.

Dr. Caitlin Lee:

Yeah, thank you.

Maj. Gen. R. Scott Jobe:

And I'm going to pile on one last bit. So much like the rest of the NGAD family of systems, next generation air dominant family of systems, the model-based system engineering, the digital threads that we're baking in at the beginning have already enabled us to go into the virtual environment so that we can do iteration at scale in virtual environment, which you can do much, much faster in many cases than you can do in the live fly events.

And so our validation and verification process that we're going to go through is going to have live fly events that we get data points off of and we're going to take that data, we're going to bring it back in, we're going to adjust our algorithms, we're going to adjust even the TTP and operational perspective. Then we're going to stick it in the virtual environment and we're going to go through that iteration process multiple times. So what you see flying on the range is not all the activity. There's a lot that's going on behind the scenes.

Dr. Caitlin Lee:

Got it. And I want to do one quick lightning round before we wrap up. And this is just going to be, Mike, you summed it up really well when you talked about why are we doing all this? Because we want to bolster our deterrence. And so if we look to the Indo-Pacific, what is the one thing I want each of you to say that we need to do to get these CCAs fielded rapidly west of the international dateline? General Jobe, go.

Maj. Gen. R. Scott Jobe:

Don't give up.

Dr. Caitlin Lee:

All right.

Brig. Gen. Dale R. White:

Early user involvement.

David Alexander:

Agile combat employment.

Mike Benitez:

Fix two, four letter words, ITAR and MTCR.

Dr. Caitlin Lee:

Awesome. Yes, amen. All right. Thank you all so much for being here today. Thank you to this awesome panel. Really appreciate your time. Have a great aerospace power kind of day.