Energy & Manufacturing Competitiveness Partnership

Leverage.

Phase II Sector Study: Aerospace

Compete.

Council on Competitiveness

Leverage.
Phase II Sector Study: Aerospace

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Table of Contents

Letter from the President

On behalf of the Council on Competitiveness, The Boeing Company and the University of South Carolina, I am thrilled to present the final report on the Energy and Manufacturing Competitiveness Partnership (EMCP) sector study dialogue on competitiveness in America's aerospace sector. ***Leverage: Aerospace*** analyzes a sector that is essential to growth, productivity, jobs and national security. Additionally, it outlines a set of key findings and recommendations that, if implemented, will enable America to maintain its global leadership in the face of increasing global competition.

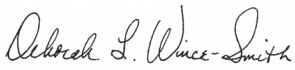
Innovation in the aerospace sector goes beyond America's competitiveness; it is at the core of America's imagination. As the manufacturing industry with the largest trade surplus in the United States, the aerospace sector is an engine of job growth and economic competitiveness, historically receiving strong bipartisan support from policymakers. And, the United States is on the verge of another golden age in aerospace. The ability to free mankind from the confines of terrestrial travel is on the horizon and has the potential to significantly change the world.

Whether innovation and the flow of new technology to market can keep up with increasing global competition is still uncertain. From lack of clarity around U.S. trade policy moving forward to concerns surrounding the ability to maintain near-spotless safety records and a demand for talent that far exceeds supply, the challenges around maintaining America's leadership position in the aerospace sector—which has thrived on competition since its inception—are numerous.

With these challenges come significant opportunities. Among the key findings and recommendations in this report, which builds on the EMCP's prior five sector studies, are the need to: better coordinate government investment in basic research; encourage and keep up with the ever-increasing pace of innovation; build cybersecurity into aerospace technology and infrastructure; encourage sharing of best practices between the aerospace and automotive sectors; and promote partnerships between industry and academia to help close the gap between the available supply of workers and industry demand for talent.

None of this would be possible without the contributions and support of our members and key experts who provided their valuable input and unique perspectives. Thank you to everyone involved for their continued engagement as we capture insights and recommendations across our sector dialogues and put forward an action plan to drive U.S. productivity and raise the standard of living for all Americans.

Sincerely,



The Honorable Deborah L. Wince-Smith
President & CEO
Council on Competitiveness

Introduction

The United States is on the verge of another golden age in aviation. Encouraging innovation in the aerospace sector goes beyond U.S. competitiveness and is at the core of America's imagination. Freeing people from the confines of terrestrial travel will change the world significantly. Whether aerospace manufacturing will ever reach an automotive scale, however, is still uncertain.

As a critical economic incubator for emerging businesses, the aerospace industry can provide job opportunities to help offset the loss of traditional U.S. manufacturing positions. Given the importance of aerospace to U.S. innovation and economic progress, the industry receives strong bipartisan support from policymakers. However, the United States is at risk of losing a key opportunity to gain an economic advantage in a growing business sector as advancements in technology, talent, investment and infrastructure of global competitors are beginning to outpace that of the United States.

In this sixth sector study of the Energy and Manufacturing Competitiveness Partnership (EMCP), the Council on Competitiveness' dialogue on competitiveness in the aerospace sector gathered experts to identify friction points, ideas and challenges facing the aerospace sector. During the day-long session, participants focused on the respective roles of government and industry in funding and supporting basic and applied research, the need for regulation to keep up with innovation and the importance of collaboration between industry and academia to fill the growing talent needs in this sector.

The resulting recommendations will be incorporated into the Council's competitiveness agenda and, if adopted by policymakers, will help the U.S. aerospace sector regain its competitive advantage and live up to its full potential to jumpstart innovation and growth in the American economy.

Findings & Recommendations

- **Increase coordination between federal, state and local governments on aerospace infrastructure spending.** Necessary updates and improvements to U.S. infrastructure are not being undertaken, causing the United States to fall behind. As a result, the United States is now ranked lower than many of its competitors in airport efficiency. Many difficult technological problems must be solved if the aviation infrastructure needed for the future will provide the level of safety enjoyed today. Better coordination and additional government funding for basic research are needed to reclaim competitiveness in this sector.
- **Reform policy in a way that encourages and keeps up with the fast pace of innovation.** Aerospace has been a technologically-driven sector from its inception. Policymakers must quickly address potential concerns around certain technological innovations, such as drones and space-based technology, in order to avoid the wealth of ethical and security concerns that could arise and to regain the global lead in space exploration and travel.
- **Capitalize on America's energy opportunity to encourage innovation in the aerospace sector.** As the energy sector progresses and moves away from traditional fossil fuels, the aerospace sector has the opportunity to innovate its energy efficiency. This could include building upon new technologies already being implemented in other countries, as well as in other sectors in the United States, including investment in areas from battery powered planes to solar-powered aircraft.
- **Increase the velocity of adoption of new materials to outpace global competition.** In the United States, it can take 10-20 years to advance an aerospace material from design to deployment. In order to maintain a competitive edge, computational techniques and methods must be applied to the qualification of new material systems through increased modeling and simulation. This will require increasing investments in science and creating deliberate linkages between academic research and commercial deployment.
- **Build cybersecurity into aerospace technology and infrastructure.** Given the outstanding safety record of the aerospace industry, and particularly high levels of risk aversion, safety must evolve before and during innovation. As the flow of data and sharing of information become crucial to this sector, and an increasing density of aircraft in the skies leads to a higher need for communication across the air and to the ground, cybersecurity will become increasingly important.
- **Encourage sharing of best practices between the aerospace and automotive sectors.** It is unlikely that cars and ground travel will ever be completely overshadowed by air transportation. Self-driving car models are now in development at multiple companies, with some already being tested for usability. Thus, it is necessary to think with a system-integration approach, where the two forms of travel and transport can work in conjunction for the betterment of society.

- **Promote partnerships between industry and academia to increase the talent pool.** The current promotion and tenure reward system discourages applied research, leaving a void to be filled by industry. However, when viewed against the backdrop of decreasing federal research funding and shrinking R&D activity in many industries, there is a need for collaboration to ensure innovation and motivation can be effectively translated into results and impact.
- **Redesign academic curricula at all levels to create a more diverse workforce.** Creating a talent pool diverse in gender, ethnicity and skill will be essential to building competitiveness in the aerospace sector. Educators and employers alike—as early as K-12 and up to mid-career professionals—must encourage the pursuit of opportunities in this growing industry. This might include engineering competitions, continuous learning opportunities through trade schools, classes offered by companies, online courses or community college offerings.

Setting the Stage

Meeting the grand challenges of the 21st century—and taking advantage of even grander opportunities—demands an innovation-driven economy powered by a secure, sustainable and affordable energy portfolio, and a robust and agile advanced manufacturing sector. One such advanced sector that will be a lynchpin for U.S. competitiveness is the aerospace industry. The United States aerospace industry directly employs nearly 500,000 workers in scientific and technical jobs and supports more than 700,000 additional jobs in related fields.[1] These numbers continue to grow.

Maintaining a competitive aerospace infrastructure is essential for growth, productivity, jobs and national security. This advanced sector is an engine of manufacturing, with U.S. aerospace exports reaching $147 billion in 2016 and boasting the largest trade surplus of any manufacturing industry.[2] U.S. aerospace exports increased steadily over the last several years, up more than 40 percent since 2009, indicating strong and stable future demand. Such long-term strength allows the industry to avoid the short-termism that often plagues research and development, while enabling the integration of new technologies and processes. The expanded timeline has considerable implications for energy productivity, costs and sustainability.

As the U.S. aerospace sector seeks more energy-efficient fleets and continues to rely on energy-intensive raw materials, manufacturers must out-innovate their global competitors. Importantly, the aerospace industry also represents a potential source of new jobs that will mandate a higher level skill set. In many ways, the competitiveness of the American aerospace sector over the next decade will be defined by the ability to develop, standardize and deploy advanced materials, technologies and processes on a broad scale supported by a highly skilled workforce.

Despite the vast competitiveness opportunities and room for innovation, the United States is operating under a cash-starved, technologically limited FAA that uses limiting, ground-based radar. At the same time, other nations have begun building quasi-government, cash-generating business entities to manage their commercial air control and infrastructure using satellite systems in low Earth orbit. Along with insufficient investment in basic research needed to retain a global leadership position in the aerospace sector, a decline in infrastructure spending—particularly in the aviation sector—hinders U.S. competitiveness in this critical sector. The American Society of Civil Engineers in its 2017 annual Infrastructure Report Card estimates an anticipated $42 billion funding gap between 2016 and 2025 as airports struggle to keep up with investment needs.[3]

While, for decades, space was exclusively the purview of governments and militaries, in recent years this previously restricted domain has presented increasing commercial viability. In 2014, the United States, Russia, Europe, China, Japan, India, Israel and multinational provider Sea Launch conducted a total of 92 orbital launches, 23 of which were conducted by the United States. Of these 23 U.S. launches, 11 were commercial orbital launches by companies like SpaceX and Virgin Galactic, making 2014 the most active year since the late 1990s. The estimated

1 *Aerospace Spotlight: The Aerospace Industry in the United States*, SelectUSA, accessed September, 2018.

2 ibid.

3 2017 Infrastructure Report Card, American Society of Civil Engineers.

Participants in the Energy and Manufacturing Competitiveness Partnership aerospace sector study dialogue, November 3, 2017, hosted by Greg Hyslop, Chief Technology Officer, The Boeing Company, and Senior Vice President, Boeing Engineering, Test & Technology, at Boeing's Chicago offices.

commercial orbital launch revenues of $1.1 billion for U.S. providers were the highest since 1998. With this new and expanding potential for commercial development comes an increasing reliance on industry to fund applied research, as well as a new field of competition in defense and cybersecurity as the United States enters what can be considered a renewed space race.

Over the next decade—as airlines demand more energy-efficient fleets; as military capabilities demand more agile, long-range and fuel-efficient technologies and vehicles; and as the industry continues to rely on energy intensive raw materials from steel to carbon composites—manufacturers must overcome challenges to the production of specialized and frequently energy-intensive design and manufacturing processes. As the United States looks at the aerospace infrastructure and this entirely new frontier, it is increasingly important to explore and capitalize on the abundant opportunities not only to keep pace with, but also to accelerate and out-innovate competitors.

Stakeholder Dialogue

America's Aerospace Infrastructure

Maintaining a competitive aerospace infrastructure is essential for growth, productivity, jobs and national security. But U.S. air traffic control is operating under a technologically and financially limited system that has fallen behind the satellite systems and business models of global competitors. As a consequence of underinvestment, U.S. airports are ranked 26th in efficiency. At the same time, U.S. airlines still rank among the most profitable globally. This means there is ample opportunity to advance American competitiveness if proper attention is given to infrastructure modernization and optimization. Advancing the country's aerospace infrastructure is a key enabler of economic growth, given that the sector currently constitutes 5.4 percent of U.S. GDP and has the largest trade balance of any U.S. industry. Improvements in aerospace can impact other sectors as well, including logistics, where there is opportunity to increase profitability by moving from ground transport of goods to air transport.

Coming off the safest year in aviation history, one factor that contributes to the high level of risk aversion in the aerospace industry, thus slowing its progress, is the maintenance of a stellar safety record. Ground transportation, and the strides that have been made as far as safety in the sector, can serve as a model for modernization in the aerospace sector. Policymakers and industry experts must encourage risk acceptance and shared data standards to improve cooperation and operability, as well as investment in technologies to enhance performance while simultaneously maintaining a high level of integrity and safety.

While it is unlikely that the automotive industry and the demand for ground travel will ever be completely overshadowed by air transportation, self-driving car models are now in development at multiple companies—many already being tested for usability—while at the same time the concept of aerial taxis through services like Uber Elevate are inching closer to reality. Thus, it is necessary to adopt a system-integration approach, where the two forms of travel and transport can work in conjunction for the betterment of society.

When it comes to the aerospace sector, the national security implications require that cybersecurity be among the first capabilities built into product and process development. Data flow and information sharing are crucial to this sector, making cybersecurity increasingly important as a growing density of aircraft in the skies creates a higher need for communication in the air and on the ground. Increased communication necessitates increased reliance on technology to maintain performance.

Even with the promise of growth, the United States must focus on how to accomplish these developments as quickly as possible in order to retain its leadership position as global competitors and demonstrate continual willingness to make advancements. It remains to be seen, though, whether innovation and regulation can keep pace in a way that allows for new, revolutionary technologies to make it to market—both in the United States and abroad. While competition endures, there are lessons to be learned from countries such as Singapore, Portugal and Denmark, who are becoming leaders in incentivizing and implementing advancements in the aerospace sector.

Innovative Aerospace Technologies

Encouraging innovation in the aerospace sector goes beyond America's competitiveness: it is at the core of America's imagination. Technological change has quickened across all industries, but with new technology comes government responsibility to ensure policy and regulation keep pace with the speed of innovation. If policymakers cannot quickly address potential concerns, such as drones and space-based technology, a wealth of ethical and security dilemmas could arise.

Technology and aerospace go hand in hand, as U.S. technological advancements have allowed travel to the moon, satellites to circle Jupiter and a solar explorer to travel to the sun. There are even now plans for missions to Mars, some involving private companies interested in human travel. But recently, innovation and motivation have not translated into results. Concerns have risen over the future of U.S. competitiveness in space exploration and travel, and how to regain the global lead.

A key part of aerospace innovation is energy—fuel emissions, energy efficiency and resources all dictate the effectiveness of innovation efforts, especially when it comes to commercial aviation. Hybrid and electric aviation is no longer just on the horizon—Germany showed five electric planes last year showcasing its research and development (R&D) accomplishments. The United States should embrace this shift as a means to solve challenges with regional air transport, but inadequate funding and the current regulatory environment make it a challenge to take the helm.

The aerospace sector can only thrive in an environment that encourages responsible innovation, while both preserving safety and encouraging partnerships between industry and academia. The United States' competitive edge is narrow and will continue to decline if issues remain unaddressed, leaving the field open for China and other nations to overtake the United States in research funding. Chinese investment in artificial intelligence and advanced manufacturing is far out-pacing that of the United States. There is a desperate need for leadership, a focus on foundational technologies, a system to promote and fund R&D and policies that support innovation and new innovation models.

The United States has a competitive edge in the development and design of new materials—an essential component to the aerospace sector. Nevertheless, as other countries gain ground and come closer to matching U.S. capabilities, maintaining this lead becomes increasingly challenging. New and better materials will be key to American aerospace competitiveness, along with working quickly and efficiently to move these products to market. The Materials Genome Initiative, a 2011 Obama administration effort, concluded it takes 10-20 years to take an aerospace material from design to deployment. It is crucial that the United States cut this time range down by at least half to maintain a competitive edge. One challenge is connecting the research world with commercial deployment, but a focus on science investment and commercialization can alleviate this.

One way to increase the speed at which the United States adopts new materials is through modeling and simulation. Recognizing the digital advancements being made and applying advanced computational techniques and methods to the qualification of new material systems will be crucial.

In addition to modeling and simulation, smart manufacturing has the potential to carry a cost savings of up to 10-15 trillion dollars in the next 15 years. The integration of smart manufacturing and new materials into aerospace technologies is, and will remain, crucial to furthering U.S. competitiveness against its global peers. Funding, regulatory and timeline issues need to be resolved to keep America on track to maintain its edge.

Investing in the U.S. Aerospace Sector

Aerospace serves as an engine of manufacturing and economic growth for the United States. Long-term strength of the industry allows it to avoid the short-termism that often plagues R&D. And while, for decades, space was exclusively the purview of governments and militaries, in recent years this previously-restricted domain has shown increased commercial viability. In order to maximize the effectiveness of investment in the aerospace sector, the tendency to stovepipe public and private investment must be broken down.

In addition to traditional industry funding, competitiveness in the American aerospace sector—and across all manufacturing sectors—is reliant on funding universities, where talent is cultivated, and national laboratories, which have unique capabilities. Connecting academia, industry and the national laboratories is essential to creating a competitive aerospace industry—as well as a competitive manufacturing industry. Laboratories and research centers need to work in conjunction with education centers to continue to progress the sector's advancements.

It is also important to understand the distinct but complementary roles of government and industry funding when it comes to the aerospace sector. A sector with direct implications on national security, basic research in aerospace requires government investment and support, while applied research requires financial commitment on the part of industry. Many difficult technological problems must be solved if the aviation infrastructure needed for the future will provide the level of safety enjoyed today. These challenges require both the focus of government and input from industry.

Opening up new markets by aggregating and integrating new intellectual property will encourage investment in the aerospace sector, creating a new competitive advantage. This will challenge universities, industry and government, but cooperation across these sectors is needed for collective advancement. These challenges ultimately can offer opportunities for growth and further discoveries of new technologies and intellectual property. But, the research paradigm must be redesigned to produce intellectual property that can lead to market-ready products—capitalizing on the immense potential of America's innovation ecosystem.

U.S. investment must catch up to global competitors, as places such as South Korea and the European Union have already pledged to increase research spending. Aerospace is not the only sector to suffer

from financial neglect: as previously noted, there has been a 40 percent drop in overall infrastructure funding in the United States. Commercial and global investments dwarf federal research investment, creating a competitiveness gap between the United States and other countries. For example, China and Japan are both investing heavily in developing and manufacturing their own materials to gain an edge. While competitiveness is not only defined by investment levels, it plays an undeniable role in the United States' ability to keep pace in this increasingly important field.

Building Talent in the Aerospace Sector

In years forthcoming, aircraft will continue to be essential modes of transportation—some autonomous or semi-autonomous. However, the way these aircraft look and operate, as well as the space in which they function, is constantly evolving. The workforce being trained to operate these changing products and systems will need a certain set of fundamental skills perhaps not fully understood today.

As the skills required in this industry change, the amount of information students are required to learn will continue to increase drastically. Coupled with a blurring of the distinctions between majors, the number of required courses will grow increasingly overwhelming. In many ways, the overall curriculum has become outdated to meet changing industry needs. A focus on multidisciplinary education at the grade school and undergraduate level will be increasingly more important in order to equip graduates with the skills necessary to function in a new paradigm.

Focusing on diversity and inclusion presents another tremendous opportunity to cultivate talent and skill in the workforce, but universities can no longer be the sole entities responsible for expanding interest. Freshman year is too late to properly engage those not already interested. The K-12 education system must invest in diverse communities and expand the pools of students who want to pursue degrees and jobs in the sector. Industry must play a role as well, both by helping to define the opportunities and making clear to students the path to a good job.

With the aerospace sector growing and technological advancements increasing, there is also a need for workers skilled in energy management as demand on the grid increases. Power distribution and battery systems will require additional talent, and related skill sets are indispensable and carry a heavy workload. Lifelong learning also is a crucial component to producing a talented workforce. Cooperation between industry and academia should be encouraged, as industry has a role to play in continuing learning and professional development.

Moving Forward

Leverage: Aerospace is the sixth and final sector study of the Energy and Manufacturing Competitiveness Partnership (EMCP). This sector study looks at competitiveness in a sector that has long symbolized American leadership and innovation and one that is essential to growth, productivity, jobs and national security. The dialogue built upon key findings from the previous five sector studies, and the recommendations outlined in this report will inform the Council's larger policy agenda for Congress and the administration.

One of the cross-sector concerns that has been illuminated in these sector studies—and was reiterated in the discussion on aerospace—is the threat of cyber-attacks to America's critical infrastructure. In the first half of 2018, the Council launched a three-dialogue series on the impacts on industry, the government and the military of cyber-attacks and put forth a coordinated set of proposals for policymakers to consider that take into account each of these interconnected perspectives. It is crucial to continually evaluate this evolving threat, as all parts of the American economy and government will need to constantly strive to recover from and build resilience against cyber-attacks.

As the Council's EMCP builds upon the success of its six sector studies on water and manufacturing, advanced materials, bioscience, agriculture and consumer water use, energy and now aerospace, it continues to identify common themes, challenges and opportunities that apply across a wide swath of American industries and transcend sector boundaries. Several key insights and recommendations have been identified and will be highlighted as part of a summary report to be released in 2018.

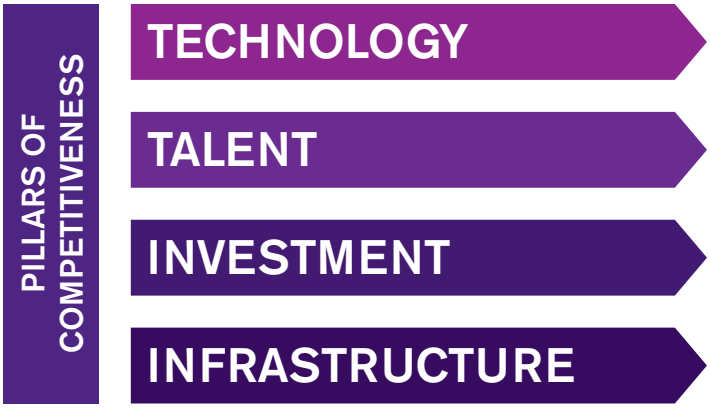
Beginning in late 2018, the findings and recommendations from the EMCP will be integrated into the Council's National Commission on Innovation & Competitiveness Frontiers, which will work with members and other critical stakeholders around the United States to double down on all efforts to optimize the nation for a new, unfolding innovation reality.

About the Energy & Manufacturing Competitiveness Partnership

The aerospace sector study is part of a larger initiative of the Council on Competitiveness known as the Energy and Manufacturing Competitiveness Partnership (EMCP). The EMCP, since it began in 2015, has united Council members to focus on the shifting global energy and manufacturing landscape and how energy transformation and demand is sharpening industries critical to America's prosperity and security.

The EMCP has tapped into a diverse membership of leaders from business, academia, the national laboratories and the labor community to understand the discrete and distinct challenges critical sectors of the U.S. economy face in the energy-manufacturing convergence and how decision-makers can bolster the critical pillars of competitiveness—technology, talent, investment and infrastructure.

Throughout the six EMCP sector studies, it has become increasingly apparent that while manufacturers face sector-specific challenges and opportunities at the national level, the enabling environment at the regional and local levels significantly influences America's competitiveness in the global economy. In 2019, the Council will continue to draw upon the findings and recommendations from the EMCP and look for ways to affect change at the state, local and national levels.



The Energy & Manufacturing Competitiveness Partnership Concept Paper, August 2015.

About the Council on Competitiveness

For more than three decades, the Council on Competitiveness (Council) has championed a competitiveness agenda for the United States to attract investment and talent, and spur the commercialization of new ideas.

While the players may have changed since its founding in 1986, the mission remains as vital as ever—to enhance U.S. productivity and raise the standard of living for all Americans.

The members of the Council—CEOs, university presidents, labor leaders and national lab directors—represent a powerful, nonpartisan voice that sets aside politics and seeks results. By providing real-world perspective to Washington policymakers, the Council's private sector network makes an impact on decision-making across a broad spectrum of issues from the cutting-edge of science and technology, to the democratization of innovation, to the shift from energy weakness to strength that supports the growing renaissance in U.S. manufacturing.

The Council's leadership group firmly believes that with the right policies, the strengths and potential of the U.S. economy far outweigh the current challenges the nation faces on the path to higher growth and greater opportunity for all Americans.

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APPENDIX A

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APPENDIX B

Agenda

MORNING

9:00 Welcome and Opening Remarks

Dr. Greg Hyslop
Chief Technology Officer, The Boeing Company; and
Senior Vice President, Boeing Engineering, Test & Technology

Dr. Harris Pastides
President
University of South Carolina

9:15 The Council, the EMCP and the Energy Landscape

The Honorable Deborah L. Wince-Smith
President & CEO
Council on Competitiveness

Mr. William Bates
Executive Vice President and Chief of Staff
Council on Competitiveness

Today, America's competitiveness is shaped by the convergence of a distinctly modern breed of energy abundance with a re-emergent manufacturing sector. Challenges from globalization to climate change are forcing us to understand the nexus of energy and manufacturing as a whole more powerful than the sum of its parts.

The Energy and Manufacturing Competitiveness Partnership (EMCP) is a collaboration among national leaders from all sectors of the economy committed to deepening our understanding of the complexities of the energy landscape and building a roadmap to ensure that America captures the competitiveness opportunity of this new frontier.

9:45 America's Aerospace Infrastructure

Presenter
Brig. Gen. (Ret) John Michel
Executive Director
Skyworks Global Inc.

Key Discussant
Ms. Jennifer Fletcher
Deputy Secretary
SC Department of Commerce

Maintaining a competitive aerospace infrastructure is essential for growth, productivity, jobs and national security. But U.S. air traffic control is operating under a technologically and financially limited system that has fallen behind the satellite systems and business models of our competitors. This session will focus on the challenges and opportunities around regaining a competitive edge by advancing America's aerospace infrastructure.

Key questions

- How does America's aerospace infrastructure compare to that of its competitors? What can the U.S. do to out-compete countries that have or will soon overtake our leadership position in this space?
- Does the current regulatory infrastructure enable the U.S. to innovate and compete with Russia, Europe and the rest of the world when it comes to the aerospace sector? If not, what types of policies are needed to spur innovation?

10:45 Coffee Break

11:00 Technological Innovation in the Aerospace Sector

Presenter
Dr. Keoki Jackson
Chief Technology Officer
Lockheed Martin

Key Discussants
Mr. Greg Bowles
Vice President, Global Innovation Policy
General Aviation Manufacturer's Association

Dr. Jason Sebastian
President
QuesTek

As airlines demand more energy-efficient fleets, as military capabilities demand more agile, long-range and fuel-efficient technologies and vehicles, and as the industry continues to rely on energy-intensive raw materials from steel to carbon composites, manufacturers in the sector must overcome both existing and new challenges, including issues around defense and cybersecurity that stem from commercial development

in the sector. This session will focus on the technological innovation needed to accelerate and out-innovate our competitors in the aerospace industry while safeguarding national security and intellectual property.

Key questions
- How does the aerospace industry view the development of alternative energy and fuel sources? How does the need for new and advanced materials, technologies and products complement--or compete with--energy efficiency and product development?
- How is the increasing commercial viability in this sector changing the way we look at aerospace defense and national security, particularly as it relates of cybersecurity and intellectual property protection?

AFTERNOON

12:00 Lunch and Presentation

1:00 Investing in America's Aerospace Sector

Presenter
Mr. Jeff Witters
Aerospace & Defense Marketing Manager
Arconic

Key Discussant
Dr. Jeff Binder
Associate Laboratory Director, Energy and Global Security
Argonne National Laboratory

Aerospace is an advanced sector that serves as an engine of manufacturing and economic growth. Long-term strength of the industry allows it to avoid the short-termism that often plagues R&D. And while for decades space was exclusively the purview of governments and militaries, in recent years this previously-restricted domain has shown increased commercial viability. The new frontier that exists as a consequence of this renewed space race is ripe for development and, as a consequence, investment, and presents an opportunity for government, military and industry. This session will focus on maximizing the effectiveness of investment in the aerospace sector to drive competitiveness and growth for the U.S. economy.

Key questions
- What roles should government and the private sector play in terms of funding the research and development needed to accelerate American leadership in the aerospace sector vis-a-vis our global competitors?
- How will the competition between the public and private sectors for leadership in the space frontier impact the overall investment climate in this space?

2:00 Building Talent in the Aerospace Sector

Presenter
Dr. Dave Williams
Dean, College of Engineering
The Ohio State University

Key Discussants
Dr. Hossein Haj-Hariri
Dean, College of Engineering University of South Carolina

Dr. Caralynn Collens
Chief Executive Officer
UI Labs

The aerospace industry represents a potential source of new jobs that will require new and higher skills. In many ways, the competitiveness of the American aerospace sector in the next decade will be defined by the ability to develop, standardize and deploy advanced materials, technologies and processes on a broad scale supported by a highly-skilled workforce. This session will focus on how best to build the talent needed to support this critical sector.

Key questions
- What formal, alternative and continuing education platforms must be established or strengthened to ensure a robust talent pipeline and domestic workforce in the aerospace sector?
- What domestic skill shortages and talent deficits hinder America's ability to achieve the full potential of the aerospace sector?

3:00 Conclusion & Next Steps

APPENDIX C

Compete.
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Aerospace: A Sector Study of the Energy & Manufacturing Competitiveness Partnership

Meeting the grand challenges—and even grander opportunities—of the 21st century demands an innovation-driven economy powered by a secure, sustainable, affordable energy portfolio and a robust, agile, advanced manufacturing sector. One such advanced sector that will be a lynchpin for American competitiveness is the aerospace industry. The U.S. aerospace and defense sector is one of the nation's top employers. With direct and indirect employment of 4.1 million workers in 2014, spread across the nation, the sector paid $115.6 billion in wages to those directly employed and employment in commercial aerospace continues to grow.[1]

Maintaining a competitive aerospace infrastructure is essential for growth, productivity, jobs and national security. This advanced sector is an engine of manufacturing, with U.S. aerospace exports reaching $128.74 billion in 2013, up 8.6 percent from the previous year. U.S. aerospace exports have been experiencing a steady increase over the past several years, up almost 37 percent since 2009, indicating strong and stable future demand.[2] Such long-term strength allows the industry to avoid the short-termism that often plagues research and development, while enabling the integration of new technologies and processes. The expanded timeline has considerable implications for energy productivity, costs and sustainability.

As the U.S. aerospace sector seeks more energy-efficient fleets and continues to rely on energy-intensive raw materials, manufacturers must out-innovate their global competitors. Importantly, the aerospace industry also represents a potential source of new jobs that will require new and higher skills. In many ways, the competitiveness of the American aerospace sector over the next decade will be defined by the ability to develop, standardize and deploy advanced materials, technologies and processes on a broad scale supported by a highly skilled workforce.

Despite the vast competitiveness opportunities and room for innovation, the U.S. is operating under a cash-starved, technologically limited FAA that uses limiting ground-based radar while other nations have begun to build quasi-government, cash-generating business entities to manage their commercial air control and infrastructure using satellite systems at the earth's lower orbit.

And while for decades space was exclusively the purview of governments and militaries, in recent years this previously restricted domain presents increasing commercial viability. In 2014, the United States, Russia, Europe, China, Japan, India, Israel, and multinational provider Sea Launch conducted a total of 92

[1] *US Aerospace & Defense Labor Market Study,* Deloitte, February 2016.
[2] *Aerospace Resource Guide,* U.S. Commercial Service, 2014-2015.

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orbital launches, 23 of which were conducted by the United States. Of these 23 U.S. launches, 11 were commercial orbital launches by companies like SpaceX and Virgin Galactic, making 2014 the most active year since the late 1990s. The estimated commercial orbital launch revenues of $1.1 billion for U.S. providers were the highest since 1998, when the total was $1.12 billion.[3] With this new and expanding potential for commercial development comes a new field of competition in defense and cybersecurity as we enter what can be considered a renewed space race.

Over the next decade, as airlines demand more energy-efficient fleets, as military capabilities demand more agile, long-range and fuel-efficient technologies and vehicles, and as the industry continues to rely on energy-intensive raw materials from steel to carbon composites, manufacturers must overcome challenges to the production of specialized and frequently energy-intensive design and manufacturing processes. As we look at the aerospace infrastructure and this entirely new frontier, it is increasingly important that the U.S. explore and capitalize on the abundant opportunities not only to keep pace with, but to accelerate and out-innovate our competitors.

Key Questions for the Sector Study to Address

1. How does the aerospace industry view the development of alternative energy and fuel sources? How are these innovative sources impacting the development of new products?

2. How does the need for new and advanced materials, technologies and products complement—or compete with—energy efficiency and product development?

3. Does the current regulatory structure enable the U.S. to innovate and compete with Russia, Europe and the rest of the world? If not, what types of policies are needed to spur innovation?

4. What roles should government and the private sector play in terms of funding the research and development needed to accelerate American leadership in the aerospace sector vis-à-vis our global competitors?

5. How can we ensure universities attract and retain the talent needed to excel in this evolving sector?

6. Smart manufacturing and the greater use of sensors has been raised at previous discussions. How might this apply to the aerospace sector?

7. How do cybersecurity, defense and other new-age issues impact knowledge sharing and innovation in the aerospace sector?

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[3] https://www.faa.gov/about/office_org/headquarters_offices/ast/media/FAA_YIR_2014_02-25-2015.pdf

The EMCP Methodology

Energy and manufacturing are inextricably linked with America's new found energy abundance creating a window of opportunity for the nation. How this opportunity manifests across different sectors of the economy is the central question of the EMCP. For each sector study, the EMCP will explore four cross-cutting pillars—technology, talent, investment and infrastructure—with the end goal being to find commonalities across sectors as well as key differences or even policy conflicts.

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