

The Hypersonics Force Multiplier: University Engagement

Although hypersonics research began in the 1940s, a recent resurgence of interest in the field has compelled stakeholders from the DoD to find ways to accelerate the rate of technical innovation across the country. To achieve its ambitious goals, the DoD is now supporting an integrated model that leverages government, industry and university resources to advance the nation's hypersonic capabilities. In light of these developments, Lockheed Martin's university engagement provides an expedient pathway for advances in the fundamental understanding of future hypersonic systems.



Hypersonics leadership from academia and Lockheed Martin engage to train additional workforce (November 2019)

In an effort to support national security interests as proposed by the DoD, Lockheed Martin focuses on programs that are already funded by the government on behalf of industry and maximizes those investments. The company also devotes resources to maintaining close relationships with universities, partnering on research that furthers innovation and serves as a recruitment pipeline to support existing programs within Lockheed Martin. In a recent interview, Dr. Larry Schuette, Lockheed Martin's director for global research and innovation,

explained, “Our university engagement strategy aims to create awareness across the business areas and to focus our resources on what we call our partner universities.”

In what could be described as a two-way street, Lockheed Martin benefits from capturing outside innovative ideas to integrate into our existing programs, while the universities enjoy Lockheed Martin’s support as a force multiplier for their own research projects. As Schuette proposed, the company’s university engagement strategy in the area of hypersonics is a symbiotic relationship in which both the company and the schools gain access to people and resources beyond their normal capacities.



Echoing Dr. Schuette’s sentiment, Lockheed Martin’s hypersonic program manager, Dr. Barry Bauer, highlighted a three-part rationale that provides direction for the company’s university engagement activities:

- (1) Technology roadmap:** address gaps in the technology roadmaps, including the specific university research that will contribute to closing those gaps.
- (2) Talent recruitment funnel:** identify and familiarize Lockheed Martin employees with graduate students working on hypersonics projects who can one day be recruited into the company.
- (3) Cost efficiency:** benefit from existing government-funded academic projects that seek to answer hypersonic challenges in the industry.

“Engaging with academia allows us to leverage the capabilities of the universities where there is already a vast wealth of knowledge. At the end of the day, the relationships that we have with the universities make us smarter and more capable.”

Dr. Barry Bauer, Hypersonic Program Manager



In the fall of 2020, the hypersonic university engagement team cast a call to academia and received 83 research abstracts from 19 universities. A team of subject matter experts from each of the business areas then selected ten of the projects for potential funding based on criteria that would address technology gaps. The recommendations were socialized with Lockheed Martin’s CTO and former DARPA director Steve Walker, who gave the green light to fund 10 projects for FY 2020-21.

This investment represents an enabler for impactful research across academia to transition directly to industry. “These projects are funded based on alignment with Lockheed Martin’s interests from an industry perspective, which of course tie back into the customer’s ultimate objective to improve the nation’s hypersonic capabilities,” said Dr. John Rhoads, Chief Scientist for Revolutionary Technology Programs at Lockheed Martin Aeronautics. “We are looking to build upon existing research and rapidly pull these advancements forward.”

One example is the BoLT 2 (Boundary Layer Turbulence) program sponsored by the Air Force Office of Scientific Research. The BoLT 2 team is led by the Texas A&M University System and consists of multiple institutions that are designing, building and flying an instrumented flight test article. Lockheed Martin has partnered with Texas A&M to extend the analysis and improve computational models based on wind tunnel and flight test data collected from that program.

“We also value the human skills that these brilliant people bring to the table,” said Schuette. “The student and faculty are not only finding answers to existing hypersonics challenges, but also posing interesting questions that will drive more comprehensive solutions.”



The Ecosystem: Lockheed Martin, Academia and the DoD

Mike White, the principal director for hypersonics in the Office of the Under Secretary of Defense for Research and Engineering (OUSD R&E), recently described hypersonics as [“one of the top DoD modernization priorities”](#) to confront the looming hypersonic threat of U.S. adversaries, such as China and Russia. With the DoD heavily investing in hypersonics as a national security priority, the hypersonics budget since 2016 has expanded to \$3.5 billion in 2020 – and is expected to continue climbing.

“There’s a very compelling national security need,” explained Bauer. “The vision is an inclusive ecosystem of universities collaborating with industry to bring to bear the best and the brightest, accelerating the rate of technical innovation and delivering the workforce necessary to advance modern hypersonic flight systems.”

“Development of hypersonic systems represents a combination of very tough problems. To bridge gaps in knowledge and testing capabilities, Lockheed Martin is joining forces with our partners in academia to meet this urgent need for the nation.”

**Dr. John Rhoads, Chief Scientist for
Revolutionary Technology Programs, Aero**



“Lockheed Martin’s engagement with academia goes back for quite some time,” said Dr. Graham Candler, associate department head of Aerospace Engineering & Mechanics at the University of Minnesota. “We had a really interesting workshop in Tullahoma, Tennessee about two years ago that was very useful for academics to come hear the Lockheed perspective – the industry perspective, that is – of what the barriers are to hypersonics development, which is obviously quite different from the academic perspective.”

“We tend to think of problems in unit, such as physics problems,” he continued. “But Lockheed Martin is answering a government need and thinks about both how to fly hypersonic vehicles as well as how to manage project schedules, risks, systems and sub-systems.”



“This powerful alliance between industry and academia will greatly accelerate the rate of technical innovation, enabling a capability never seen before,” asserted Bauer. “For all these projects where the government has spent their money, we are spending Lockheed Martin money to carry it a bit further, to take it to the point of transition, from research to reality.”

Lockheed Martin’s Relationship with Texas A&M and UCAH

Beyond sharing research and facilities, Lockheed Martin and Texas A&M have an even larger enterprise to engage with regarding hypersonics research: the [University Consortium for Applied Hypersonics \(UCAH\)](#). The Consortium, established by the Pentagon’s Joint Hypersonics Transition Office (JHTO), is managed by the [Texas A&M Engineering Experiment Station \(TEES\)](#) and led by Dr. Rodney Bowersox, associate dean for research at the Texas A&M Engineering program. Approximately [\\$100 million will flow to the Consortium over the next 5 years](#) in an effort to unite academic and industry brainpower.

According to Bowersox, “Lockheed Martin has really been at the forefront of not only hypersonics in terms of national defense, but also the initiative it has taken engaging with academia. There’s technical leadership and competencies at all levels of Lockheed Martin that will be beneficial to supporting the JHTO goals for the Consortium.”

The vision for the Consortium is based on the government’s interest to expedite the national effort in delivering high-speed flight capabilities into the hands of the warfighter. Instrumental to UCAH’s main concept and funding is the support of Dr. Mark Lewis, the Acting Deputy Undersecretary of Defense for Research and Engineering, and Dr. Gillian Bussey, the Director of the JHTO.

[Briefing reporters on October 26, 2020](#), Dr. Bussey emphasized that advancing hypersonics development on a national level will require the combined power of congressional funding, industry leadership and a multi-university syndicate: “When Congress provided funding and direction to establish this consortium, they highlighted the important role that our country’s academic institutions play in national security-related technology development,” said Bussey. “While we’ve always turned to our colleges and universities to advance important technologies, this Consortium is unique in its diversity and scope.”



The Mach 6 Quiet Tunnel at the National Aerothermochemistry Laboratory at Texas A&M.
Image source: Texas A&M Engineering

In an interview with Dr. Bowersox and his colleagues, UCAH co-directors Dr. Graham Candler and Dr. Wesley Harris, the hypersonics experts discussed the key milestones they endeavor to accomplish in the next year. They talked about the establishment of the Consortium via the research prototyping process, the successful implementation of that process and the formation of industrial, federal and national advisory boards to help direct the Consortium's activities.

More specifically, their intent is to coordinate research projects and engagements between the JHTO, industry, and national and federal laboratories to address the country's workforce development needs.

"We are very excited to work with our industry partners who have practical experience in integrating hypersonic systems and can guide us in creating the most useful and pertinent research to support the industry need."

Dr. Rodney Bowersox, Interim Governance Board Director of UCAH



To illustrate the enthusiasm for the Consortium in both academic and industry circles, UCAH has already received dozens of white papers and hundreds of interested applicants from across the country. Bowersox, Candler and Harris agreed that in order ensure that UCAH would be fully functional, they needed to execute the following activities:


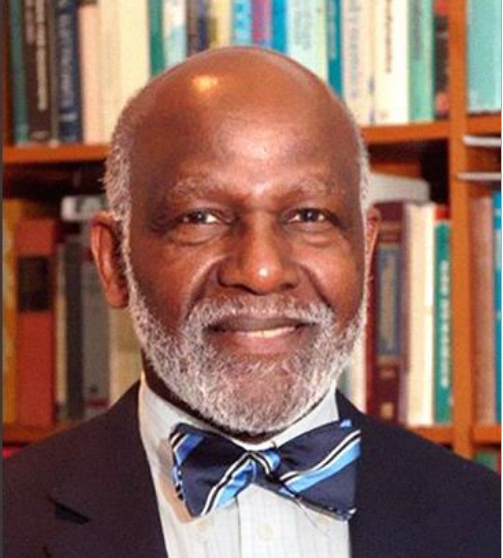
- (1) Establish a leadership team that would bring in the nation's top experts to participate in the Consortium and provide guidance.
- (2) Build a team of relevant universities across the country to work together in an inclusive and engaging atmosphere.
- (3) Utilize the existing [Texas A&M Engineering Experiment Station \(TEES\)](#) infrastructure, which includes finance, compliance, research development and outreach management. (Note: TEES is an engineering state agency and part of the Texas A&M University System.)



(4) Invite support from industry to match academic research to the needs of industry's development and manufacturing of hypersonic systems.

“We welcome the technical strength, experience and competence that comes from an industry leader like Lockheed Martin, in the sense that they deeply understand the technologies and have actually created hypersonic systems.”

Dr. Wesley Harris, Interim Governance Board Co-Director of UCAH



One of the key milestones that UCAH is positioning to achieve in 2021 includes the establishment of an industrial advisory board, along with national and federal advisory boards that will help provide the demand signal for workforce development and technology transition. This will result in academics transitioning from what they're comfortable with – that is, 6.1 basic research – to involvement in more applied research that will directly benefit industry.

“Lockheed Martin has demonstrated that its engagement with the academic community is an important ingredient for advancing what we know about hypersonics.”

Dr. Graham Candler, Interim Governance Board Co-Director of UCAH



Rhoads, who serves as the technical liaison between Lockheed Martin and Texas A&M, believes that the Consortium is perfectly suited to help bridge the “valley of death” between academic advancements and practical industry use. For example, Rhoads, along with Bauer and the rest

of the Lockheed Martin hypersonics engagement team, have been providing advice to Bowersox's team at Texas A&M, including best practices for the configuration of an onsite hypersonics research facility.

"The foundation that supports this ecosystem is based on mutual respect for the technologies and advances in these technologies," opined Harris. "Each group is at the table and ready to contribute – in terms of R&D road maps, in terms of workforce, curriculum, and products. So the ecosystem is already strong and it's growing stronger."

"Today you can practically count on your fingers how many hypersonics experts exist in the U.S.," said Candler. "We're hoping to change that through the Consortium."

Hypersonics University Engagement in 2021

In the face of the COVID-19 pandemic, 2020 was a difficult year that required a ramp up in remote communications and other workarounds. Lockheed Martin, however, was already well-positioned to continue promoting its hypersonics initiatives through its close academic relationships.

"Similar to any collaboration," said Rhoads, "Lockheed Martin's success with our academic partners comes down to building close relationships and providing meaningful engagement with key individuals. That was something we already had in place before the pandemic hit."



Lockheed Martin's Dr. John Rhoads introduces Dr. John Schmisser and Dr. Mark Gragston during the training course at Lockheed Martin Fort Worth (November 2019)

In addition to strengthening Lockheed Martin's relationship with TEES and Texas A&M, Bauer talked about replicating a number of university recruitment events and TED Talks in 2021. He also expressed excitement about continuing hypersonics education at Lockheed Martin. Earlier in 2019, Bauer's team invited Dr. John Schmisser from the University of Tennessee Space Institute to deliver a one-day short course on "Introduction to Modern Hypersonics," which garnered much attention in the company, with over 300 Lockheed Martin employees from Palmdale, Fort Worth and Marietta participating in the first available module.

During 2020, Dr. Schmisser also provided the opportunity for members of Lockheed Martin to participate in a pilot run of a Hypersonic Certificate course, presenting an opportunity for the company to provide feedback regarding relevancy to industry needs. Lockheed Martin is actively involved in shaping and supporting the DoD-funded hypersonic curriculum development project led by Dr. Schmisser, along with its other hypersonics-related activities that will continue to deliver critical capabilities to the warfighter well into the future.

"Lockheed Martin is a strong, positive and visible participant – not just this year, but for the coming years too," said Bowersox. "I think the academic community is very excited to collaborate closely with our industry partners, responding to the needs of the hypersonics workforce."

"This is where Lockheed Martin excels," agreed Schuette. "Pulling together a team of people with a common vision and a common purpose."

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