

Center for Strategic and International Studies

TRANSCRIPT
Online Event

**Project Convergence: An Experiment for Multidomain
Operations**

Date

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FEATURING

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Acting Commanding General, Army Futures Command

Colonel Toby Magsig

Deputy Exercise Director, Project Convergence

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Data Collection and Analysis Lead, Project Convergence

CSIS EXPERTS

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Dr. Tom Karako: Well, good morning, folks. I'm Tom Karako, a Senior Fellow in the International Security Program here at CSIS. Delighted everybody can join us today.

We're going to be talking about Project Convergence, the Army's campaign of learning that's being conducted by Army Futures Command, as well as some broader efforts related to joint all-domain command and control. The Army's been excited to talk about this, about their progress, and we're pleased to host them today to kind of formally roll out their findings for the first time. So we're going to be talking about how Project Convergence relates to the Army's modernization priorities, some joint service integration, and of course how all this connects to the National Defense Strategy.

We've got a great audience today online and I'd like to encourage folks to continue to submit questions. I'll get those. They will converge to my tablet and I'll read them here for the – for the speakers today.

We're happy to welcome several great folks today from Army Futures Command: first up, of course, Lieutenant General James Richardson, Acting Commanding General of Army Futures Command; Colonel Toby Magsig, Deputy Exercise Director for Project Convergence; and Dr. Gary Lambert, Data Collection and Analysis lead for Project Convergence. So, gentlemen, welcome to CSIS. Thanks for coming up from Austin to D.C.

We've got a lot of interesting topics to cover today and a lot of good audience questions that have come in. But before we get started and dig into Project Convergence, I want to stay kind of at the high level, at the strategic level. And so, General Richardson, I want to turn it over to you to talk a little bit about Army Futures Command – what AFC is up to and what you're doing on the big Army side and the joint side before we dig in. So over to you, sir.

Lieutenant
General James
Richardson:

Sure. And, Tom, thanks so much for hosting us today. We're really excited about rolling out some of our analysis to Project Convergence. You talked about Project Convergence being a campaign of learning and you talked to the fact of why AFC, and I'd like to first just start off with why AFC.

Back in 2016, the National Defense Authorization Act came out, led by then-Senator McCain, and they tasked all the services to take a look and study and report back to the United States Congress on how each service was going to link and streamline requirements, acquisition, science and technology, acquisition logistics, and contracting. I was picked to be the lead for that at the time and we started through the process for about a year and a half. And really, when we got into linking and streamlining all the processes together, it jumped right out at us that we did not have a command to do that.

And so when you look across the lifecycle, there was not a four-star general really, you know, designed that the chief could put his finger on from the unity of command, the unity of the effort perspective as it related to the lifecycle. And back then, General Milley was the chief of staff of the Army. And you know, he said right up front if he has a problem with readiness, he talks to the FORSCOM Commander. If he has a problem with training and doctrine, he talked to the TRADOC Commander, or if he had a problem with sustainment. But really, when you look at the whole process, the whole lifecycle from requirements all the way to divestiture, there was not one command or four-star general that really oversaw that and reported to the chief of staff of the Army.

And really, that's why Army Futures Command. We stood up three years ago down in Austin, Texas. I remember going down. It was about 15 people. We had a big acquisition and a merger take place, and now we're 26,000-strong in Army Futures Command. We merged organizations from AMC, RDECOM; and we merged ARCIC, that was formerly in TRADOC, in the FCC; and formed the organization. And since then, we've sprouted some more smaller organizations to get after the effort of innovation and better do that. So, really, that was why AFC.

And as many of you know, we stood up the cross-functional teams about three, three-and-a-half years ago, really commanded by a warfighting general to look at how do we better put reliable equipment in the hands of soldiers faster and really take a look at our processes that we're utilizing. And that team was really composed across the community, and that's what makes them so successful today. You have capability developers. You have program managers and PEOs. You have scientists on the team. You have acquisition logisticians on the team. You have – it's really a combined-arms team that gets after this problem of making sure that we put reliable equipment in the hands of soldiers faster.

And so we stood up the cross-functional teams. Each one of the cross-functional teams really had about five or six major programs that they were focused on. And after about a year and a half, the chief of staff of the Army came to me and – with a concern. And he said: Hey, Jim, you're doing a great job with the cross-functional teams. Everybody's working well together. You're really laser-focused on these 31+4 priority efforts. But do you remember back when we were in Afghanistan and I assigned a battalion from another division to your organization and you had a problem? And that problem was we could not talk. We could not pass data even though we're in the United States Army, but we're in different divisions. And he goes: I don't want that to happen and I would like for you and the command, with the cross-functional teams and the entire enterprise, to start experimenting to make sure that we can converge data and information. Many of you know

that multidomain operations, that convergence really is a tenet of multidomain operations, and therefore, Project Convergence.

And so we started down the path about two, two-and-a-half years ago when we were actually forming the organization. We only had a hundred Department of the Army civilians and soldiers onboard when he asked us to do that. And we really started off Project Convergence very small back in 2020. One of our cross-functional team directors, General Ross Coffman, led that effort with AFC oversight. And we started off with, really, about four cross-functional teams involved with technology, so it's about 30 technologies. We had – we really started with one use case, which was a sensor-to-shooter use case. So how do we decrease the time from the time you see a target until you put rounds on the target? That exercise was – well, Ross did a phenomenal job. We learned a lot from that exercise.

And what we're able to – I'm happy to share with you today is that we – you know, from a sensor-to-shooter perspective, just in that small exercise, on average it's about 14 minutes when you go out to the National Training Center and you watch the OPFOR roll down the valley and you see a soldier see the OPFOR coming down the valley. It's usually about – takes about – on average, about 14 minutes from the time you see the target until you put rounds on the target. And after Project Convergence 21, we got that down to seconds.

So we've expanded. We learned a lot. The biggest thing that we learned in Project Convergence 20, really, that the network was the backbone, was the center of gravity. And we also learned that a lot of our technologies, they don't talk to each other. They're not configured properly – the standards, the message formats. So the biggest lesson I learned out at Project Convergence 20 is we need to stand up a joint systems integration lab. And we did that in a year with the help of the entire community, where we brought in all these technologies that we wanted to take to the field and take to the dirt and put them through the wickets in a – in a lab. Paid huge dividends for Project Convergence.

And after Project Convergence 20, the chief came back and my old boss General Murray said: Jim, we need to expand on what you did. We need to scale it. We fight not just as an Army; we fight as a joint team, and we want to bring the joint community into the equation. And I would tell you we did that. And it kind of made me a little nervous because we scale – we went from 30 technologies to over 110 technologies. We brought in all the services with their technologies and we really went from one use case – sensor to shooter – to seven different use cases. Three of those use cases that we'll talk about today were joint use cases.

It was a great event. We established a Joint Board of Directors. We had 19 different three-stars on our board from all five services. We met monthly and we outlined what were the questions that we wanted to answer in this exercise, in this experiment. This is a campaign of learning. I will tell you that took about six months to – all of us to agree on the questions that we wanted to answer. And then, from there, we went and decided on what were the use cases that we wanted to execute. What were the technologies? And then, most importantly, we - you have to evaluate. You have to analyze once you get out of the dirt, agreeing on an analysis plan that Gary will talk about that he led.

The Joint Board of Directors, probably the best thing we ever did was bring all the three-stars together from five different services to lay out Project Convergence. And we went into it as a team, a joint team. We learned a lot. And today, we'll share some of those experiences.

Dr. Karako: So we're going to – we're going to get to that. Let me stay high for a little bit longer.

Lt. Gen.
Richardson: OK.

Dr. Karako: You talked about bringing in ARCIC from TRADOC and things like that, so let me just sort of set – continue the organizational lay of the land. How do you interrelate with TRADOC, with other parts of the Army in terms of big picture?

Lt. Gen.
Richardson: Right.

Dr. Karako: And then, also, you emphasized the JBOD, the Joint Board of Directors. So could you talk a little bit about how, from a – from a big picture, this is informed by the work that's being done on the Joint Warfighting Concept but also the Army's multidomain operations? So let's stay at that big strategic level.

Lt. Gen.
Richardson: Sure.

Dr. Karako: Organizational and how you're informed by those big concepts. And then we'll dig in.

Lt. Gen.
Richardson: Well, our mission in Army Futures Command is to integrate and synchronize modernization across the entire modernization enterprise. And that enterprise is composed of FORSCOM, Army Materiel Command, and TRADOC

– as well as ASOC, who’s a huge player in this. And it’s important as we go forward to do this as a team. And that’s the secret sauce, operating as a team of teams across the enterprise daily, integrating and synchronizing as we go forward to modernize our force.

As it relates to the JBOD, phenomenal group of general officers. And really, what Project Convergence ultimately does for not only the Army but the joint force, it informs. It is informing the Joint Warfighting Concept as they are writing it today. It is informing multidomain operations that we’re working – that we’re updating for the future. It’s really informing how we’re going to fight and how we’re going to organize for the future.

And I will tell you the last – the seven weeks in the desert really paid huge dividends, and everybody was out taking notes. But the one thing people don’t understand about Project Convergence is it’s just not one event, seven weeks in the desert. It’s a yearlong campaign with over 20 different events that lead up to Project Convergence. And all of our joint partners involved along the way because we all learn from each other. And I will tell you, a lot of the things that the Navy, the Marine Corps, and the Air Force did really informed us on some of the aspects where we need to go for the future. So the collaboration, the cross-communication was phenomenal.

Dr. Karako: Well, I think what we’ll do is we’ll transition to Project Convergence.

Lt. Gen.
Richardson: Sure.

Dr. Karako: You have a video we want to show, so if we can go ahead and pull that up that’ll introduce our conversation.

(A video presentation begins.)

Narrator: Project Convergence is the Army’s campaign of learning created around one essential idea, that tomorrow is worth protecting. Partnerships of our military and industry colleagues is crucial to the demonstration. This year, more than 130 companies, including 81 small businesses, were involved in Project Convergence exercises and experiments. These strong partnerships help move our joint forces into the future. Our mission is to gain the ability to converge effects across all warfighting domains: air, land, sea, cyber, and space. This convergence of cross-cutting technologies yields the information advantage necessary for decision dominance and joint-force overmatch.

The latest iteration, PC 21, integrated artificial intelligence, robotics, and autonomous vehicles to connect sensors with shooters, improve battlefield situational awareness, and accelerate the decision-making timeline. PC 21 executed a series of joint multidomain engagements with members of the

Army, Navy, Marine Corps, Air Force, and Space Force to inform DOD's all-domain command-and-control efforts. PC 21 was the largest joint experiment in 15 years. Our partners understand, as we do, that speed, range, and convergence give us decision dominance, and decision dominance gives us the overmatch we need because tomorrow is worth protecting.

(Video presentation ends.)

Dr. Karako: All right. Good video.

So let's just talk real quick about the threat and the need statement. You know, what's the problem, what's the threat, and what are the characteristics of the threats that Project Convergence is trying to solve?

Lt. Gen. Richardson: Well, if you look at our competitors today, everybody recognizes that China and Russia are competitors. If you look at our National Defense Strategy, Security Strategy, the current strategy, those are our competitors. You know and everyone knows that we've been at war, you know, in Afghanistan and Iraq for the last 20 years. And what we're trying to do is regain the momentum from a high-intensity conflict. And so as we look at how we're going to fight in the future and our concept that – multidomain operations and the concept that we're working on for the future, there are gaps, and they are gaps that we need to fill from a modernization – from an equipping perspective, from a technology perspective.

Project Convergence is just not one event; it's a campaign of learning. But it allows us to take this technology, put it in the hands of soldiers that we call soldier-centered design, and learn from that, from these experiments in the dirt, and then inform where we're going as an Army or as a joint force.

The one thing I'd like – that I failed to mention that was in the video, we talked a lot about joint and our partners but we could not have done it without industry. Industry, academia, you know, our joint force, all were involved in Project Convergence. And we – and we did this, really, as a team approach because we can't do it ourselves. And we learned a lot. And today we're going to share – the first time sharing it publicly – what we did learn that Toby and Gary will talk about.

Dr. Karako: All right. Well, do you want to introduce these gentlemen, what they do?

Lt. Gen. Richardson: Sure.

So just to introduce Colonel Toby Magsig. Really, Toby was the Director of Project Convergence. He designed the exercise, planned the exercise across the joint community, and he executed the exercise on behalf of Army Futures Command. So Toby will talk a little bit about some of the lessons learned.

And we also have with us Dr. Gary Lambert from TRAC. And really, Gary was our lead analyst. There were over 300 analysts and data collectors out in the desert at two different – really, two major different locations, collecting data. Gary was the guy tagged to help us gather the data, analyze that data, and provide recommendations, and he'll do that today.

So, Toby, over to you.

Colonel Toby
Magsig:

OK. Well, thanks, sir, and thanks for those kind words in the intro.

So, Tom, really, when you look at Project Convergence, we started with, you know, as General Richardson did, five key questions. And so those questions really talked about what – you know, these 110 technologies that General Richardson mentioned, would these technologies really help defeat anti-access and area-denial weapons systems that our adversaries have? And then, which of these technologies really enable joint all-domain operations? And then you know, General Richardson talked about the importance of the network. And so how much bandwidth does the joint force require to do joint all-domain operations? And then how do these technologies perform in a degraded, intermittent, and limited environment? And so, you know, we really developed the questions first, and that took a long time to get all those three-star generals to agree this is the right technologies that these are the right questions that we're trying to answer.

And then we had a fantastic team of action officers from across the joint force come together and really, in the span of about six months, pool these technologies and integrate them into seven operational- or tactical-level use cases. And these use cases varied from how the joint force maintains all-domain situational awareness across competition, and then as we blend into crisis and conflict. They talked about how the joint force together can do air and missile defense, ballistic missile defense in new and creative ways. Talk about how we perform the tasks of joint fires and effects. Talk about integrating artificial intelligence and automated threat recognition to both do reconnaissance tasks and then transition to an attack. And then, you know, the last two were the all-important logistics. So, how do we do tactical- and operational-level logistics in a contested environment? And then, finally, how do we take new systems like the Integrated Visual Augmentation System, the IVAS goggle that the Army's developing, and how do we build that into an operational-level air assault?

So that's the kind of – kind of questions we're answering. And then the seven use cases that we developed. But it was really a full joint effort to integrate all the joint technologies into those.

Dr. Karako:

Dr. Lambert, do you want to talk a little bit about your role before we dig in?

Gary Lambert: Yeah. So, as the lead for the data collection and analysis effort, as General Richardson talked, we had over 300 observer analysts that were involved in Project Convergence 21. And the backbone of that team, the data collection and analysis team, was basically four different agencies. One was the Army Test and Evaluation Command. And then the other three were from within AFC itself. And so one is my organization, the Research and Analysis Center, or TRAC; the Joint Modernization Command that Toby also commands; and finally, the Data and Analysis Center. And so those four agencies were the ones who were involved in collecting the data for the effort.

We keep talking about those five questions, and those five questions that the Joint Board of Directors approved drove everything. And it was worth every month it took to get those five questions straight because, from a data collection and analysis perspective, obviously, you can't have an experiment without a good plan and a data-collection plan that meets the needs in terms of what we want to learn from the use cases and also handle any RFIs or different questions or what-ifs, if you will, as we – after we do the exercise.

So we took those five questions as analysts, you know, decomposed those, and worked out all the way down the measures that we wanted to collect. And then we figured out, OK: Who's going to collect it? Where are they going to collect it? When are they going to collect it? And how? You know, are we looking at system log files? Is it going to be an observer analyst looking at something in terms of how soldiers are interacting with the technologies? Et cetera, et cetera.

And so we then organized our effort overall into four different lines of effort to kind of compartmentalize the things we wanted to look at. The first line of effort was technology assessment. The second was within those use cases looking at the operational piece of that, so an operational assessment. And the third was looking at the network, the backbone of everything we're trying to do. And the last one, because this was joint, was a joint integration assessment where we're looking at how we integrate it across all the services.

And the last thing I think I'll say is, you know, we had both to – in stride execute analysis. And so we were trying to help, you know, Toby Magsig and the team as we were actually executing – hey, we might need to make some course corrections here. And then, also, we did more deliberate analysis over the days and weeks when we were in the desert. And then, finally, we've been doing analysis ever since, as General Richardson brings up new questions almost every day. So we've continued to do that.

But that's the overall kind of scheme in terms of data collection and analysis for PC 21.

Dr. Karako: So you each highlighted these five questions. Why don't we talk about those a little bit? Let me take the first two, perhaps, together. They're both explicitly about technology. I guess in some ways they're all about technology, but the first two are: What emerging technologies contribute to how the joint force fights in joint all-domain operations? And the second is: What technologies enables the joint force to penetrate and disintegrate enemy A2/AD at echelon? You talked about moving from 30 to a hundred and some. If those are your first two questions, what are some of the answers?

Lt. Gen. Richardson: Well, I'll let Toby begin with that and describe the – Toby, the three joint-use cases and the technologies and what did we learn.

Col. Magsig: Yeah. So our three joint-use cases, again, were joint all-domain situational awareness, how the joint force maintains connectivity in a variety of environments, joint air-missile defense, and joint fires.

And so what we did is – and I'll just talk kind of the overarching theme of one of the biggest takeaways from Project Convergence, and that's this – you know, and we haven't named this. Informally, we've called it the joint integrated fire-control network because, really, it's this assimilation of technologies to be able to do both offensive and defensive fires, active and passive sensing, and third-party shooting off of – off of other people's sensings. And so it's really taking future technologies that are coming down the pipe along with existing legacy programs of record, integrating them together across all five services, and then the ability to pass data seamlessly between. And that's not easy, and Gary will tell you some of the challenges we've had.

But the importance of being able to do that, the necessity of doing that, really enables the second question, which is joint all-domain operations. And you can't – you can't get at joint all-domain operations unless you can seamlessly pass data. And you know, General Richardson colloquially has said that data's the new ammunition, and it really is. Without access to and the ability to share, parse, understand, and recode data, we're going to be, you know, sort of left in fighting how we did in the '80s and '90s, and that's not going to be good enough against the adversaries that we've already talked against.

Dr. Karako: Let me dig in on the penetrate and disintegrate enemy A2/AD. What are you – what are you seeing coming down the pipe to creatively change how we deal with that?

Col. Magsig: Well, first, there's no single-service solutions, OK? If we fight as a single service, the adversary has already watched us do that for 20 or 30 years. They know our playbook as well as we know it ourselves. And so we've got

to integrate existing and future technologies in new and creative ways. And we've got to be able to, you know, understand that our adversaries are going to deny us in GPS, they're going to sever our comms link, they're going to jam, and they're going to obfuscate in the electromagnetic spectrum. And so if you – if you know they're going to do that, then you can start to say how do we have the ability to maneuver around those capabilities.

Dr. Karako: Your next big question is, you know – a lot of buzzwords here – artificial intelligence, machine learning, autonomy, robotics, common data standards. How does that help decision speed and multidomain maneuver?

Col. Magsig: So you can't get to seconds from minutes without getting to computer speed or machine-to-machine and machine learning. And then, from automated target recognition, you know, we've got to be able to use all of our sensors from space to air breathers down to terrestrial and even subsurface sensors to be able to fuse data together and understand and detect, you know, to find, fix, target, track, engage, assess, all the steps of the joint targeting cycle. You've got to be able to pull all that together and use machines to find and fix and target and track, and then – and then pass data to increase the speed and the tempo of our targeting cycle.

Lt. Gen. Richardson: And I'll pile on to that. When we went to Project Convergence, coming out of Project Convergence our narrative was any sensor, the best shooter, and the right C2 node. And that's extremely important, especially when you look across the community. So what – it showed us speed.

And I will tell you, you know, I talked to the secretary and the chief about some of the personal observations that I learned as it relates to speed, because you always hear the chiefs talk about speed, range, and convergence. And I will tell you that speed matters. Speed increases our lethality. We're able to put more rounds on target faster. It also increases our survivability. If you're able to move – shoot then move, it increases your survivability.

The other thing that we learned out at Project Convergence besides speed and range is with our network. With a mesh network, we extended the division commander's battlespace by over 150 kilometers. And so what will that allow us to do? That will allow us to operate and dispersed formations to increase our survivability, because as everyone knows you can't hide today. So you're probably going to have to operate in smaller formations in dispersed terrain, and that's really what we got after out at Project Convergence with speed, range, and convergence, and these technologies that allowed us to make decisions faster, to execute faster.

And I will tell you, some of the – a lot of the technologies work. Some of them we're going to improve upon. Some of them we're going to divest of. That's what an experiment is all about.

Dr. Karako: Well, you've put a couple of things on the table there, especially fire centric, speed in fires. I want to come back to that, and Colonel Magsig really highlighted some of the networks in the air and missile defense aspects. I'll come back to that, too.

But I want to hit the last two questions, which are both DDIL focused, and this is, I think – you know, the other aspect of that is not only can't you hide, but the enemy is going to be messing with us in lots of different ways and if data is our ammunition they're going to be interfering with that ammunition.

And so the last two questions you looked at, how do you have a joint network with the necessary bandwidth to operate in that delayed, disconnected, intermittent, and limited environment and how do your technologies do that?

Lt. Gen. Richardson: I'll start off with the DDIL environment and then I'll pass it over the Toby. And this was a crawl-walk-run methodology where we did. Each use case we ran for about a week, and on Friday we operated in a denied, degraded environment. To be honest with you, some Mondays we were operating in denied and degraded environment. We did it to ourselves.

But we wanted to see what this technology, you know, would do in that environment. Did we – we could do more and that's one of our objectives of Project Convergence 22 is to really get after the degraded, denied environment. It did have an effect. But it allowed vendors, it allowed us to go, OK, now we know the technology that we need to mature and what we need to do better. But I'll have Toby answer the second part of your question.

Col. Magsig: So on the network, I think, you know, it's vital that we're able to pass data but there's a lot of data to be passed, and some of the data is not essential. So precision – position location information – PLI, as we call it – some days was consuming 96 percent of our bandwidth, and this is just, hey, here I am, here I am, here I am, coming across hundreds of times a second.

And so what we've got to do is we've got to, you know, leave available bandwidth for the essential traffic, and I deem essential traffic to be those pictures that allow the commanders to make decisions to employ lethal munitions. You know, so as we start getting into computer speed, machine learning, artificial intelligence, automated threat recognition, there still has to be a human on the loop. By DOD policy, we still need to have a human decision-maker to use lethal munitions or lethal effects. And so how do you do that?

Well, in our day and age, in the last war it's full motion video. But in the next war, it's going to be small amounts of data that enable and provide that level of comfort, that level of trust, for commanders to make decisions. And so we've got to have assured bandwidth to be able to pass those, that level of fidelity, to give commanders the ability to take the next step.

Lt. Gen.
Richardson: We stress the network and that was the purpose of the experiment. I would say what we learned is we got to process at the edge. We don't need – all that information doesn't have to come back, and so that's how you reduce the bandwidth, and we did a lot of that out at Project Convergence and we're going to focus that next year.

We broke the network a couple of times just to see how much it would take, and the reason I don't have hair today is because we were in the dirt for seven weeks, and as I told you, the network was the center of gravity and the backbone. We learned a tremendous amount on the network.

But I think, as an army, we're going in the right direction with our new integrated tactical network that we're going to start – that we're fielding today.

Dr. Karako: So the bad guys are investing in lots of electromagnetic and jamming and all this kind of stuff. Can you – to what extent can you characterize how much stress you put on the network? How "DDIL'ed" was this that you were operating through, if I can coin that?

Col. Magsig: Well, I think what we'll say is, hey, we operated in GPS-denied environments. We operated in satellite-denied environments for satellite communications, and then line of sight communications. So across the electromagnetic spectrum. We took out segments of that spectrum and denied them and still ensured that the technology was able to adapt. And so we used tools like bandwidth virtualization, and instead of relying just on –

Dr. Karako: What does that mean?

Col. Magsig: Well, so automated pace, so primary alternate contingency and emergency. So instead of relying just on geosynchronous satellites, we now can go from terrestrial to low Earth orbit, mid Earth orbit, and geo satellites, and then if the adversary takes out one we can hop between others. And so the essential aspect of both opening up the spectrum and then opening up different avenues, different routes, if you will.

Dr. Karako: Yeah.

Mr. Lambert: Tom, just to add a little bit, too, to kind of double down on this notion we call the joint systems integration lab.

It allows us to reduce risks so that before we go in the dirt, you know, with our partner soldiers and so forth, we do other things. And so we did, like, cyber activities and things like that in a lab before we even got out in the dirt. And that helps us not only to refine those capabilities and technologies that we're actually going to use and implement in an operational scenario or vignette, but it also allows us to inform industry and others, you know, hey, this is what's not working in a much more controlled environment.

Dr. Karako: So you talked about the – working through that. Like, what networks are we talking about here? What networks, data links, bridges? You know, what were you stressing exactly?

Lt. Gen. Richardson: Talk about the number. It was an experiment, and we were experimenting with a number of different technologies, a number of different waveforms, to pick the best. But Toby and Gary can give you the outcome of some of those events.

Col. Magsig: First, you know, so the networks. The joint force fights on operational networks – you know, JWICS, SIPR, the secure but unclassified networks. So those were the networks or the enclaves for passing data. Waveforms – we experimented with eight different waveforms. Some of them perform better than others. We're not going to go into, you know, details on kind of which waveforms.

But some of those, we found, performed better than others in different environments. And so when you sort of take three enclaves, multiple waveforms, and then message formats. So, you know, the joint force – you know, from all of our existing programs of record and the future systems, when you lay them all out, there's, like, 28 or 24 different message formats. And so how do you get, you know, from variable message format to USMTF to UCI. You know, you tie all these message formats together, cursor on target, and you need sort of arbitrators or Google translators that can take, ingest data in one format, switch it around, and make it recognizable to others in a universal format or, you know, allow you to pass data quickly.

Dr. Karako: Which is critical for all this JADC2 stuff, right?

Col. Magsig: That's exactly right.

Lt. Gen. Richardson: It is.

Col. Magsig: You know, we like to talk about, you know, cell phone calls, and it doesn't matter if you have an Android phone. You can still receive a phone call from an Apple phone or – and so an iPhone. Well, you know, we've got to get seamless between the joint force so that you can pass data quickly between, you know, one legacy system or one weapon system to another regardless of what service you're in.

Lt. Gen. Richardson: And I'd like to pick up on that point because that's a lesson that we learned. When you talk about message formats and standardized standardization. For the past 20 years, we're building our weapon systems, really, in stovepipes and that's how we write our requirements documents. That's how the joint – our other sister services do it the same way.

What we learned out there is when we're looking at requirements we got to look at it from a systems approach. What does that weapon system connect to? What system – what weapon system, how does it pass information? What format? And we have to standardize the data formats. That is a huge lesson learned.

I will tell you, we came back and I went back and pulled all the requirements documents that we approved for the last year and started really taking a look at each one of those documents from a systems approach, from a standards approach, and from, you know, a message format. But we've got to get to a joint standard that we all can pass and receive both data and information.

Dr. Karako: And that's a great lesson. And this is why I emphasized the JBOD earlier, is, OK, this sparked you to go back and look at the requirements that you're putting together –

Lt. Gen. Richardson: That's right.

Dr. Karako: : – AFC's putting together – but to what extent is that – are these lessons being applied out through all those other three-stars, as you said? Can you speak to that? OK. How did the lessons, the experiences of this experiment – no kidding, how is that learning being used?

Lt. Gen. Richardson: Let me give you an example of what we did out in the desert with our sister services and coming to an agreement on – think about this. You're in the desert. You got all the sister Services and we all agree on a standard. We write a proposal to the J-6 and I'll let – Toby led that effort so I'll let he expand on that a little bit.

Col. Magsig: So we developed standards for message formats that either don't exist today or the formats that exist today don't enable us to fight in a way that we need to fight today and beyond. So this is really about creating optionality for a

joint force commander. It's about giving him a range of plays instead of just one play.

Like I said, there's no single service solutions and it's about simultaneity, bringing in multiple technologies to be able to work together to create multiple dilemmas for our enemy. And so these message formats today don't enable us to do that. There's no message format for BDA – for battle damage assessment.

So we created a – proposed a standard to be able to do that, because if you're moving to artificial intelligence and automated threat recognition, your algorithm could also be your own enemy. It could be the reason that you're depleting your magazines firing after a target that's already been destroyed.

And so we need a message format that says, hey, this – that's recognizable across the whole joint force that, hey, this target's been destroyed, no longer service it, and shift your resources to another target. That's just a good example of what we're doing.

Dr. Karako: You've mentioned – you've alluded to the use cases. You mentioned three of the seven were joint. You highlighted AMD and fires use cases in particular. Can you kind of give me a rundown of the several use cases, perhaps, some of them that were most instructive, perhaps? And it sounds like those are two of them.

Col. Magsig: Yeah. So I'll just talk air missile defense first. And so how do you – you know, detect, target, track, engage, and destroy multiple threats? And we know it's not going to be a singleton coming at us from any adversary that wants to harm the joint force. It's going to come multiple speeds, multiple vectors. You know, we'll have ballistic missiles, cruise missiles, hypersonic missiles, sea-skimming missiles. And so we need to be able to detect across all domains and pass data, and then seamlessly decide who's the best shooter and start to whittle down hundreds of missiles into tens of missiles and then, finally, ensure that the joint force is protected and we're able to destroy it.

And that's really tough to do. You know, again, it's – you know, we have service solutions – you know, Aegis for the Navy, Patriot for the Army. But how do you take those and merge them together to be more effective as a team?

Dr. Karako: And you – go ahead.

Lt. Gen. Richardson: But in the same sense, now, you look at the radars. We have offensive radars and we have defensive radars. Well, we need both offensive and defensive radars that are integrated. We need passive radars that pick up so we can keep our active radars off for protection.

We experimented with that, and as we go toward the future – that was one of our lessons learned going into this. It just can't be defense – you know, air defense, build artillery. It's got to be fires, integrated fires, both offensive and defensive, from system radars to command and control, you know, to actual missiles and systems that shoot down or shoot at these targets.

Dr. Karako: You know, this is a vision that has been articulated and admired for some time. But it's those two wings of Fort Sill, of the schoolhouse. It's FA and ADA.

Lt. Gen.
Richardson: That's correct.

Dr. Karako: And they each have their launchers. They each have their effectors. You're saying – and this is why I keep asking, you know, OK, what's the output here? How is this going to be applied? You know, the Army is – we had General Thurgood here a couple of weeks ago and he talked about the Army's mid-range capability effort, which has the potential off of a single platform to be the first offense/defense defense launcher.

So I want to keep digging in here. But just keep going on that point. What you're talking about is modifying, potentially, bringing these two branches together, right? Or these functions anyway.

Lt. Gen.
Richardson: I don't know about bringing the branches together. But looking at the functions and, more importantly, looking at it from a joint perspective, you know, where a G/ATOR radar that the Marine Corps has can communicate information with our radars back to our C2 systems, how do you connect across the joint force? And I will tell you that we were successful at doing that.

Toby, if you would, please, talk about the use case with the targets and third party sensing and some of our lessons learned.

Col. Magsig: So, you know, we did several joint fires use cases. We did some where, you know, a SOF operator – we talk about distributed formations. They're still going to need support – sensor support and fire support. And so we sensed in space and we fired off of platforms that nontraditionally support SOF. You know, so think of a Tomahawk missile or, you know, another service's capability that can now be in support of a SOF team, whether it's sort of –

Dr. Karako: Using that Tomahawk sensor is what you're talking about.

Col. Magsig: Using all kinds of sensor data from space to aerial layer, all to inform and refine the targeting data for that lethal effect. And so think of firing solutions that inform, that involve multiple services, multiple weapon systems from

each service. So every service has sort of, you know, exquisite missile systems that can fire.

But what if we took all those service missiles and fired them against the same target in a way of developing simultaneity and to present options that our opponents may not be expecting?

Dr. Karako: First of all, I'm struck by the fact that when I asked, you know, of the use cases what are most instructive. You went to air and missile defense, and what you're pointing towards, and I think – you tell me if this is fair – it's the stressing time-critical quality of that – of the data requirements for air and missile defense that is driving or that is beginning to be seen to drive the requirements for JADC2 stuff. Is that fair?

Col. Magsig: Yeah. Yeah. So, you know, all these weapons systems have fidelity that they need to be able to fire. You can call it track quality, and in order to pass track quality data between different – from sensors to different shooters you need a network, and this goes to the importance of the network, the importance of assured bandwidth, and the importance of minimizing the number of translations and hops and jumps and skips that our data needs to do because all those slow down the ability to maintain the data quality that's needed to fire.

Dr. Karako: Yeah. But that's fascinating because what that tells me and, you know, admittedly, long-range fires is the Army's number-one modernization priority. But you're really pointing to this network, and especially coming out of air and missile defense as, perhaps, having an outsized importance for shaping the broader fires enterprise but also data sharing and sensor information sharing across the Army and the joint force. Is that right?

Col. Magsig: Yeah.

Lt. Gen.
Richardson: Absolutely.

Col. Magsig: You know, I think that the secretary talked and her first three were air missile defense, long-range fires, and the network, and the three of those tied together is really what enables this joint integrated fire-controlled network from the Army and across the joint force. And I think that was not just the Army's a-ha moment. That was the joint forces' a-ha moment between all five services is that, hey, there's something here and we've got to really focus on how we – how we do that.

Dr. Karako: But, of course, I mean, to some extent, this sounds like Nirvana, right. It's hard. This is a wicked hard priority. So talk to me a little bit about you had all these guys out in the desert. There's this epiphany, recognizing, you know,

kind of the path forward here. But what went well and what didn't work well? And this is maybe a little bit more on the analysis side. What milestones, what kind of things were identified, to shape the path forward?

Mr. Lambert: So in terms of, like, joint fires and the joint air and missile defense and so forth, we learned a lot, and it spans everything. We've spent a lot of time, I think, talking about network, you know, and the interoperability of systems – so, you know, the common operating picture. No common operating picture across the joint services provide the two picture, right, or a complete picture. And so we have all those things associated with these different command systems and fire systems and so forth that we had to integrate.

And so we learned that – for example, we've talked about the sensors to the shooters to a lot of different routes, right, across the five domains. But to do that you need to have that persistent stare, if you will. So the sensor side of that, and then as Toby talked about, the track quality. We gathered data and showed how track quality either got better or degraded over time as you lost, maybe, a lock on a target from a space-based asset and so forth.

And so one of the things that kind of came out of that is, OK, we depended a lot in Project Convergence 21 on space and aerial sensors. You need to balance that. You need to look also at terrestrial, SOF, and other things to help, again, provide lots of opportunities and lots of redundancy to allow that track quality to get better over time.

We also talked a little bit about the complexity of what we did in Project Convergence 21. Big change in terms of the number of sensor to shooter combinations. I won't say how many but, essentially, really scaled up from what we did in Project Convergence 20.

Not only that, we also increased the speed in terms of what we did, and General Richardson already alluded to that. We found we were kind of optimizing on the lower end of that, you know, from the tactical space layer down to the shooter, and we were kind of forgetting – and this gets back a little bit to the persistence piece, in terms of, you know, how hard it is to get some of the space assets to the right place and to stay on station, or it would have to wait for – you know, come around again and those kinds of things.

And so we talk about thickening that constellation through LEO/MEO/GEO and so forth, and providing commanders direct access so you're not sending it back for processing, exploitation, dissemination back in the rear and things like that.

Dr. Karako: And I think – does that tie into what General Richardson was saying about edge processing? Can you elaborate on that?

Mr. Lambert: So –

Dr. Karako: The back and forth business? Yeah.

Mr. Lambert: So – well, I look at the edge piece and I guess – I thought we were talking more about the robots and doing the AI algorithm out at the edge.

Dr. Karako: Fair enough. Fair enough.

Mr. Lambert: OK. So that's going to be a profound effect on the Army and the joint force. And so you imagine those robots out there. They're all saying, here I am, here I am. They're sending a lot of information and so forth. But you're sending those robots in lots of different environments, you know, and then – and each environment has an effect on in terms of the algorithms and the data that underpin those algorithms so that those robots can make the right choices in terms of target identification, target location, and so forth.

And so we found that – and we had soldiers in the dirt recoding algorithms as we went, oh, that was a – why was that a false classification of a target? What happened there? And they were adjusting it, literally, you know, as we were conducting the different runs for the experiment.

That's going to be something that we're going to have to figure out as an army and as a joint force, going forward, is, like, how do you cradle to grave – you know, bring people in, train them, and put them to that purpose? Because while we might save – have savings in terms of where people are with robots doing a lot of the jobs for us, the people now have to be on the loop or in the loop, right, in terms of making decisions in lethal actions.

We got to train them to be able to code at the edge and we also have to have this huge data library or a repository that allows us to characterize and train the algorithms so they can work anywhere in the world against any threat. And so that's a huge undertaking. That's something the joint force has got to deal with.

Lt. Gen. Richardson: And I want to spin off something that's extremely important for the Army and for all the services. Out at Project Convergence everybody keeps saying we had soldiers with this new technology. Well, we had soldiers coding at the edge, and so when we look at talent and management as we go forward as an army, that's a big deal. We have stood up the AI Center of Excellence at Carnegie Mellon with the Army. Two weeks ago, I brought all the services in to show them what we're doing there, our training program where we're providing master's degrees in soldier technologies.

But we've also stood up the Army's Software Factory in Austin. The purpose is to solve tough Army problems, be able to code at the edge, and do it with

soldiers because when we get into conflict you're not going to have a contractor sitting right beside you.

I remember going into OEF 1 [Operation Enduring Freedom] and General Cody was our division commander, and we went with what we had and it was a learning experience. And what we've learned is we have to have these types of soldiers and we're doing that. And it was really – it was a phenomenal learning environment for these soldiers that we've spent a couple years training out there, and it provided us some direction on where we needed to go with their training as well.

But, really, it's about the talent of our soldiers and it's about the talent of the airmen and the Navy and the Marine Corps. And we've come together just recently up at Carnegie Mellon to look at that and how do we do this from a joint perspective, because it is about speed. It is about autonomy, machine learning. That's where we're going as a joint force. That's where we're going as an army. And I will tell you that we're leading the effort in the Army and I'm excited.

We did one of the use cases that Gary kind of sort of talked about where it was a ground use case, and we gave the ground force a zone reconnaissance mission. Told them the type of targets, and we used robots to go out and do that reconnaissance, not soldiers. These robots didn't stay on roads. They went off road. They avoided obstacles. They collaborated with each other. It wasn't soldiers controlling them. We just gave them the type of target we wanted to find.

The sensors were collaborating with each other. And then we had AI algorithms on those robots that knew what the enemy was, who was – and what was the best shooter that could shoot it and then pass that information back. We learned a great deal from a ground perspective, from an autonomy robotic perspective, out at Project Convergence, and the key is it's our soldiers that helped develop this at Carnegie Mellon.

Dr. Karako: Well, I appreciate the Carnegie Mellon shout out. I've been teaching for them for about six years and lots of smart people up there.

Lt. Gen.
Richardson: There are. (Laughter.)

Dr. Karako: We didn't organize that. It was just spontaneous. But before we go to the joint piece – you mentioned the joint piece – before we go there, let's stay with the soldiers and talk to me a little bit about the lessons – you just alluded to some of them – the lessons and how they would be applied, for instance, for the multidomain task forces. So whether it would be an MDTF out in INDOPACOM or somewhere else, apply it to that construct.

Lt. Gen.
Richardson:

Right. Well, so you know, we keep saying we had soldiers out at Project Convergence. We had the 82nd Airborne division with a brigade, battalion, company, all the way down – bits and pieces of each one, not the entire brigade – with the division staff and the division commander out in the field.

We also had the multidomain task force out in the field, and what amazed me is when we put this technology in the hands of soldiers we thought they would use it one way, and they were so innovative that they completely turned it on us and used the technology in ways that we didn't even think about.

They took technologies that we design – a couple of technologies that we designed to do certain things, combined those technologies and innovated, and executed a completely different task. It was amazing. Having those soldiers out in the field it's amazing these young kids that we have in our Army today and all the services today. Boy, they're innovative. When you put technology in their hands they really think of unique ways to use it. They provided great feedback of where we needed to go for the future.

Toby, you could probably give some examples of the technology that I'm referring to.

Col. Magsig:

Well, so the MDTF is created to do many functions. The first MDTF in the Pacific, General Eisenhower, you know, our most credible, capable adversary in the most challenging terrain that – of anywhere we're going to fight. And so when you look at fighting, distributed and dispersed formations, it's really about how to have some land capabilities on – you know, on islands and on the land, Marine littoral regiment MDTF operating side by side, being able to do, really, three functions. You got to do – you got to be able to do offensive fires, you got to be – protect joint forces, because we're not going to put Americans in harm's way needlessly, and then you got to be able to sustain them.

And so, you know, we took, you know, autonomous resupply capabilities, we took a network, and we took this joint integrated fire control network and we handed it to those two formations and said, how do we connect together to be able to allow you to do those three operational tasks – those three functions – in terrain and geography that mimics the distance that we'd have to operate in the Indo-Pacific.

Lt. Gen.
Richardson:

And, Tom, one thing. We've talked about, really, three use cases with you. One use case that we haven't talked about from a joint perspective is the joint common operating picture, and what I'd like to do is – and we learned a lot from that use case, and it was completely joint.

Dr. Karako: What did you learn?

Lt. Gen. Richardson: And, Toby, we spent a couple of weeks trying to get this right, and so I didn't elaborate.

Col. Magsig: So we thought this was going to be our warmup pitch. It was the first thing we did and it ended up – you know, we extended that use case two more weeks to experiment with it. And so what we wanted to do is in competition, you know, we rely on this GCCS-J architecture – very hierarchical architecture – and we said, hey, what if that is degraded by an adversary or, for some reason, that doesn't exist? How do we get tactical and operational level commands, you know, sort of two-, three-star and below, to talk to one another, share past data and have a common operating picture? And we thought, OK, if we can just do that that's a good warm up pitch.

It was tough, and it took us three weeks to figure it out how to remove that hierarchical framework and then just get Navy, Marine Corps, Air Force, and Army common operating pictures to share and pass data between and that's because, you know, we sort of lacked some data standards and we don't have a firmly established data fabric, or as our secretary calls it, a data quilt, and the ability to pass data seamlessly at the tactical or operational level without this sort of hierarchy is very difficult. And we had some challenges there where, you know, graphics that we passed from one service to another were inverted or flipped, and that can change a meaning. A green box for the Navy and a red box – it becomes a red box for the Army. Two very, very different things, two very different meanings, and so there's work to be done there. You know, we pushed it to as far as we could go, but even then, I would say we are probably only integrated about 95 percent.

Dr. Karako: Why don't we have the analyzer-in-chief – (laughter) – maybe elaborate on that because, as you say, that's a big deal and you may have sent three weeks on it; I'm guessing you didn't completely solve it.

Lt. Gen. Richardson: Nope, yeah.

Dr. Karako: So what's the output now? What's the analysis of that, and what's the output?

Mr. Lambert: So what we're talking around here, I think, is the difference between interoperability and integration, and what we were able to do, after three weeks, is stitch these things together using the data quilt, what have you – right? – and other things to be able to conduct the use cases. But to me, from an analytic standpoint, what came out of it – you know, we have these translation problems that Toby just talked about. We have firewalls. We have

different, you know, data standards – a litany of things that prevent us from having truly integrated C2 networks and FARs networks. And so, going forward, we have to be serious and say, no, this time we're really serious about, you know, enforcing standards and making sure that if a new capability is brought into anywhere in the joint force that it adheres to these standards and it's built to do that to be integrated, not Band-Aided in, you know, as we've been doing a lot in the past.

Dr. Karako: And that's going to take time.

Lt. Gen.
Richardson: It is.

Mr. Lambert: And it's going to take some forcing mechanisms to make sure that happens.

Dr. Karako: OK. All right, well, I think now is probably the time to transition to the joint picture. You really emphasized the fact that PC 21 had a joint presence. Could you speak to a little bit of what you learned from the joint partners, Air Force, Navy, Marines, and maybe what you collectively got out of it?

Lt. Gen.
Richardson: Well, I'll start with the first. And we've been talking about it together and all of my counterparts would agree with me, and we're not joking when we say data is our new ammunition. It is really important. We're going to fight differently in the future as we fight today, and we've all recognized that. And technology's going to play a role. What we learned is we have to come together when we're doing our requirements documents. We have to – we all agree that we have to look at it from a systems approach. We can't be parochial within our services. All of us have recognized that we fight as a joint team, and we've got to share our lessons learned; we've got to share what we know; we've got to share our documentation, our standardization. You know, I agree that going forward – when we do these – Toby talked about the 28 different message formats. Well, I want to make sure with every one of our documents that there's a joint message format. We don't want a translator anymore or a cross-domain solution. Going forward, we want to be connected from a standards and a data perspective and a message-format perspective. That – believe it or not, it sounds simple but that was the “aha” moment and it was because of our great noncommissioned officers, warrant officers, and commissioned officers – they got out in the dirt and figured this out, and it was hard. And for the first time that I – my 40 years in the Army – have you ever seen five services agree upon anything? And we all got there; they were all in the desert and they all agreed because we've been fighting the war together for 20 years. And you had the warfighters there and they care about things. We don't worry about the politics in the building. It was all about mission accomplishment, and hats off to these kids who experimented, found these hard problems, solved the problems in many cases, and I will tell you, we still have a lot of work to do in a lot of different areas. But that was

the big lesson that I shared with my counterparts. Toby had some additional lessons learned, big lessons learned at his level; he's working on his counterparts.

Col. Magsig:

So when you look at the joint force, Tom, you've got to look at how the joint force fights. And we talked a little bit about multi-domain operations. That's the Army's concept; it's now written in draft, FM 3-0, our operational manual, is out to make multi-domain operations into our doctrine, but that's not the only service doctrine out there. So every service has their own concept that they're experimenting with. The Marines have expeditionary advanced space operations; the Navy, distributed maritime operations; the Air Force, agile combat employment. So, really, it's putting all five services out there to experiment with their service-specific concepts and how those nest underneath the joint warfighting concept. And so all of us were informing the joint staff J7 team in the next iteration of the joint warfighting concept. And so this experimentation is essential to getting it right. And really what we walked away with was the underpinning of the joint warfighting concept, this JADC2, this philosophy of joint all-domain command and control, this ability that to fight simultaneously in five domains, this ability to pass data, and – so we are a unified joint team. And then, you know, when you look forward to PC 22, it's not just the U.S. as a joint force. It's our combined joint force, so taking our closest allies and partners, being able to pass data seamlessly, being able to have that trust in the data that we've passed so that, you know, an Australian shooter might feel very comfortable off of a British sensor or a Canadian C2 node. You know, I mean, it's – the permutations have got to get there. And so it's really experimenting to inform both JADC2 as the basement or the foundation, and then the joint warfighting concept.

Lt. Gen.
Richardson:

It's more than informing about material, you know. [Vice Admiral] Stu Munsch, who's our – the J7 for the joint staff, was on our board of directors. The J6 was on our board of directors. The JAIC Director was on our board of directors. So they got to help plan this and we thought we were going to one – but more importantly, they saw the lessons learned and be able to apply that from a joint perspective. And so when you have – everybody has a common operating picture across the services of where we need to go. That's what project convergence did. It informed us all. It informed the concept. It really, truly is going to inform us how we're going to fight in the future.

Dr. Karako:

But let me focus on the how do we get from here to there, because, you know, you said something about we've got all these stovepipes and we're trying to find the Band-Aids to get them – or the universal translators to get them – the bridges to get them to talk together. But you also said, but we don't want to rest with that; we want to have almost like a clean sheet where folks are talking the same language and we don't have to have that translation. But that's going to be a challenge. We've got a lot of stuff right

now and, you know, it's going to be a big challenge to redo everything, and maybe impossible. So then the question becomes, how much are we going to be translating, and how much is it going to be clean sheet? Because that's kind of where the rubber meets the road, right?

Lt. Gen.
Richardson: Our systems today are our systems today. We're not going to go back.

Dr. Karako: Yep.

Lt. Gen.
Richardson: It's too expensive to go back and touch every system that every service has. We're going to need translators for those and we've identified the type of translators that we need in Project Convergence. But as we go forward to, you know, purchase and acquire our new weapons systems, we've got to go forward together with one common standard. There's no way that we could go back on our legacy.

Dr. Karako: Right. Just wanted to make sure that was – so let me – you alluded to it, but can you talk a little bit about your relation between Project Convergence with Project Overmatch and with Purple Flag, all these other field exercises that are out there? You know, this is nevertheless an Army-led effort. How are you relating to those?

Lt. Gen.
Richardson: Project Convergence was an Army-led effort, a joint exercise. But we're participating with the other services in their exercise. I mean, I – a team just left – is at Yuma today for one of Ms. Shyu's experiments that she's doing, out there with counter-UAS. We're together participating with every service, and it's just not they come do an Army exercise; we're working hand in hand together in their exercises as well as our exercises, and the key is, we are capturing lessons learned from all of our experiments across the joint force that make us better, so – and at your level, Toby, I know that you're working very closely with the other services and some of their ongoing –

Col. Magsig: Yeah, in many cases, it's the same people, Tom, working these different service-specific experiments, and so it's neat to take three different approaches and, you know, excuse the phrase, but converge on what the solution's going to look like. And so if we only go at it from one vector, we may or may not eventually arrive at the right decision. So, you know, from the Air Force's approach with ABMS, from the Navy's approach with Overmatch, and, you know, the Army – (laughs) – we're probably the one service that can't fight without the other four services. I mean, we've got to have – and so, you know, we're integrated by design in Project Convergence, and we need the joint force to be able to fight together to both support on the land domain and then be supported by the land domain. And so, you know, each service taking a slightly different approach to this is probably good for the American taxpayer and it's good for our collective security.

Dr. Karako: So, Gary, let me turn back to you. You mentioned TRAC; maybe you can say what TRAC is and talk a little bit more about the analytic component of this. You know, again, this all about, how is this campaign of learning going to be used? And I want to blend this with a question that came in from the audience, which is, how does this compare to the network integration evaluation of old? Right? Maybe compare and contrast that exercise that perhaps didn't have as much output. So over to you.

Mr. Lambert: So TRAC, first of all: So it stands for The Research and Analysis Center and our agency is a direct reporting unit to General Richardson, and so that's powerful for a lot of reasons. So we're an analytic organization. We do kind of operational analysis associated with capabilities, formations, concepts, and so forth, to help inform the modernization enterprise. Having that direct reporting unit relationship allows us to be free from proponency, and so you don't want your analysts to be tainted by proponency or ideas. You want it to just be the facts and that's what we report to General Richardson in our work.

From an analytic perspective, I alluded to some of the scope and scale and how we kind of laid it out, how important that plan is, and you know, we had like over, I think, 101 learning demands across all the joint force that was a part of that. And the scope and scale just keeps getting, you know, higher and higher, and so we've done a lot of work at trying to establish a data repository. So we have a location where all the data that we collect – and that's everything from observer-analyst data cards to instrumentation and everything else – that's up in that repository and is now accessible by our analysts and other folks across the joint force to go back, if we have to, and have – you know, now you've got that data set that helps you to go, OK, how do we do this and how well was it? And we didn't think of all the questions that we wanted to have answered up front. And so that's going to be an enduring capability that will get better over time as we get more cloud-based and so forth moving forward, but it also will help us to see ourselves longitudinally. We can go back and see, OK, are we improving over time as we do this?

You mentioned briefly the NIE and how does, you know, this relate to the two, and in fact, I direct one of the subcenters of TRAC down at White Sands Missile Range and we have a footprint that basically have a division – direct support to Toby that, prior to Toby, we were still doing the network integration exercises some years ago that did the analysis for that. And I think the probably slightly pejorative words for it is it's more of like a petting zoo. So industry brought out their technologies and we did some, you know, work with them in the field, but it was more about kind of, you know, can these work and so forth, with almost zero prior lab-based risk reduction that I talked about before and things like that. And so – and there's also Army-

only, which I think is another aspect that's different – what we're doing now in Project Convergence. And the scope and scale was nowhere near what we're doing right now. So that's changed how we do the work and the analysis, obviously, and I need an army of analysts now to do the support for Project Convergence, compared to the NEI, which was essentially just some of the members of my organization.

So I think going forward, as we bring in the combined piece, we have relationships with our allies, from an analytic perspective, data exchange agreements in place. In fact, we're doing studies with the U.K., for example, right now that will help us as we go forward in PC 22. And I'll hold there. It looks like Toby's got his –

Col. Magsig: So, Tom, you know, what I'll say is NIE started with great intentions as well, but it kind of expanded to the point of exceeding its usefulness, and, you know, gentlemen like retired Lieutenant General Tom Spoehr have reached out to us and cautioned us on Project Convergence from going that same route. And so, you know, what we have deliberately tried to do with Project Convergence is keep it defined: define our requirements, keep it on, you know, how we inform the joint force, and form the joint warfighting concept, but then it's also our relationship with industry. It allows us to send a clear and unified message to industry so that they can prioritize their IRAD investment and they can understand where the joint force is moving together. So as long as we keep to that sweet spot, I think Project Convergence will be of great utility.

Dr. Karako: So what is the message to industry? And is there going to be an industry day following up on this?

Lt. Gen. Richardson: There is going to be an industry day. I think we're going to have an industry day the third or fourth week of March. But the message that we're trying to send is – I think a couple of messages: number one, we can't do it without you. You've got to be in the game with us. Number two is, you need to know, what are those hard problems we're trying to solve for the future? You don't need to be guessing. We need to be able to define those problems, work together with industry, take the technology and put it in the dirt. We learn, they learn as we go forward. That is the key. And then if we're able to do that, that not only benefits us in the services, it benefits industry and where they're putting their money and having a clear vision of where we're going in the future.

Dr. Karako: Any particular priorities you'd like to highlight for that?

Lt. Gen. Richardson: Well, we talked about a number of the priorities. We talked about the joint use cases. We talked about something that's near and dear to your heart, which is fires, defensive fires and offensive fires. That is absolutely a priority

that we're going to continue to focus on in the future. We talked about the network, the Integrated Tactical Network – extremely important. It's the backbone that – to everything we do, and without it – (laughs) – we're not going to be able to execute the exercises.

I will tell you that we're really focused on – if industry's listening, we're focused on autonomy, robotics, machine learning, as we go to the future. Something that we left out is we did a lot of experimentation with our medical out there, and people don't often think about that. We no longer want to think about the golden hour when you deploy; we want to think about the golden 24 hours, and how do we do that better? Our research, medical research center was involved. And then, lastly, from a contested logistics: It's going to play huge in Project Convergence 22. General Daly and I have had many conversations. You know, I took the lead for Project Convergence 21 but I asked General Daly, I said, hey, sir, when we go to Project Convergence 22, contested logistics is going to be a use case. He's taken charge of that use case personally. He has co-located his guys with Toby's guys out at Fort Bliss. Logistics is important. It's extremely important. And if we're going to start operating in dispersed terrain and smaller formations as we go forward, we've got to figure out how we're going to sustain ourselves, and AMC is heavily involved.

Dr. Karako: Let me hit two things you touched upon there: one, the Army tactical network. You know, you mentioned offensive and defensive fires there. What's the relation of that to IBCS? Like, what's the vision for it on that? What are you seeing about this requirements that are going to drive that?

Lt. Gen. Richardson: It informed us. IBCS – we have a requirements document. I think many of you know that IBCS is going through its IOT&E currently right now. But, you know, we also know it's tying in. They send a radar with a Patriot radar. So what do we want to tie into IBCS in the future? I will tell you, I've talked to Brian Gibson, I've talked to the air defense community of where we – you know, we all agree of what we learned out of Project Convergence and where we need to go to the future. We talked about connecting other radars. We talked about integrated radars. So as we go forward with IBCS, it is an important aspect program in the Army as we go forward, and what this really did was inform us of where we need to go from here.

Dr. Karako: Let me hit the logistics thing as well. Toby, if you want to talk about the lessons learned. I'm thinking especially of INDOPACOM, getting stuff out in the contested environment, DDIL, and also the tyranny of distance. Over to you.

Col. Magsig: So we did a lot of work with prognostic and preventive maintenance and sensors. We did it in the view of maintenance for PC 21, but we have got to up our game and distribute that across all classes of supply to give – and we

need a dashboard that integrates that data and aggregates it and presents it in a way that allows two- and three-star-level commanding officers to make decisions at the point of need, because, you know, just-in-time logistics is usually just – (laughs) – is a bad way to fight a war. And so from a contested logistics standpoint, we – what we did in sort of maintenance parts was good but we can extrapolate a lot of requirements from that and then getting it tied into our mission command systems to provide the ability to make decisions. From a tactical perspective, we need to get autonomy into our logistics systems and our supply chains. I mean, Amazon, you know, quite frankly, is probably ahead of the Army in terms of using autonomous delivery systems for packages and things like that, and we've got to up our game to get there. And we did some good experimentation towards that, and I think you'll see that continue in a more robust manner in Project Convergence 22.

And then when you speak of the Indo-Pacific, I mean, there's great challenges there – the tyranny of distance, the tyranny of gravity, or the principle of gravity, and so we're taking, you know, some Army watercraft that's being developed in PC 22 and tying them in there in new and creative ways. The Maneuver Support Vessel (Light) hopefully will be a big part of the sustainment efforts in Project Convergence 22.

Dr. Karako:

So it was – I'll get to 22 in just a second, but let me stay with this. You mentioned, for instance, you compared what you're doing and correlated it with the IOT&E coming up for IBCS, for instance. How does your testing, how does the new Project Convergence campaign of testing kind of stuff, how does that relate to the more standard testing and evaluation processes that you do? What's that relationship and how would you describe that? And then, number one, how does it inform it? And then, number two, what are some lessons and how are what you're learning being applied to the acquisition process for the Army as well?

Lt. Gen.
Richardson:

Well, number one, I think if there's one thing that people should have gotten out of this conversation today, yes, it's joint, but it – the modernization enterprise is ASA(ALT). The modernization enterprise is FORSCOM, AMC. We're doing – and ATEC. We're doing this as a team going forward. It's not one organization that does Project Convergence. It takes a village.

Specifically to your question on testing and evaluation: ATEC, under Major General Jay Gallivan, is in direct support of Army Futures Command, and Jay attends – Jay is on the board of directors. Jay has – attends all of our staff meetings, completely embedded with Army Futures Command and his entire team. He's got all of those with our organization. Jay worked very carefully with Gary and the data collection plan, because a lot of his Department of the Army civilians and soldiers were part of that effort of collecting that data. What's critical with this? He's starting early. He's not waiting for a test event.

He's already collected the data over all the project convergences. What does that do? That shortens the testing timeline when we do get to a program of record. And so working early with all the different organizations truly helps out. As it relates to ASA(ALT): a critical team player and a member of the modernization enterprise.

As you look at this aspect of the life cycle, you have a concept that's written by our – one of our subordinate elements, FCC. Right? We turn those concepts and look at the gaps into requirements documents. We're developing those – we're developing that together. But more importantly, what we're doing is we're prototyping. Right? We're designing, we're building, we're putting this equipment in the hands of soldiers in the dirt, and we're learning, and we're informing our requirements documents, number one, so we get it right. Number two, the PEOs and the PMs have been in this from the get-go. They're the ones that helped us with the ideas of where we wanted to go to the future. They're there to develop these attributes. They're actually doing the prototyping. They're learning. And so what you learned and you test while you're prototyping – what does that do? You go into a milestone decision; you may go in at milestone B; you may go in at milestone C. What that does is shrink your EMD phase of the acquisition cycle. It shrinks it because you built the weapon system. Now, there's probably some more testing. You test it.

Dr. Karako: This has a lot of risk, though, and kind of the things, the priorities that RCTA –

Lt. Gen. Richardson: And some of the things that RCTA were doing, and they spun off of us after standing up RCTA. And so what do you do? You shorten that acquisition cycle together and it's a team approach in doing this. And if there needs to be adjustments to requirements based off of what we learned, we're all there together. And so I think it's paid huge dividends of project convergence, our CFT efforts, and everything as we're going forward, and the process and the concept of how we're going about it with our soldier-centered design and learning before we go to an MDD.

Dr. Karako: Well, I think kind of to rap us out, I might have each of you talk a little bit about any other highlights of PC 21 you want to foot stomp, and then also how PC 22 might be a little bit different and what else you're going to be trying to accomplish. So maybe start with Gary and work our way down?

Mr. Lambert: I think, going forward, the scope and scale's changing so we've already talked to that. What's interesting to me is, as we do these iterations – and we were talking a second ago about the ATEC piece, you know, the testing side of the house and then Project Convergence. Another aspect of that, I think, is the reps we're getting. We're getting soldiers that touch us more than once and to inform, so we even had, you know, some fixes that went to ICBS, for

example, from PC that they were able to jump on before they go to test. But I just want to kind of close out with that. But, you know, going forward, I'm excited because, you know, I've been doing the analysis business for quite a while and I lived through a few NIEs and things, but we never had a good way of seeing ourselves longitudinally and going forward – how are we doing? How are we getting better at, you know, closing the kill chain, or whatever the problem is that we're trying to solve as a joint and now combined force?

And so, for the first time, we're bringing all of the team players together; we're tying in up front with malice aforethought the analysts. OK? And then we're gathering the information and data so that we can see ourselves as a joint force and then figure out how to fix what we can't do in overcoming these problems. And so yeah, we're increasing complexity but it's also allowing us not just to look at technologies now; we'll be a little bit more concept-focused, for example, in 22, which is a different aspect of this and a different problem in terms of analysis. But I just – I'm excited that we're basically starting to establish a foundation of learning, not just a campaign of learning, that allows us to, again, see ourselves and move through and then also identify the places where we need to have emphasis, where we're still falling short, and then, you know, fix those problems.

So I'll guess I'll stop there.

Dr. Karako: Great.

Col. Magsig: Yeah, so if PC 21, Tom, was can we do something, can we connect technologies, can we demonstrate how the joint force can fight in a new, creative, different way, more optionality, more simultaneity, increasing the speed and doubling down on the ranges that we're traditionally used to fighting in – we did that, largely. You know, at the secret and top secret level, we've passed to commanders the insights that we've learned from PC 21. PC 22 is going to be how – so now we know we can do it; how does that scale? How do we get it from singletons to the level of complexity that we know that our adversaries are going to impose upon us? And then, you know, how do we integrate our closest partners and allies? And then how do we experiment against all the service concepts to further refine the joint warfighting concept?

And so I think that's what you can expect to see in PC 21: greater scale and complexity, greater involvement of our partners and allies, the criticality of a mission-partner environment, in some cases, and then the ability to tie everyone together, you know, across the joint force.

Dr. Karako: General Richardson, in your closeout, I wonder if you might also give us a little bit of a vision of how we get from PC 21, 22, to 2028? So much of big

Army is oriented to 2028, so where do – you know, where are we going in 22, and then, what’s coming after that?

Lt. Gen.
Richardson:

You know, as we go forward, the – what I tell people today is the technologies are here. It’s here. It’s before us. You know, for the Army of 2030, we’re identifying those technologies that are going to go in those weapons systems today, but I will tell you, we’re really focused deep on 2040 and beyond, and 2050. We’re actually testing some of those technologies. A lot of the technical readiness level, the technologies that we – you know, were tier L6, where it’s almost ready to be integrated into a weapons system, but we looked at some of the technology at the tier L3 level. And so I’m really excited about where we’re going. We’re scaling. Like Toby said, we’re – you know, we did the joint; we’re going to work with our coalition partners next, and then after that, we’ll go back to another technology-driven-type project convergence, looking at those technologies that are 2040 and beyond.

What I love about it is we have the support of our secretary and our chief. They understand the technologies. They understand the use cases. If you talk to the secretary, she knows it as well as I do, and they’re really excited about where the Army’s going and the project convergence. It’s really good to have the support of your leadership, and more importantly, the support of our other services chiefs and secretaries as we go forward. And so that’s what’s been really, really – you know, for me, growing up in an Army that fought combat for the last 20 years – I mean, I’m alive today because of the Air Force. You know? We fight as a joint force, and it was so nice having my counterparts that we served together in combat as colonels and lieutenant colonels, and now we’re all three-stars. We came together, you know, for our sons and daughters of the future. And so really, really game-changing, a lot of learning going on. Things worked, some things didn’t work, and then there are areas that we needed to place more emphasis on. It’s a campaign of learning. It’s an exercise, a joint exercise with the Army, but we will be supporting all the other services in their exercises as they go forward as well.

And I just want to thank you for taking the opportunity today to allow us to come and – this is the first time we’re publicly releasing information. I’m sure there will be a lot of questions at industry day now.

Dr. Karako:

I’m sure.

Lt. Gen.
Richardson:

We’ve kept it at the unclassified level for a reason, but many of our industry partners were out there with us – over 130 industry partners. And what I’m excited about is our small business. There were over 80 small-business partners participating in Project Convergence, because we can’t do it as an army; it takes all the services, our coalition partners, but more importantly, industry and academia as we go forward with our further –

Dr. Karako:

Well, we're glad you came over here to roll it out, and congratulations on PC 21; good luck with 22. And hopefully we'll have you back some time in the future to talk about that.

So thanks, everybody, for joining. We'll sign off, and we really appreciate you tuning in.