Episode 212—B-2: Still Got What It Takes

Heather "Lucky" Penney: [00:00:00] Welcome to the Aerospace Advantage podcast, brought to you by PenFed. I'm your host, Heather, "Lucky" Penny. Here on the Aerospace Advantage, we speak with leaders in the DOD, industry and other subject matter experts to explore the intersection of strategy, operational concepts, technology, and policy when it comes to air and space power.

And today, we're talking about the B-2. Let's just be honest, folks. It's a bomber and one of the coolest aircraft ever to fly. It's also one of the most capable ever invented. And anyone who's ever seen it will never forget its unique shape and its presence. I mean, it just looks like a bird of prey. It's one of those airplanes that will always look futuristic, state of the art.

But there's a catch to that. It's hard to believe but the B-2 first flew over 35 years ago, in 1989. That's the same year the World Wide Web was invented, and let's face it, back then, most of us were using phones that were bolted to the wall, a far cry from today's cell phone reality in the information age. But [00:01:00] across those 35 years, the aircraft has really delivered.

The B-2 has executed a number of combat sorties, been a keystone in multiple operations, and it continues to stand as a cornerstone of the nation's nuclear triad. But the aircraft on the ramp today is very different from the one that Northrop Grumman built three decades ago.

And Northrop has teamed with the Air Force continually to modernize the aircraft to ensure that it remains relevant and viable in today's operational and information world. So that's what we're here to discuss today. How the B-2 is still evolving to ensure it can deliver the promise of striking any target around the globe anytime.

And there's no one better to discuss this than Doug Young, Sector Vice President and General Manager for Strike at Northrop Grumman Aeronautics Systems. His portfolio includes the B-2, the B-21 Raider, and several other highly capable systems, most of which are classified. So, Doug, it's awesome to have you here.

Thanks so much for joining us.

Doug Young: Hey, Heather. I am [00:02:00] really excited to be here and share about what we've been doing and really focus on B-2. I don't often get a chance to talk a lot about B-2, but it's, what's out there today. you know, when you guys called and offered up this opportunity, I felt like it would be a real privilege to stand here and talk about some of the great things the team's doing.

We've got over 7000 people that get up every morning focused on our mission of delivering systems that. Can operate and deliver capabilities in the non permissive and highly contested environment. And, part of how we do this do that is across our portfolio of these types of systems. We learn from each other about how sustainment needs to work.

In the field, the implementation digital threads, how do we produce these kind of aircraft? Because we've got systems in all different phases of the life cycle. So, we take that responsibility seriously. And ultimately, all that is manifesting in what today, you know, as the B-2 and the B-21.

Heather "Lucky" Penney: That's amazing. I love how you're talking about the crosstalk and we will [00:03:00] definitely get to that a little bit later in this episode. The B-2, I mean, that is really a cornerstone of our nation's capability to shape and deter. I mean, it can hold any target anywhere around the globe at risk at any time.

So, I'm a fangirl, love the B-2, even though I flew pointy nosed jets. Um, But really grateful that that is still in our inventory and I firmly believe that even as we onboard B-21 and we need them as fast as we can get them and as many as we can get, we have to retain the B-2 within the inventory because of its range, its unique capabilities and its payloads.

So thanks again so much for coming to speak with us about the B-2.

Doug Young: You're welcome.

Heather "Lucky" Penney: We also just had you on a panel at our Airpower Futures Forum a few weeks ago so you're pretty much a Mitchell regular by now. Your candor, the information, it was fantastic. And we're really pleased that you're here to spend more time with us. After all with the B-2 and the B-21, you have one of the coolest air power portfolios in the industry. So to set the stage for the B-2 modernization [00:04:00] discussion, can you help our listeners understand what the state of the art looked like when the B-2 was first developed and fielded?

I mean, you joined Northrop back in 1985, and you were a young engineer on the program, but a lot of folks don't realize that what the state of the art then really, um, was advanced, and at the same time, when we look retrospectively, constrained based on what we can do today. So I really want folks to understand how far the B-2 has come.

Doug Young: Yeah, that's a great question. And yeah, the, forum, uh, was really, a lot of fun to interact with our customers on an important topic. Very timely. But, you know, if you really roll the camera back or the clock back to, the mid eighties, recall that we were in the midst of the Cold War.

that's about the time I came out of college and started. On the B-2 when it was at its CDR. So I had the opportunity to be on that program from the CDR through the rollout, the 1st flight into the ultimately the 1st, delivery and during that evolution, which really [00:05:00] was part of a change to how we design aircraft of the time, B-2 being revolutionarily different in its shape. We had to control the shape of that aircraft very precisely. The wingspan was 172 feet. We had to control that within half an inch. Curvature was dictated by very precise models of how electromagnetic waves behave when they encountered a shape.

So, if you recall, the F-117 was a faceted shape, very flat.

Heather "Lucky" Penney: Those flat panels, yeah, yeah.

Doug Young: It was easier to model, and less computing power, as that aircraft went through its evolution, more computing power became possible, these giant Cray computers, they used to call them, that gave us the ability to

Heather "Lucky" Penney: Yeah, I remember this.

Doug Young: Yeah, they gave us the ability to process these, equations that, describe that behavior and implement them into the shape of the airplane, which then drove us to the [00:06:00] manufacturing and design approach, which had to be to control. The shape from the outer mold line in and develop all our tooling from that shape very precisely. So 3d tools were a key element of that. So computer aided design was there at the time and two dimensions, but we were the first program in the industry to go to three dimensions.

Heather "Lucky" Penney: Yeah. you developed CADCAM to, B-2, right? I mean, it's really, the B-2 is one of the first instantiations of real digital engineering very early, as you said, but there's no way you could have achieved

the precision, the curvature, and really the, LO signature of the B-2 if you hadn't had that kind of processing and software and modeling.

Doug Young: That's correct. In addition to controlling the shape and the manufacturing process with a whole new approach, we also had to rethink how do you design all the features on the aircraft so that they don't reflect radar?

How do antennas pop out? how do you do the windows? [00:07:00] How do you do all those critical features? Those had to be done in an entirely different way. And then finally, the whole realm of materials and processes. There were over 500 materials and processes had to be developed to give the aircraft its ability to operate most effectively with those electromagnetic waves to either absorb them or allow them to pass over the aircraft and in a non reflective way.

So a whole host of material developments had to occur that are still, you know, evolving today over 30 years to the future. Ultimately this lead to the most sustainable and survivable capabilities that are manifest in our 6th generation platforms

Heather "Lucky" Penney: Like the B-21, which we can talk about. But this is again about the B-2.

So, as you mentioned, the design of the physical airframe was incredibly challenging, was the first instantiation of digital engineering, required the invention of new materials, new processes, um, new models, uh, new tooling. I mean, [00:08:00] really, it was a major leap forward, but the other piece of the B-2's capabilities were its mission systems and the associated processing, right?

I mean, a lot of folks are only now beginning to realize that like swap C, the size, weight, processing power, cooling, like all of those are physical attributes of an aircraft. And for the B-2, because it was going alone and unafraid deep into the Soviet territory, had to have all of this technology and mission operations, all of these systems organically embedded on the aircraft.

Can you talk more about how this, impacted the B-2's design and your capabilities?

Doug Young: Yeah, I mean, you're exactly right. Um, it is a very self contained aircraft and in general, these aircraft that do these kind of missions need to be. However, what's been happening over the last 30 years as we've evolved and developing protected communication means, and evaluated how we can best connect these aircraft to off board [00:09:00] sources so that we can get in flight

updates, rather than maybe doing them over a radio and, doing them verbally and trying to punch them in or using a different set of cards for different situations and doing a lot of manual work, we can now do those in a machine to machine, format.

And so the B-2 is, well on the path to being able to do that. And, actually, uh, we've done some recent testing and are implementing that on B-2 today. So, uh, really proud of that breakthrough because it's going to offer a lot more efficiency and effectiveness for our warfighters.

Heather "Lucky" Penney: That's fantastic. I mean, the B-2 and the direction that you're taking it in is really kind of the best of both worlds because it still has its organic capability to close kill chains on its own. But because it now has that connectivity and that machine to machine data transfer, you can be part of the family of systems in the system of systems.

Doug Young: That's correct.

Heather "Lucky" Penney: So, the B-2 has been making a lot of history throughout its entire life cycle. I mean, for example, it was the first airplane to ever employ a JDAM, so [00:10:00] a GPS guided bomb in combat. That was during Kosovo. And some of its other missions have set major endurance records. That has to be a source of pride for you and your team.

Doug Young: Yeah, it is. I mean, these pilots are amazing. You know, they, live in the Midwest and in Missouri and they, take off from Whiteman Air Force Base and they fly missions. All over the globe without landing. I mean, they refuel a couple of times and they return home and they go home and mow the lawn, probably after sleeping for a while.

But, you know, the fact is the long endurance of the aircraft is solid, 30 to 40 hour type missions have happened and it's all inherent to the robustness of the design. And really part of our modernization effort along those lines, Heather has been focused on weapons. I mean, And that's really important, obviously, because that's the business end of what we're trying to deliver.

And so, you know, in addition to JDAM, you know, we've implemented, onto the platform, the Massive Ordnance Penetrator, the [00:11:00] GBU-57, the JASM and the JASM ER, which is the, uh, as you know, probably the AGM-158 and then, uh, we're in the process of, working on to the platform GBU-72. And, if you recall, at the forum, I mentioned the fact that there's a whole new wave of weapons being developed by the Air Force for these type of missions

because, uh, you want to have, weapons that are also compatible with some of these, uh, more unique and sophisticated missions that we're asking our, uh, penetrating force to do. And addition, as well, recently, we had that mission in Yemen that the Secretary of Defense talked about several weeks ago, uh, which was the most recent operational, utilization of B-2. So it's, it's alive and well and, performing missions every day.

Heather "Lucky" Penney: Well, and nothing sends a message like B-2, because there's really nothing that you can do to stop that aircraft.

And that's one of the reasons why it's so core, not only to our nuclear deterrence in the triad, but really, frankly, our ability to shape and deter [00:12:00] around the world conventionally. so the B-2, I think, is an essential capability that we have to retain and continue to modernize within the force. And to be this strength in this powerhouse, and I do believe in peace through strength, the B-2 has evolved a lot over the years.

The last one rolled off the line in 1997, and if you asked me, I think we should have built a lot more of them. We only bought 20. We should have bought at least 120 to 180. Um, but as I understand that, that's my own personal opinion. Um, but as I understand it, there have been a lot of upgrades, a series of upgrades that have impacted everything from the stealthy coding to the radar.

So could you talk us through the progression of those modernization efforts? You mentioned, um, how you're advancing weapons. But what are some of the other modernization efforts that the Air Force is pursuing?

Doug Young: Yeah, we really look at this accross an integrated roadmap of capabilities. So we focus on comms and weapons.

So no comms, no bombs is what we say. [00:13:00] I mentioned some of the things we're doing in comms. There's also lot of things going on, as you know, in terms of the space comms networks that are going up that will provide additional opportunities to start to tie in systems like this. So comms and weapons and talked about those.

The survivability of the platform. So, we've gone through several iterations over the last 30 years of modifying, refining the material systems on the aircraft to make them more robust for sustainment purposes for operations and sustainment and more durable, but then also to make, step increases in the signature of the overall platform.

So there's a lot you can do over time to the exterior of the aircraft to improve that. And then finally, being able to sustain the aircraft, not just the material systems, but on the hardware end, where are some of the things that are our frequent failure elements? What things are going? Diminishing suppliers.

That's a big part of our thrust. So comms and weapons, [00:14:00] survivability and then ultimately sustainability is key so we can drive up the availability numbers for the platform and make as many of those 20 aircraft ready to go to war every while we continue to refine and maintain them, and keep them flying.

Heather "Lucky" Penney: Yeah, and I'm so grateful that you're focused on the sustainment piece because we need to retain the B-2 within the active inventory for as long as possible. We've got to make sure that we ramp up B-21, but we can't let go of B-2 because that is so core and so unique in terms of its reach and its payload.

Um, and as you, as you go deep into bad guy land, as you are also connecting the aircraft through advanced communications, you're enhancing the operational success and viability of the rest of the force. So let's talk about this new wave of B-2 modernization. The B-21, which is kind of like the B-2's baby sister, she's garnered a lot of attention, but the reality is that America's first stealth bomber is going to be on Air Force flight lines for several years into the future.

Take care. it's going to take a while for the B [00:15:00] 21 to work through its test program and gain initial operational capability. Plus, that's very different. IOC is very different from being fully mission capable. And we need to have the aircraft in sufficient numbers, so it has to be there on the field, capable of taking off and employing in operations in meaningful numbers.

And the build rate takes time, especially if we don't advance it to the maximum that we can get. So, we've got to have the B-2 on the line for as long as we possibly can.

Doug Young: Absolutely. And, and the way we look at it and the way we talk about this with our customers is we need to maintain the full operational capability of B-2 and that includes nuclear and conventional until the B-21 can come in line in sufficient numbers.

to address again, the nuclear and conventional mission and so, in that vein, then keeping the B-2 capable and relevant as the threat continues to move towards us is really what we focus on in the modernization. And again, in the comms arena with the, battlefield collaborative combat [00:16:00] communication framework

that within which I mentioned one of the connectivity items that we have is there, uh, Continuing to evolve on survivability, continuing to drive up the availability so that B-2 continues to be robust to deal with both nuclear and conventional as B-21 comes along and comes on in numbers.

So, we've got a few years to be doing that and these modernization efforts are maintaining that relevance. to accomplish that goal.

Heather "Lucky" Penney: Yeah, we've gotta make sure we've got the B-2, uh, fully mission capable and is available as possible until B-21 is fully mission capable and can really take hold of the nuclear piece of that triad, as well as have enough numbers to be able to achieve the capacity, and the, density that the attack density that we need in combat.

So one of the upgrades that really caught my attention this summer, was the Spirit Realm initiative. As I understand it, this ties to an open mission systems architecture that allows for far more rapid responsive [00:17:00] upgrades to the B-2. Can you walk us through what this means and what the different elements of the Spirit Realm is?

Doug Young: Yeah, Spirit Realm, we're really proud of that. the team received an Air Force award for that actually, in standing that up. And it's actually not something that goes on the airplane. It's an environment. Think of it as a software development environment that, uh, is built around our digital ecosystem.

And it actually was derived from the same way we're approaching things as we stood up B-21 in this era of, Agile software development. And how do you apply that then to a, um, weapons system grade environment with its multiple, uh, certification requirements and the need for agility and leverage commercial tools that are out there that have evolved in the last 20 years in the, in the evolution of all the, all the information systems that we have commercially available.

How do you apply those in a weapon system environment? And that's what Spirit Realm is. And it allows us to [00:18:00] rapidly update software rather than taking a year or more and even numbers of months. We can get it down to weeks and single digit months to in order to be able to make those modifications quickly.

So it makes us more agile and bringing capabilities on to B-2, even though it was developed 30 years ago. This is also enabled by the fact that we have sort

of retroactively incorporated the concept of an open mission system architecture by segregating the mission software features from the flight software features so that when we make a change to the mission, we aren't touching anything and how the airplane flies, which brings with it its own airworthiness constraints.

So that separation, if you will, has given us another big enabler to that agility that operates inside of that Spirit Realm ecosystem of software development, capability development.

Heather "Lucky" Penney: That makes a lot of sense. I mean, it seems like a key element for this upgrade, you [00:19:00] mentioned, was separating out the flight architecture from the mission system architecture.

And so then, um, because you now have this separated and segregated mission system architecture you can rapidly upgrade that without impacting the airworthiness certification or having to go through all of additional flight tests to validate that new mission capability isn't going to cause any safety of flight issue for the B-2.

Doug Young: Exactly. And in fact, you know, that was enabled really by a hardware change that was for another reason, which was we had to replace the displays in the B-2.

The platform. So obviously display technology has evolved a lot in the last 30 years. So, we basically had done a modification that started several years ago to bring on the latest, commercial type technology and, and incorporated into B-2. We're actually just about complete with the, the flight testing on that.

It's gone very well. And by making that implementation, we were [00:20:00] touching the system in a way that gave us the opportunity to create this portal in which to segregate, mission systems from flight systems. So it was really enabled by a hardware change that was a major modification of the aircraft and we were able to enact that open mission system architecture philosophy with that.

Heather "Lucky" Penney: That's really impressive 'cause that was gonna be one of my other questions is how did you have to change the processing? So the core computer, if you will, uh, to enable you to then install this open mission systems because a lot of the hardware and these older processors didn't have the ability to host the advanced software and certainly not in this kind of open mission systems kind of way.

Doug Young: Yeah, and actually, it's really cool because, we're actually now with these more modern displays, which have better color features.

I you're a pilot, uh, you know what it's like to interact with that screen and. so now we have the latest visualization method, all the same physical features. We didn't change the way the cockpit was laid out and the buttons or anything, but we changed the way. [00:21:00] The information is presented and we've been in the B-21 realm, we've been doing a lot of work on how to show the mission behaviors and the off board sensing information in a way that's more beneficial to the pilot.

We can now start lifting out some of those elements that are relevant for B-2 and incorporating those on those displays. So it's really, again, one of those synergy elements that's a manifestation of going to this Agile software environment, while at the same time, bringing our displays up to speed and making it look and feel more like a modern aircraft.

Heather "Lucky" Penney: I love the fact that you're really looking at how the vehicle and its displays interact with the human pilot, because how that information is presented to the human, to the pilot and their operators. Operators is really an important element of operational effectiveness because human cognition, I believe, in the forward edge of the battle space will continue to be our asymmetric advantage, especially when we do this human machine teaming with the platform that we're [00:22:00] interfacing with.

So I love your approach there and also that you're leveraging your investments in B-21 back into B-2 and you're taking investments in B-2 and forwarding, those lessons learned into B-21. So is this also decreasing overall cost in terms of modernization, development, sustainment across both platforms?

Doug Young: Yes, absolutely. Now that we're able to cut the cycle time down by so much and get away from having to certify the aircraft every time we make a change, we're able to do these changes much more affordably.

So, it really drives a big affordability advantage. to make, changes more rapidly, and it's ultimately going to enable us to do things like integrate on new weapons much more efficiently because, rate of evolution with weapons is, as I mentioned earlier, fairly fast now, driven by the environment. And being able to put new weapons on B-2 is going to be a key, outgrowth of some of these new [00:23:00] digital methods we're implementing onto B-2.

Heather "Lucky" Penney: I love how, um, this environment, this ecosystem of Spirit Realm allows you to agily accelerate the iterations of software development and field that more quickly because I have long said that the, the third offset is really about time.

Whoever can iterate and field more quickly, whoever can adapt to the battle space more quickly will have that combat advantage. And that's exactly what you're providing to the B-2. So, this also then ties into DoD's DevSecOps processes, the development, security, and operations of software development. Can you help our audience understand what that really means because you were a DevSecOps pathfinder as far as the nuclear triad goes, right?

Doug Young: Yes, absolutely. And we passed, all that knowledge on to, you know, the Sentinel program is it's stood up. and so, yeah, we're very proud of being that pathfinder and have been learning a lot as we've gone through that process. So a little bit about what that is. What is [00:24:00] DevSecOps? It's really It's a label for what I mentioned earlier is, is this agile software development environment that allows you within a multi security level, framework, deliver weapon system grade, uh, software evolution, which requires a lot of checks and balances as a function of certifications.

We have numerous certifications, not the least of which is nuclear and airworthiness that we have to certify as we evolve and develop software. I mentioned that we've been able to segregate airworthiness. That's good, but, DevSecOps really applies even if we were going to make a flight software change.

It's really that process and that discipline, instrumenting the process so that we know every aspect of how that software is being developed. Again, the commercial world has been doing this for a while, but it's never really been brought into this kind of environment. And that's really the breakthrough, and that's really what DevSecOps is and DevSecOps means to [00:25:00] contemporary weapon system development.

Heather "Lucky" Penney: Yeah, the Air Force has been working on DevSecOps, uh, for a while. They've got their own agile software development factories, um, like Kessel Run up in Boston. but I'd like to differentiate what they're doing from what you mentioned specifically, the weapon system grade certification. Can you describe how actually employing and putting this agile software, um, process into a weapon system, how that's different than say, like business IT.

Doug Young: Yeah, I think it's, having the rigor, traceability, and involvement of the stakeholders in that process. So the certification processes, many of them have been around for many, many years. And they were had never been involved in that kind of software development. So they have to fundamentally understand how that process works. So a lot of work went in on the front end for us to bring those stakeholders in, make them part of the process so that as we put our software builds out and certified them, they [00:26:00] were in the game with us, shoulder to shoulder, such that when it came out the other end, everyone could be confident meeting their certification requirements.

And so over time, we'll be able to get into a much more repetitive pattern where we no longer will need to be those additional checks and balances. So it's been an evolution and it requires a high degree of stakeholder involvement on the front end to make sure everyone understands the process and that is robust to the kind of things that can cause issues down the road.

Heather "Lucky" Penney: Yeah, and also, I mean, you're driving towards a much more rigorous level of quality because you can't have that blue circle of death up when you're flying and penetrating into bad guy land. So we can't be dealing with nightly debugging types of issues. We have to ensure that when you install that new software drop into the mission system that there are no bugs at all.

Doug Young: Exactly. And in fact, I am proud to say that what we're finding is, that the process is working extremely well. I mean, if you look at the number of discrepancies, [00:27:00] we're finding in flight test when we take the diplays out into Edwards and gone through the process of, going through flight certification with those we've, we've had very few discrepancies, which, for a modification of that magnitude, is really exceptional. And so the process is proving itself out with fewer discrepancies and better quality in the software. And more efficiency in developing the software and more flexibility in incorporating features that bring operational capability rather than having to oversimplify in order to just deliver the bill.

Heather "Lucky" Penney: Yeah, um, because delivering the bill is a lot more when you're talking about delivering capability to the airmen that are flying and maintaining the B-2. Because this ultimately comes down to how mission effective, how survivable the Um, will the B-2 be for the young men and women that are flying this aircraft into bad guy land, executing the missions that our nations has asked of them, and then their ability to [00:28:00] be able to come home safely.

So how will their lives change under this new paradigm?

Doug Young: Well, I think it's, uh, a lot of it's incremental in a collective way, which is they're seeing a platform that even a few years ago did not have the kind of comms connectivity that, they've been used to in the previous, decades.

They're seeing, a level of survivability that's enabled them to do new things in the mission, mission capability wise and, where they can go and what they can do. The weapons, adaptability, now they're being able to, have a more versatile ability to add weapons to the aircraft, which in the past has not been the case. It's been very monolithic.

And then finally, most importantly, really, where the rubber meets the road is in the availability of the aircraft and its robustness in terms of not having to come back because it's non mission capable now, because you've got a failure on board. It's having that robustness to failures and also having the ability to turn the [00:29:00] aircraft around more quickly so you can get back into training or back into operational missions.

Heather "Lucky" Penney: Exactly. And for our listeners, some of you might not realize that the quality of the coding and the materials, and the structure of the aircraft, even though the airplane might still be flyable, if those coatings do not meet certain thresholds that impacts the survivability and therefore the mission capability of the aircraft.

So, that's another important piece, I think, of the upgrades and sustainment that you're doing in making the vehicle more sustainable is that the B-2 now has more robust, and more resilient coatings to ensure that it's got that mission capability for the types of missions that we're demanding of it, right?

Doug Young: Yes, exactly. I mean, you point out surface treatments. Um, absolutely critical. The smallest defect can light up like a flashlight on the, on the radar. So attention to detail is critical, but our job is to make that material system as robust as [00:30:00] possible. And that's been a big part of the modernization. Um, and then in ease of maintenance, and ultimately we want, something like the B-2 that was developed 30 years ago to get as close as possible to being a daily flyer, if you will, so it can be turned around quickly, uh, and get back into the action.

Heather "Lucky" Penney: Yeah, because with as few B-2s as we bought, and we prematurely terminated that production line, we, we had always needed more than just 20. We need those 20 aircraft to fly as much as we possibly can

to be able to get the utilization and the sorority rates out of them. And frankly, also to provide the training and in an operational context, the mission effectiveness, because there are things that the B-2 that note can do that no other platform in the U.S. inventory can do across any of the Services.

So you mentioned, um, you know, new communications, we've got now advanced avionics, you're, integrating new types of weapons on this. How does this change how you envision the B-2 being employed versus what we might have seen in the past decades?

Doug Young: [00:31:00] Well, I think you're going to see, uh, well, you probably won't see it because, you know, how the aircraft is employed, obviously, is, uh, very sensitive.

I think when you look at this, portfolio of modernization initiatives and other things we've been doing on the platform, it's really about giving it that mission versatility as, as a platform goes into harm's way. And one of the things we didn't talk about when we talked about survivability, the platform shape and capability is, is critical at multiple levels as far as its survivability.

But the other big part of survivability is how you fly the mission. And how you mission plan, but how you mission plan and your ability to take on new information that informs your mission plan as you're conducting that mission plan is, you know, it's all about situational awareness. So, I think when you look at the, the comms type, modifications and other sensor things we might have done.

That gives you the ability to [00:32:00] adapt once you're conducting the mission and then in the weapons realm, more sophisticated weapons that are able to operate at different ranges are able to operate in different, non permissive environments. Uh, those kinds of things will enable more flexibility to that pilot who's going into harm's way and trying to conduct that mission plan and be able to, uh, react and respond, by, employing different weapons as the situation may require, given, scenarios.

The other component of it is PDM, our, depot maintenance cycle, uh, you know. We take each of the aircraft every 10 years through, A depo maintenance cycle out in Palmdale.

So all our programs are built, maintained, sustained, out there in Palmdale, an exciting place. You've come out and check it out. Sometimes Heather, it's pretty amazing what we've got going on and on in Palmdale, In the case of B-2, we

generally have a couple of aircraft there that [00:33:00] are in that process where they go through and we, we strip the coatings and we replace some of the key LRUs. We do a lot of refurbishment and we've gotten that cycle down. Most recently, we had our fastest delivery cycle in over 6 years. So we're really proud of what the team's doing there. Spirit of Nebraska, Nebraska. came out, uh, the fastest in six years and so increasing efficiency and manufacturing, taking on, different ways of, conducting the, refurbishment process, but overall driving to a higher level of efficiency is another component of kind of this modernization journey, is all aimed at driving up availability of B-2s with the latest capabilities.

Heather "Lucky" Penney: Yeah, because if they're sitting in depot, they're not available to go fly missions You know in what you mentioned regarding the dynamic signature management in real time as you're going through combat, you know operational execution a lot of folks might not realize but like for example, you take the F-117 our first stealth platform. They spent a lot of [00:34:00] time mission planning. They understood where the threats were. And then they would figure out how would they fly their ingress and egress so that they could really minimize their signature as those threats could see and detect them because stealth doesn't make you invisible. It just make you super hard to see. And but once the F-117 got airborne it couldn't change because it had no situational awareness to either identify how the threats moved or their new pop up threats and therefore they couldn't respond in real time to manage their signature presentation. And they also didn't have, um, the weapons that would allow them to be able to respond to that.

So these are all things that, again, as you're evolving the B-2, you're putting onto that platform, really to make it a dynamic, platform that can respond in real time to signature manage, and really, improve its survivability and then mission effectiveness as a consequence. I think that's awesome. So, as we go forward and we look towards the future of the B-2, how should [00:35:00] we grade your homework?

Doug Young: B-2, being, uh, as mature as it is, is very visible. People know and can see, what's going on. But I think, the important thing to, to watch for is, new weapons coming online, new capabilities like I've described relative to comms. I think, the amount of, global deployments that you see, uh, the profile of the B-2 is increasing, over the past couple of years, obviously due in large part to the geopolitical environment and threat that we all see globally. So I think you'll see more visible, utility of, B-2 and, uh, that adaptation of weapons and comms, are the key elements that will be visible to the outside, outside world.

Heather "Lucky" Penney: Oh, fantastic. You know, all the guys, and women that have flown the B-2, uh, they just, they love the spirit.

So, what are you transfer, what are your lessons learned you're transferring forward into B-21? We've talked a lot about how you are [00:36:00] iteratively moving back and forth in terms of capabilities and technologies and software. But what other lessons learned are you applying from the B-2 modernization journey to the B-21?

Doug Young: Yeah, I mean, we've been talking about a number of those, but I think if you really think about it as basics, having built the B-2s in the 80s and then operated them for 30 years and done many other things in between. It's that foundation of knowledge across the realm of how you sustain them, how you design and model them so that you're confident in their performance when they get into harm's way.

All those elements have been brought forward into the realm of B-21. I think we've talked about a few good examples here. in terms of the daily flyer element. I mentioned that briefly before, but we have really taken that to a new level here on B-21 by making it, effectively able to operate on a daily basis, able to be turned around quickly without a lot of hand work or [00:37:00] touching or maintenance and get back out into the fight or get back out into, training missions. It taught us a lot about building in affordability. Uh, the affordability element is critical if you're going to build these platforms in, numbers, of course. And so having built a complex flying wing for flying these missions, uh, with lots of composite materials and, the sophisticated nature of, of many of the features of that aircraft, really rolling it forward to a sixth generation platform that is the B-21 today is built on that foundation of knowledge from B-2.

I mean, I can certainly speak from personal experience having worked 10 years on the B-2, but, you know, our workforce has a lot of people that have been doing this for quite a number of years and have grown up on these programs, coming up to the present. So we feel confident we know where the risks are, uh, that is starting to bear out as we've been testing, the B-21 and so far so good on, on how the aircraft is maturing and moving into production. [00:38:00]

But again, built on those same lessons learned, many of the same processes, but improved for using contemporary and commercially available tools that are really part of that digital transformation. So, the digital transformation, as you mentioned, goes back to really in the 80s, where we went into the 3D design realm. And we've had these design tools for a lot of years. We've had the data,

but in the commercial world, many things have been developed for other purposes, like, something we call a highly immersive virtual environment. It's using virtual reality in order to be able to visualize how to maintain the aircraft or agile software as has been mentioned. Many of these tools, are well proven now commercially, but we've been bringing them into this military grade if you will, design environment and leveraging them, to make this really, truly a 6th generation, platform, that being the B-21.

Heather "Lucky" Penney: Yeah, she's got the right pedigree. I'll tell you that. I get that this part is sensitive, but as best as you're able to discuss it, what will the B-21 be able to [00:39:00] accomplish from a technical perspective that might just be a bridge too far for the B-2? I mean, the upgrades that you and your team are executing on the B-2 are incredibly impressive, but there are some core facets that tie back to the limiting factors from the 1989 design, uh, and you don't face those realities of the B-21, it's a totally different technical baseline. So can you share with us some pieces of that?

Doug Young: I think the way I would answer that. I mean, that's obviously very sensitive as you said, but I think if you really, think about the comparison in technology from the realm of the 80s to the present. As a 6th generation, platform that we've got in -B-21, we've baked in from the start open mission system architecture.

So I think connectivity is at a whole another level for something future like B-21.

You can also consider, Looking at it, like, actually, there's an example I've used before. It's kind of fun if you think about it. But if you get into your, dad's, [00:40:00] uh, 65 Mustang and you drive it and you look at the dashboard and you understand the kind of the push buttons for the radio and the three on the tree with the shifter.

And you look at sort of the simplicity of the design and how what the interface is. That's really going back to the era of A's and B-2 and then you fast forward to today and 6th generation platform if you get into a Tesla, it might have updated the software overnight and you're looking at a new display format, from, uh, an evolutionary viewpoint that rapid evolvability.

The B-2 is, is evolvable, much more evolvable than it ever was, but it's nowhere near what we're going to be able to do with the contemporary platforms that incorporate these kind of features of open architectures, um, the software

development realm coupled together with all these other. Features that we've incorporated. So that's how I would try to describe it.

Heather "Lucky" Penney: That's a great description because the B-21 will essentially be a software defined platform. Um, [00:41:00] whereas the B-2 be based off of the era that it was designed in, we upgraded modernized via hardware. And now where you are at with the B-2, you're kind of doing a little bit of both worlds. So this is in no way, your grandpa's, you know, B-2. Very, very capable and will be capable, uh, and even more so into the future. So we need to continue to maintain the B-2 within our inventory. But the B-21 is going to be a step function of capability.

Doug Young: Absolutely. Yep. Yeah. Function is a good way to put it.

Heather "Lucky" Penney: You know, it's, we, we call that the B-2, the Spirit, but I like to think of it as our adversaries' nightmare. You know, thanks again for taking the time today. .

Doug Young: We, like to think that we're pacing the threat, right?

Heather "Lucky" Penney: No, we are, we are the pacing threat. And I think folks need to remember that, uh, you know, around the world, we no longer have, uh, the, the monopoly on, on advanced technologies and capabilities, but our engineers, our manufacturing workforce, uh, our industry is still [00:42:00] by far the best in the world. And we need to remember that we are the pacing threat, not China.

So again, thanks for your time today. And, just to remind the audience, the B-2 is here and it needs to be here to stay for a long time. I mean, it still remains relevant in combat now and the modernization and the upgrades you're making will continue to make it incredibly lethal in the future if for global reach and global power.

So there are times when range payload and survivability or linchpin and the B-2 has delivered and it will continue to deliver. You know, Doug, any, uh, any last thoughts or parting shots? ?

Doug Young: No, I just, uh, just extremely proud of the work we do here on this team, uh, for these critical capabilities.

As you said at the beginning, it's one of the coolest portfolios out there. I certainly believe that. But the B-2 is really the beneficiary of many things that

we've been doing in the digital realm. And we're proud to be pioneering those on a legacy [00:43:00] platform while incorporating them on the future platform, that next generation, that 6th generation.

So, we're uniquely leveraging those innovations and those technologies, uh, to give the warfighter a better capability, really, and faster and today so we can pace that threat.

Heather "Lucky" Penney: Well, thank you again so much for your time and hopefully I'll see you in Palmdale.

Doug Young: Yeah, there you go. Thanks, Heather. All right. See ya.

Heather "Lucky" Penney: With that, I'd like to extend a big thank you to our guests for joining in today's discussion. I'd also like to extend a big thank you to you, our listeners, for your continued support and for tuning into today's show. If you like what you heard today, don't forget to hit that like button and follow or subscribe to the Aerospace Advantage.

You can also leave a comment to let us know what you think about our show or areas you would like us to explore further. As always, you can join in on the conversation by following the Mitchell Institute on Twitter, Instagram, Facebook, or LinkedIn. And you can always find us at [00:44:00] mitchellaerospacepower. org. Thanks again for joining us. And have a great aerospace power kind of day. See you next time.

So with the B-2 and the B-21,

Heather,

Doug Young: sorry to interrupt, but your audio is, uh, about every 10th word, not, not there's something going on in terms of your audio, at least how we're hearing it. So, so why don't we do this?

I, If it's good on your end, then, then if we can't fix it, and I got an idea to fix it on my end, let's, let's hang up and dial back in. Will that be a problem for you guys if we do that? Because I think a new connection might just make it go away.

Heather "Lucky" Penney: Yeah. Turn it off, turn it on. Sounds good. We'll wait for you.

Yeah.

Doug Young: Yeah. We're going to recycle the avionics. You know that you're a pilot.

Heather "Lucky" Penney: Exactly. Turn it off, turn it on.

Doug Young: Exactly.