INTERVIEWER: Today is Tuesday December 1, 2015. And I'm Joe McMaster. As part of the MIT Infinite History project, we're talking with Dr. Eric Evans. Dr. Evans is the Director of the MIT Lincoln Laboratory in Lexington, Massachusetts. Dr. Evans Is responsible for MIT Lincoln Laboratory's strategic direction and overall technical and administrative operations.

Since its founding in 1951, the laboratory is focused on advanced technology development and system prototyping for national security needs. More than 96 companies have been spun off from Lincoln Labs during the last 60 years.

Dr. Evans has been the director of Lincoln Laboratory since 2006. Prior to becoming director, he held several positions in the air and missile defense technology division at Lincoln Laboratory. Dr. Evans holds bachelor's, master's, and PhD degrees in electrical engineering from The Ohio State University. Thank you for speaking with us Dr. Evans.

EVANS: Glad to be here.

INTERVIEWER: So I noticed on many of the Lincoln Laboratory publications and website a phrase that says "Technology in Support of National Security." And I though that might be a good place to begin to talk about what is Lincoln Lab, and how does that motto relate?

EVANS: Our mission is "Technology in Support of National Security." And we work very hard to take on the most difficult national security problems. And we try to develop new systems, new ways of combining sensors, or communication networks, or other technology in a way that creates something dramatically new for the DoD and others. And some of it involves technology inside Lincoln, some from outside Lincoln. Some of the ideas come from campus. And we combine all that and create prototypes that the DoD can then take and test. And then if things look good for the long term, they'll transition those to industry. And they'll be produced at a scale where the military can use them. But we have a whole range of projects like that going on at any given time.

INTERVIEWER: So what kinds of projects are there? Because it's quite a breadth I understand.

EVANS: So we have a lot in the RADAR area. So we try to create systems for either looking up, or out, or sometimes down at the ground that can look for small objects in what's called clutter, things that interfere with finding the targets. And we develop a lot of new techniques for finding small signals in a whole range of clutter and noise. And some of the systems get used on aircraft. Some get put on satellites. Some are used in systems on the ground.

We're also doing a lot of optical sensor development using LADAR systems. So we can look at things in a very precise way and track objects, identify objects.

And another area of work is in the communication area. So we develop new communication links. The most exciting work for me is with laser communication. And we just had a project where we could communicate from the moon to the Earth with over 600 megabits per second on a half a watt of laser power. And we passed a lot of data back and forth.

So those are the kinds of projects we have at Lincoln. And many of us find them very, very interesting to work on.

INTERVIEWER: So how does the typical project work then? Is this someone comes to you guys, or you're making proposals to them? Or how does that work?

EVANS: So it happens two ways. Sometimes we'll have a sponsor come to us with a problem, and we'll work to find a solution. Other times we'll discover a problem, and we'll go down to a sponsor, a range of sponsors, and highlight that there's a need. And we can sometimes motivate the creation of a program to get something new done. So we do it both ways.

INTERVIEWER: And the sponsors are-- there's a variety of them, or is it all DoD? Or how does that--

EVANS: So there are a lot in the DoD. But we also work for the Department of Homeland Security, and for the FAA, NASA, NOAA, and other sponsors. We have a whole range of people that we work with. We have about 500 programs now at the lab.

INTERVIEWER: Great. So what is the relationship of the laboratory to MIT?

EVANS: So Lincoln Laboratory is what's called a federally funded research and development center. And we are run by MIT for the Department of Defense. And it's a very unique arrangement to have a lab at the scale of Lincoln Laboratory run by the world-class MIT is very unique. And the DoD really benefits by that and that relationship.

And it's the combination of the research going on on campus that can then flow through Lincoln and have other research added to that, which creates something very different than can be found elsewhere in the country, or around the world for that matter.

So that's how the arrangement is set up. It's been running now for over 60 years. And the relationship is very strong. We get a lot of great support from the president, provost, vice president for research, and others, and a lot of great relationships at the faculty and student level. And we hire a lot of great MIT students.

INTERVIEWER: So is there a lot of communication and interaction back and forth between students, faculty, and people working directly at Lincoln Lab?

EVANS: Yeah, we have over 50 projects now that are funded that involve research going on at Lincoln and on campus. And usually we have a faculty member or two working with a few students and Lincoln staff together developing something. And if there's a classified part of it, it will transition to use through Lincoln. And then ultimately we hope to hire the great students we connect to.

INTERVIEWER: Or what percentage is sort of classified work verses other kinds of work. You mentioned the FAA for example.

EVANS: So about half of the work that we do is classified. And the other half is more open. Even some of the DoD work that we do is unclassified, and is open, and can be published and discussed on the outside.

So there's interesting work going on, both classified and unclassified. And we try to get people working in all aspects of that throughout their career. So they're not always in a classified zone doing work.

INTERVIEWER: So tell me about the path that led you to Lincoln Lab, and where you came from. You grew up in Ohio I guess.

EVANS: I grew up in Ohio, a town called Stow north of Akron, and went to Ohio State for many years. And studied EE. And I couldn't decide whether to go into physics or EE. I chose EE, but then I chose the EE most like physics which was electromagnetics, which was helpful for a lot of the work I ended up doing at Lincoln.

And I went through the program there, and went straight from Ohio State to Lincoln Laboratory. I was interested in research and development. And the projects that I was exposed to during the job interview were just fascinating.

And so I came out, and I thought I would stay at Lincoln for five years and then try something else. And the work has been so much fun I've stayed for over 27 years now.

INTERVIEWER: And you did multiple degrees at Ohio State. So something obviously appealed to you about that. How was that? What did you get from that experience?

EVANS: I was going through Ohio State during the Reagan defense buildup era. And there's was a lot of funding going from Wright Patterson to Ohio State for research. So it was very easy to stay and get a research assistantship in some very interesting areas. And so I stayed, went straight through. And in hindsight I'm glad I went straight through and could move on to the work that I enjoy now.

But that's why I went straight through there. And I was very fortunate to have a friend that went to Lincoln a couple years before me from Ohio State. And he pulled me out to Lincoln. So worked out.

INTERVIEWER: And what were your goals? You mentioned you came thinking I'll stay for five years. And what were your goals, and what were you working on at the time?

EVANS: I was thinking about maybe an academic career. And I was also looking at maybe some industry roles. So I was not sure quite what I wanted.

But at Lincoln, it was kind of a mix of the industry world with the academic world, and some very fundamental research that I was interested in doing. And all that really appealed to me at the time, and kept me interested for a long time.

INTERVIEWER: And what's the atmosphere at Lincoln Lab? Is it all like MIT, or is it very different?

EVANS: Well, I think it's like MIT in that the staff doing research are very, very bright. Most people when they talk about what they like about Lincoln, it's the great people down the hallway that they work with. And almost all the projects we have are collaborative projects. So you're working on teams of 10 to maybe 100 people for some projects. And it's just fascinating watching the dynamic of the different people working together and the problems that come up.

And almost all of our projects are a series of small to medium-sized failures that lead to ultimate success in the end. So it seems like every day there's something that comes up that you have to diagnose and figure out. And you learn from that. And then the result is something very different and useful that we transition out.

So that's the culture I've really liked at Lincoln that you can fail, and it's OK. You work through all that failure, end up with something great in the end. And you've got so many great people around to help sort through the problems, and mentor you, and advance in the areas you're working in that it really makes interesting from day to day.

INTERVIEWER: One of the things that you often hear about at MIT is sort of this very strong interdisciplinary spirit, which is kind of even fostered by the way these buildings are connected, and designed, and everything. Is it similar in that respect?

EVANS: It's similar. We have a strong nucleus within Lexington. And all the buildings-- most of the main buildings are connected. But people can get around pretty easily into the center where the main work is going on.

And most people work on different areas throughout their careers. So when I came to Lincoln, my background was more like magnetics and optics. But I learned more about radar, and then air defense, missile defense, a whole range of topics that stretched the growth in the early parts of my career.

And a lot of people have stories like that. They every five years try something new and learn something new.

INTERVIEWER: Is it a place where lots of people stay for long durations like you have?

EVANS: So for the people that like a research and development environment, it's unstructured, where they have the freedom to find their niche and guide their careers. It's a great place to work. And some people stay for their whole careers.

People who like more structure sometimes do better in industry. But we like to stay in the research and development side. And that makes it a little less structured and I think a lot more fun.

INTERVIEWER: So what's your path been? We were talking about how you came from Ohio State to Lincoln Laboratory. And what's been your path through there over the years?

EVANS: So I did research at the staff level for many years. And I learned a lot from that. And then I was given the opportunity to be an assistant group leader working on some Navy programs, and then moved on to some larger programs, eventually became a group leader, then eventually division head, which has the oversight of a whole mission area. So I was the division head for air and missile defense technology. And there was a lot of interesting prototype work going on in that area for quite some time.

And I did that for many years, and then was very fortunate to be asked to become the director of Lincoln Laboratory, which I would say is a dream for me. It's a wonderful job, being involved with a wonderful laboratory and having the connection to MIT. And it's been a very interesting role to have. And we've been doing a lot over the years evolving into some of these new areas like cybersecurity, and systems for homeland protection, and defense against chem and bio weapons, and things like that.

So there are so many important needs out there. It's been an interesting role as director to keep evolving the laboratory to some of those new needs.

INTERVIEWER: Yeah, I wanted to ask you about sort of how it's changed. But I guess first, how do you see your role? What is the director's role in the laboratory?

EVANS: So I think there are three main roles for the director. One is to set the strategic direction for the lab. So what are the areas that are most relevant and technically difficult that we should be taking on for the long haul? And we've been going through what we call mission shift now for the past several years, taking on some of those new areas like cybersecurity and homeland protection, and other areas like that.

The other role is to ensure that we hire really top people. And the lab is really driven by the top talent that we are able to pull in.

And we do then in part-- and that's the third area I'll mention-- is getting the culture right. So creating a culture where bright people can come and thrive is something that we strive to do. And that comes through making the environment very open, and creating a culture where people can take risks, and also having a culture where we have resources, whether they're laboratories, or equipment, or devices, materials that they can use to do the technology research and prototyping that they're involved in. So all that together is what I pay attention to.

INTERVIEWER: Quite a lot I imagine. You mentioned that you had been in school sort of in the Reagan era. Of course everyone thinks of as sort of the end of the Cold War and his role in that. And things have changed radically since then. So I'm sort of wondering how your own view of things has changed, your view of the work has changed, and how Lincoln Laboratory has changed in response to the sort of world situations changing?

EVANS: Well that's a great question. The lab has had to change a lot post-Cold War. And of course we're all glad the Cold War ended. And of course we're going through challenges now that we hope will stay in a stable state.

But after the Cold War, we moved onto some other areas. The lab contracted some because defense funding had come down. But after 9/11, there was a ramp up again. And there were a lot of needs for technology in Iraq and Afghanistan that we thought that we should get involved in.

So one area was with the problem of improvised explosive devices. And we felt very strongly about this. We needed to move quickly to create new systems that could be deployed in a matter of weeks to months to help find these weapons and help to protect soldiers that were out there. And so we created a number of groups that could do that rapid development. We connected to sponsors that would put a lot of funding within Lincoln, almost on retainer for us to move very quickly. We could get a phone call and then find a solution, start building it in a matter of days to weeks, and then test it, move it out. So one change is we are doing more rapid development work, which we thought was important, and was also interesting and challenging.

The other area is this cybersecurity problem has really become big. In some view, this is the most serious national security problem we have right now. So we have created a whole division around that area. And we're looking more at how we protect defense networks and civilian networks like the banking system, and the electric grid, and a whole range of systems that are vulnerable out there. And some of these need to be protected very quickly. We've had quite a bit of technology transition now to help with that. So that's new in a big way for us.

Another area, some would say that the defense of our space systems is the second most serious national security vulnerability. So we've been doing a lot to create new sensing for watching our satellites and determining what's happening up there, if it's something of concern, and developing ways to help protect what we have. Imagine losing GPS or losing our com satellites, or satellites critically important for the defense of our nation. So we look at all that and make sure we have technologies in place to help.

INTERVIEWER: So it sounds like quite a significant change or pivot since the early days anyway of the laboratory I gather.

EVANS: Yeah we have. But that's what we have to do all the time. I think we should never feel like we've got the right programs set. The world is always changing. And we always have to be watching. What are the new threats? What new technologies are coming online? Whether they are US technologies or technologies from around the world, how do we integrate all those in the new systems and continually try to stay ahead of some of the serious threats that are out there? So we should always be in motion.

INTERVIEWER: Yeah, you mentioned this sort of rapid turnaround type projects that have become more common. What's changed, or what have you found sort of enables that really quick turnaround? Because that's extraordinary to get something going within days or weeks like that.

EVANS: So we tried some experiments. We have a laboratory center within Lincoln where we have hardware people, software people, systems people all working side by side in very close quarters, with lots of fabrication equipment around them. And so they can come up with new ideas, and then debate them, and maybe make some mistakes and adapt. And then create prototypes, either with machines, or 3D printers, or other facilities we have around, and then take them out very quickly to areas around the New England area or around the country to test them.

And we've also done something very different in the past few years. We have a lot of military fellows now working at Lincoln side by side with us. So these are people with recent operational experience. And so they come into Lincoln understanding how things are really used. And they help us to get the initial condition better, because sometimes maybe we could get that better. But by getting the input on how soldiers are using technology and the assistance they need to interpret some of the data that comes off is very helpful for us. And then we use that to help design a better first cut of the prototype that we give them.

INTERVIEWER: Literally the boots on the ground, huh.

EVANS: Yeah. We get the fellows for a year or two. And many of them have been off in war zones for extended periods. And their view, we put supreme in deciding what we do.

INTERVIEWER: Interesting. So it does sound like a very interdisciplinary approach as you described there, similar to MIT or the rest of MIT I should say.

EVANS: Yeah. I think so.

INTERVIEWER: If you can take us back to just generally the history of Lincoln Lab, why was it formed? Because during World War II of course, MIT was very famous for its work on radar, which was done here on campus and in Cambridge. And you guys of course are not in Cambridge. You're in a different location. So how was the decision made to sort of form a separate place?

EVANS: Yeah, so Lincoln was started in 1951. And the concern at the time was the Soviet bomber threat. So many in the US and many of our allies were worried about waves of Soviet bombers coming in a surprise attack with nuclear weapons. And the US didn't have an effective national air defense system at that time.

So MIT agreed to create Lincoln Laboratory to prototype that air defense system. And we developed a new radar systems. So a lot of the technology from the Rad Lab fed forward into Lincoln Laboratory. And a lot of people that were formally in the Rad Lab came to Lincoln Laboratory. And the organizational structure of Lincoln is still very similar to the original Rad Lab era, and has served us very well.

But we pulled together a whole range of technologies. We borrowed some of the computing technology from the campus. So the whirlwind computer efforts fed into the work at Lincoln to create the Semi-Automatic Ground Environment system, or SAGE, which is the main overarching name for the air defense system. And there were a lot of technologies related to memory development. Magnetic core memory grew up through the SAGE program. New techniques for interacting with computer screens with handheld devices were developing through the SAGE program. So a lot of way ahead of its time technology came through that. And the system was completed in 1957. And it was transitioned into national use after that.

And then Lincoln Laboratory moved in into other areas like satellite communications, and missile defense, and other sensing needs. So we had a lot of problems to continue working on after SAGE was complete.

INTERVIEWER: And then that sort of continued up through the Cold War era that we were talking about essentially?

EVANS: Yeah, so we worked on a whole range of things. There were radar systems needed for the Vietnam War effort that we had a role in. There were new systems related to satellite communications. So the laboratory prototyped many of the first sat com systems that the Department of Defense needed. And these were systems that had a lot of bandwidth and new techniques for protecting the communication links that were incorporated in them. And we had a major role in that.

And then I talked about more recently evolving into the cyber domain, and advance networks, and homeland protection, and chem bio defense, things like that. So every few years we take on something fairly large and new.

INTERVIEWER: And so why is it in-- well, it's in Lexington, not Lincoln, Massachusetts as one might assume. Why is it called Lincoln Laboratory?

EVANS: So there's a long story around that. I'll give you the short story. There was a need to have this Semi-Automatic Ground Environment air defense system built near runways and where some of the military had its facilities. And it turned out that those facilities were in Lexington.

And they wanted this to start as a project. And so usually had project and a name. And it turns out that the name Project Lexington had already been taken. So if they chose a name Project Lincoln for the other town nearby. And so Lincoln Laboratory began as Project Lincoln. And then soon after that, the name shifted to, formally, MIT Lincoln Laboratory.

INTERVIEWER: Interesting. So you mentioned sort of the Vietnam era, which of course is an important era in all of our history. And it's interesting because in working on some of the other documentary projects here, I've been reading about some of what was going on on campus here during that time. There were obviously folks who were in favor of MIT's role in defense, and people who were opposed to it. And it very much came to a head at time I understand.

So it's a complex issue obviously. But I'm sort of wondering how you see the relationship between universities, which are sort of generally thought of as one type of entity, and defense work. How do you see those two relating and sitting together?

EVANS: Yeah, that's a great question. And we're very, very careful about that issue. There is national security work that is more on the defense side of the fence that matches very well to university work. And we strive at Lincoln-- and in a similar way, some of the work that's defense related on campus is in a similar form. We stay more at the fundamental technology level and the early prototyping level. We don't get directly into operations in any way.

And so we prototype things that we think are important. And then others, mainly industry translate those ideas into something that could be used. There were some concerns about a range of technologies back in the '60s. We are sensitive to those concerns. And even today, we have a list of criteria for programs that we think that are appropriate for Lincoln Laboratory underneath the MIT umbrella. And we treat that very seriously.

The MIT senior leadership stays very aware of what we're working on. And if there's something that may be in the gray zone, we make sure we discuss that with them before taking something on. So it's something we watch very carefully. And we don't ever want to take on something that would somehow be counter to MIT's mission, or create some great concern about why is MIT doing this.

INTERVIEWER: And then I suppose there's a distinction even within that between defense work and offensive work I suppose you could say. I don't know if that's a distinction that you guys see as well.

EVANS: Well I can give you an example. So we had years ago a sponsor come to us requesting new technology for a high energy laser that could blind people in the battlefield. So we thought that that is something we should not be involved in. And perhaps that work should go on somewhere, but not at MIT Lincoln Laboratory. And there were a range of projects like that. In any given year, we turn away a handful programs, sometimes worth tens of millions of dollars because we don't think they fit underneath the MIT umbrella.

INTERVIEWER: No, I imagine it's a complicated set of decisions. Or maybe they're not so complicated in cases like that. I don't know.

EVANS: We usually-- after some discussion, it's pretty clear.

INTERVIEWER: So what would you say is sort of the-- what areas are you sort of most excited about in the work that is going on today at the laboratory?

EVANS: So I think what's exciting now is the whole technology world is advancing so quickly now. And so it's not just about technology work going on at Lincoln, or at MIT, or even within the US for that matter. And so it's very exciting to keep up with what's going on everywhere, and then to be able to decide what's important or what's relevant for what we're working on. And in many cases, just buy it and try it out.

And so a lot of what we're developing now is a combination of something that's very Lincoln unique, or MIT unique, combined with technologies from anywhere. And I find that whole exercise of picking and choosing what's important, and integrating it, and trying it, and adapting along the way to be a very interesting way to do innovation.

INTERVIEWER: Now are there examples that you can attach to that?

EVANS: Well, so we're doing a lot of late of LADAR work now. A LADAR is a device much like a radar that sends out light pulses that reflect off, and we can quickly get angle information, range information on a whole range of things we're looking for. And so we developed something called avalanche photodiode arrays at Lincoln which can detect individual photons. So it's an array of pixels that can detect one photon of light. And that's unique to Lincoln and to MIT.

Some of the laser technology for creating the coherent light is very mature out in industry. So we buy some of that on the outside and integrate that. And some of the algorithms are unique to Lincoln. So it goes in many different directions.

So the algorithm that we'll use to identify something that might be out there, or to filter out some of their interference so that we can see things better can be very unique to the Lincoln or the MIT research base. And so in that area, most of the prototyping work is a mix of things inside and outside Lincoln and MIT.

INTERVIEWER: Right. And you mentioned early on this communication between-- well, set up to cover distance to the moon. Can you talk about what the application of that potentially is, or what was motivating that?

EVANS: So the idea is to get a communication link to probes that NASA would be sending out to Mars, Jupiter, and beyond that would have much greater bandwidth so that we can download the data very quickly. And so for example, with the probe out at Pluto now, the link is at two kilobits per second. And it's going to take a long time to get all that great imagery data and other science data that they're collecting down to down to earth.

So laser com links can significantly increase the bandwidth for getting that data down. And this lunar laser com demonstration program was meant to be the prototype of the whole model for making that work. And one of the innovations was a collaborative effort between MIT and Lincoln in that we created something called a superconducting nanowire array which was another way of detecting individual photons and resetting very quickly. And through that, we were able to create a much lower power requirement for the transmitter out at the moon in a smaller aperture size. So that made it much lower weight and smaller. So that I think will help as they're developing new probes for going further away in the solar system to keep them lower cost, and smaller, and lighter weight.

INTERVIEWER: And the speed of that was, you mentioned before, but the data rate?

EVANS: So we were communicating from the moon to the earth at the 622 megabits per second, on half a watt of laser power.

INTERVIEWER: It's a big improvement. And you've kind of touched on this briefly, but as I understand it, there's always been a real interest in sort of this dual use, I guess if you will, technologies, things that perhaps are developed for one purpose but make their way into civilian use, or industry, or something like that. I'm wondering if you can talk a little bit about that and where that fits in the mission.

EVANS: We're doing more of this. I mentioned the transition of technology into the DoD industry base where we could do better. And we're working to do better is the transition into the broader commercial base. And we've been doing this in part through the creation of new company.

So on the average now, we create about two new companies per year. And some have done well. Some maybe don't do well. People come back and very often get reoriented into something new. And then they might try again later on. So that's one model for tech transfer.

But we're trying to think of ways where we can get closer to small companies and maybe have them reside next door to us in a way that they can tap into all the technology that we're generating. And then through separate funding, through maybe federal funding, or grant funding, or venture capital funding, they can create something new within their company, new product, and then spin off and grow. And so I think longer term, we would really like to be a stronger driver of the more civilian technology development going on.

INTERVIEWER: Yeah, I think in the introduction, it said 96 companies-- or more than 96 maybe have been spun off from Lincoln. Is that right?

EVANS: Yeah, more than 96. And more recently, the average has been, again, about two per year.

INTERVIEWER: And what kinds of things are there? Probably there are some very notable examples I would imagine.

EVANS: Well, the first major spin-off was-- there were a few before that-- but the MITRE Corporation spun off. And they're doing system engineering work. They are a not for profit that runs FFRDCs.

The Digital Equipment Corporation spun off from Lincoln. Ken Olsen was once a Lincoln employee. And a lot of the basic technology came out of the SAGE effort.

And the company Sycamore has many of its roots within Lincoln Laboratory as well. So there have been some big companies that have come out. And we have a whole range of smaller companies developing, more at the component and subcomponent level, interesting technologies for sensing.

INTERVIEWER: So some of this is transferring the technology directly to industry or directly to-- where does it end up in some of these cases?

EVANS: Well usually it goes to companies. We sometimes patent and get licenses for some the technologies we develop. We tend not to patent the big systems that we create because they're more DoD oriented. And we want those to transition in a very fluid way out of the lab to use.

So sometimes somebody will create something interesting like a new laser diode that has applications for industry. And so they'll spin off and try to produce that at scale in a commercial company. And then MIT and Lincoln will benefit from some of the license royalties from that. And then the company of course benefits from their profits.

INTERVIEWER: Great. It's interesting because being here in Cambridge of course, they always talk about the ecosystem here. But it's such a vital place here with all the different companies, and the campus, and the two are intertwined. And I'm sort of wondering how that compares to being separate out there in a sense.

EVANS: So we don't have that ecosystem around us. But we can connect to that ecosystem either through MIT or through other locations in the country. So it does help to have it nearby, but we can still connect at a distance.

INTERVIEWER: Not that far away. Sorry. I see we've covered-- it's great, we've covered a lot of different topics within individual questions.

One of the things that was mentioned I guess on the website and that kind of thing was the sort of superior security rating from the US Air Force. And I'm sort of wondering what that means and what that translates into.

EVANS: So we do a lot of defense work that would be viewed as something that foreign countries might want. So we have to protect that very carefully. And there are a whole array of practices we put in place to protect that information. And the Air Force reviews all that and gives organizations ratings for how well they're doing.

We've been very fortunate. This has been a lot of hard work by many, many people to receive a superior rating for the last nine years. And we think that's critically important for how the laboratory functions.

It's the right thing to do to protect information, but it also helps-- we want our sponsors to see that we are very careful about the work we're doing and the knowledge we create, and work very hard to protect it.

So we've been working to make this superior rating the level that we want to get every year now. And so we're hoping for a tenth rating. We'll get that very soon.

INTERVIEWER: Critical to the work though it sounds like.

What sort of-- if you look ahead to the next number of years, are there other things sort of on the horizon that you're thinking about? You mentioned some of the current challenges, but are there others that come to mind?

EVANS: The area that's emerging now is work in the bio area. And some of it is related to biodefense. We're concerned about bioweapons that might be emerging. But there's a whole body of work that involves biology for manufacturing, or even computing through very creative development of new chemicals, new genes, new organisms in some cases. So we are working on more and more of that.

And I wouldn't be surprised if we had a whole bio division at the laboratory in 5 to 10 years. We've got a couple groups working in that area now. The work is growing. There's a big need. And I think that will continue to grow.

So we have wet labs at the laboratory now for bio work. We have EEs working side by side with biologists, a very interesting dynamic. And I think we'll have more and more of that as we look out many years.

INTERVIEWER: When you, say, were in school and thinking about a career, did you think you would see that kind of convergence? Was that ever in your mind?

EVANS: I didn't actually see that earlier in my career. But as the national security threats have been evolving and some of the biotech technology has been evolving very rapidly, there are a whole range of things we can do now that we couldn't have imagined even 5, 10 years ago that we're taking on. So many of us on the side at Lincoln are learning a little more biology now.

INTERVIEWER: I think we all are. It's reaching into all kinds of areas. What are sort of, if you think about kind of the challenges that a place like Lincoln faces, are there specific things that come to mind to either the kinds of work you're doing, or-- I don't know whether these could take any different number of forms I suppose. But what challenges do you guys face at this point?

EVANS: Well our ongoing challenge is always to make sure we are evolving towards the right kind of work for the long term. And we've talked earlier about how that has to be an active effort going on all the time. And we pay a lot of attention to that.

I think that we will be, as we were talking about before, evolving more into the bio area. I think the cybersecurity area will continue to grow. And the challenge we're having there is finding the people.

It's a national problem. There aren't enough people to take on some of the technology development needs, and software development needs, and system needs for the cyberprotection, cybersecurity area. So we've been hiring some very good people, but we could hire many, many more if we could find them. So that's a big challenge.

You might ask whether the defense funding uncertainty is a challenge for us. And we've been very, very fortunate with that. Even with all the defense budget uncertainty, we've managed to work through that. And we are still highly sought. We're still turning away, in any given year, tens of millions of dollars in funding that we think does not align to Lincoln, whether it's not the right kind of work or maybe not challenging enough work. So we're picking and choosing the type of programs we bring in, which is a great position to be in. So fortunately that hasn't been a major problem.

And I think we're very fortunate to have a whole wave of new talent coming into the laboratory. And the challenge there is to get them integrated as soon as we can. So we've put a whole range of programs in place-- mentorship programs, training programs, orientation programs that help to get people exposed to the broader laboratory earlier in their careers than maybe we did in the past. So that's a big effort we have underway.

INTERVIEWER: What's sort of special about a Lincoln Laboratory employee? You mentioned obviously there's skills that one would need in any number of different areas. But what sets them apart in your mind?

EVANS: We want them to have passion. Not just be great technically, but to have passion for what they're doing. And we also look for the ability to collaborate with others. So most of our projects involve many people. So people have to learn to work together. And we look for people like that.

And we also look for people that are interested in taking risks and trying something new where they jump into the unknown. We can teach some of that. But we also look for it, for experiences they've had before we hire them.

And all that together, you hire people like that. And then you have a large number of people like that. And great things happen.

INTERVIEWER: And this sort of ties into some of the outreach that I gather Lincoln does with all kinds of groups, like schools and universities. Maybe you can tell us a little bit about that kind of work too.

EVANS: So we take all of our discretionary funding-- our patent royalty funding, other discretionary funds we have-- and we spend that on K through 12 STEM community outreach. So we have programs like Science on Saturday programs. We have a program in the summer for two weeks where we bring in top high school students to build radars. And then they've got to present the results to Lincoln scientists and engineers.

We sponsor 23 robotics teams in the New England area, some in disadvantaged neighborhoods. We try to teach teachers how to teach and mentor students in these areas.

So all of this has a national security component to it. We need to have this next wave coming up nationally. And we think centers in the country like Lincoln where there's a lot of technical talent and resources to help with education of students, earlier than college, is very important to promote, because a lot of kids make their decisions about going into engineering or science in elementary school. So to the extent that we can connect with them earlier and motivate them I think is a great way approach to follow and a great role for the lab to have.

INTERVIEWER: I mean, it's an interesting-- it's a supply problem almost it sounds like is what you're saying, or potentially.

EVANS: Yeah, it is long term.

INTERVIEWER: Do you give thoughts about other ways? I mean, you hear an awful lot-- and anyone who's a parent of course hears a lot about STEM, and the schools, and the importance of it. But how do you get more people excited about it and to stick with it if that's what's needed?

EVANS: I think connecting at earlier and earlier ages, but giving them experiences where they get hands on, either hands on robots, or hands on-- I mentioned the radar program. We have programs we're running through Lincoln Laboratory facility at the edge of campus called the Beaver Works where students can come in and build things. And we find that that ignites a lot of excitement in science, and math, and engineering. And we've been working to create more of those hands on like experiences with the resources we have, but also the ideas that people come up with that we then translate to buying things to bring in so students can touch as well as learn.

INTERVIEWER: What's it like to bring students-- young students potentially too, or high school anyway-- to a place like the laboratory?

EVANS: Well we hope they find it interesting. All of us have, I think, a teaching side of ourselves. And we enjoy spending some time trying to be teachers and talk through some of the complicated things we're working on. We get a lot of great questions. We get a lot of suggestions for things that we can try to bring them in further. We're going to try to enhance our summer programs, get more students at Lincoln and working with us through MIT as well.

But when you see a kid learn something or build something, and it works after maybe failing a couple times, but they succeed in the end. It's a very exciting dynamic to watch. And that kind of experience I think really motivates kids to stay with it for the long haul.

The classwork's important. But the project work really, I think, makes a big difference.

INTERVIEWER: You mentioned the Beaver Works area here on campus. And I think you mentioned before we started that you're here on campus yourself once or twice a week, or something perhaps. What is the sort of interplay between the lab and campus, and what's that like?

EVANS: So we wanted to create a little part of Lincoln Laboratory at the edge of campus. And that was the main idea behind this whole Beaver Works construct. So it was a facility where there's classroom space, and prototyping space, and other laboratories where faculty, and students, and Lincoln research staff could come together and work on projects at a scale maybe they couldn't do through some of the programs on campus.

So we're able to find project funding through the DoD at a scale maybe much bigger than they can find on campus where students are prototyping UAVs, or new power systems for systems underwater, or new software techniques for cybersecurity. So there are a whole range of projects we can bring to campus-- all unclassified, all completely open, so people can publish their work and everything. And then our hope is that we help to drive some of the research on campus in a way that we can benefit from some work at Lincoln. But also just connecting with the research that the faculty and students are driving is very beneficial. And also hiring some of the students longer term is very good for us. We've made some very, very, very good hires through Beaver Works over the years.

It's a very busy place. Every time I go there it's very full. And so our challenge there is to maybe find other centers where we can create this interaction between the campus and Lincoln work, and get more students involved. We're working on that.

INTERVIEWER: And you mentioned sort of UAVs and that kind of thing. What sorts of projects have been going on there that you guys have been involved in?

EVANS: So we've had a whole range of autonomous vehicle and UAV-like projects. Some of them are very small. Some of them are very big. And there are a lot of the civilian applications of the work that they're doing, in addition to the DoD applications that we use them for.

And there's work-- students are developing robotic systems that might work for interesting applications underwater. And we had a group of students working on a new, very innovative way of providing greater power for devices underwater, or even in the air for some cases. And we're looking at that. In fact, there's been a company or two that have spun off to pursue some of that technology.

So it's been evolving as we go. But we are actively working to find funding through either the DoD, or DHS, or their sponsors that we can bring to campus, and then create hands on projects that the students can work on. And then the results we can adapt as we need for other applications.

INTERVIEWER: What do you sort of see as sort of the lab's, and perhaps even in your own experience, greatest accomplishments? Or what's the legacy I guess if you will?

EVANS: Well, some of that I can't talk about, unfortunately. But there are many. Lincoln Laboratory has driven radar development nationally for many, many years now. And it continues. Some of the nation's most powerful radars or most sensitive radars have been developed by Lincoln. And a lot of the technology has transitioned into companies who have advanced the technology further. And there have been some very important systems that have come out of that. So that's a major legacy.

The laboratory has had a major role in driving the whole military satellite communication network that we have right now. And that began back in the early '60s. And it continues with the laser com work that we're doing that I mentioned for NASA. So there's a whole range of work like that that I think has had a major impact for decades coming through the laboratory.

And I think, in some of the work we're doing now, if I were to pick an area that I think is having and will have a greater impact longer term, this cybersecurity, cyberdefense area is a very, very difficult problem. And it's one that we're still understanding, still working to find our way into solutions that will work in a resilient way. And I think there's some major contributions to come through Lincoln and through MIT to help with that national problem.

INTERVIEWER: You mentioned earlier on the FAA work. What form has that taken?

EVANS: So we've been working with the FAA for four decades. And some of the work has been related to weather prediction and weather forecasting. And there have been radar developments that have transitioned to around airports to help to protect aircraft from bad weather. We've also developed technology to help with collision avoidance with aircraft that has transitioned out. And we've done a number of upgrades of that over the years. And a lot of that is being used around the world now.

And we're now prototyping a new radar system for the FAA that's a phased array system that's very low cost. And it's using Lincoln technology and technology from companies around the country that will allow us to reduce the cost for developing a radar for air traffic surveillance at about a tenth of the cost of what they've been doing in the past. And if that works, then they can refresh a lot of the radar systems-- and there are hundreds around the country-- refresh them for tracking aircraft better around airports, and vectoring aircraft better around weather, and other problems that might be out there.

And in some cases we want to scale these radars up a little bit to help with homeland protection as well. So it's not just about tracking of aircraft. It's also about watching what's happening around the country in a better way, and making sure we know earlier if there's a serious problem developing.

INTERVIEWER: MIT of course is celebrating 100 years in Cambridge in 2016. Lincoln I guess celebrated its anniversary not too long ago. Not the 100th, but--

EVANS: We celebrated our 60th. We have our 65th coming up.

INTERVIEWER: What do you think about just looking forward, speculating about the next 50 or 100 years even, where do you think Lincoln will be?

EVANS: Well we've had a good more than 60 years. And we talked about the MIT relationship. I think it's stronger now than ever, which is great. And I think the relationship will continue to strengthen. And as we look out, I think Lincoln will continue to be the model for how a major laboratory tied to a major institute can have great impact on technology and innovation worldwide. And we will be striving to continue that.

And I think the key factors to make that continue will be to make sure we're taking on the right work, the most difficult work and the most relevant work, and to make sure that we have the great talent coming around that work. And we'll continue to strive for that.

INTERVIEWER: One thing that I've sort of wondered is it sounds like there's such an incredible breadth of people, backgrounds that Lincoln employees have, and the work that you're doing. What would you say is sort of the most unexpected-- perhaps someone on the outside looking at Lincoln Laboratory-- the most unexpected project that you guys have done or are doing?

EVANS: Well, we had a small project a year or so ago to look at the 3D printing of food for the Army. Now I don't know if that's ever going to work out. But there are projects like that that come along every now and then that are kind of out there. And we try a few things. And sometimes we put at rest, some things are good ideas. Some aren't good ideas. And very often when the project reporting back to a sponsor, maybe this isn't a good idea. So we take on a range of projects like that.

INTERVIEWER: And how did that one work out?

EVANS: I think it depends on the eater. I can't imagine that working long term, but who knows.

INTERVIEWER: That's great. Good. Well let me just look back and see if there are any other things that I wanted to ask. But are there other things that come to your mind about the lab or the relationship with MIT?

EVANS: No, you have a good list.

INTERVIEWER: Great. Just let me look and see. I love the 3D printing of food. Did you try it?

EVANS: So I didn't. But we had people try it. For simple things it might work. But I don't think we'll ever get to the point where you can press print pizza and something comes out.

INTERVIEWER: I know I've seen that in some movies. I think we've hit the high points that I hoped we could talk about. Well thank you. Thank you for your time. I appreciate it.