

Testimony of George Whitesides  
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Subcommittee on Space, Science, and Competitiveness  
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Chairman Cruz, Ranking Member Markey, and Members of the Subcommittee, thank you for giving me the opportunity to provide testimony for your hearing on “Reopening the American Frontier” I am here representing Virgin Orbit, Virgin Galactic, and The Spaceship Company. I will provide an overview of our current activities and our thoughts on the present and future environment for commercial space operations in the U.S.

I am the CEO of Galactic Ventures and in this role, I am responsible for guiding all aspects of building the world’s first commercial spaceline which includes both our human spaceflight program as well as our small satellite launch capability. Galactic Ventures has three privately-funded commercial space companies within its portfolio:

- Virgin Galactic, which will operate a suborbital spacecraft for the purpose of space tourism and research
- The Spaceship Company, which designs, manufactures and tests our suborbital human spaceflight system
- Virgin Orbit, which is developing, and manufacturing a dedicated, small launch platform for satellites which they will also operate

Three separate companies, but one shared vision for providing frequent, reliable and safe access to space for all. In the past few years, our companies have collectively grown from a handful of employees to providing roughly 1000 direct jobs, and supporting another 1000 indirect jobs in the aerospace sector.

Thank you for holding this important hearing about the U.S.’s role in exploring the next important frontier. The U.S. has always been a global leader in space. In part because Congress has worked diligently to create a regulatory and policy environment that is supportive of commercial space companies. The United States is, quite literally, undergoing a renaissance in space science and technology. New companies are introducing satellites technologies that allow for increased capabilities in smaller, more affordable, packages. A new, globally competitive domestic launch industry is looking to make space transportation more frequent, reliable, and safe. This new marketplace even reaches beyond the confines of our planet and serious ideas are in development to better link private sector energies with the NASA exploration vision. This industry is not only important for our future in space, but it is contributing to high-tech jobs and inspiring a new generation of scientists, engineers, and entrepreneurs in our country today.

In my written remarks, I will go over some key issues that are currently contributing to our leadership in space, as well as those that still need to be addressed such as:

- The current regulatory environment for our industry that prioritizes safety without over-reach, including:
  - The continued need to regulate based on data rather than analysis.
  - The need for a permanent indemnification regime for launch competitiveness overseas.
  - Streamlining the licensing of hybrid vehicles – those that include elements of both aircraft and spacecraft – and their operations.

- The need for legal clarity for informed consent through the requirement of cross-waivers.
- The continued need to mature and expand our concept of public private partnerships to ensure that commercial space sector plays a pivotal role in both civil and national security programs.
- Continued support for Government policy that restricts the use of ICBMs for commercial purposes. Allowing ICBMs into the commercial marketplace will irreparably damage an emerging domestic launch sector.
- Support for the Ex-Im bank and other policies such as export control reform that will keep the commercial space sector a global leader in space transportation and applications.

### Virgin Galactic

Virgin Galactic is at the forefront of an important emerging market that is developing suborbital spaceflight experiences for humans, commonly referred to as “space tourism,” as well as for research payloads. Founded by Sir Richard Branson and based in Mojave, California, we are opening access to space to change the world for good. Virgin Galactic’s voyages will allow people to experience true microgravity, and to see the Earth from space. In addition, Virgin Galactic will also provide access to the microgravity environment for research, education and other industrial applications to develop and test new applications.

Based on the historic SpaceShipOne vehicle built by Scaled Composites—which safely carried human beings into space in 2004, claiming the Ansari X PRIZE and becoming the only privately-operated human spaceflight vehicle to do so to date—Virgin Galactic’s vehicles have been designed with the intention of opening up frequent access to space while setting new standards for safety, frequency, flexibility, and cost. Our suborbital spaceflight system consists of two vehicles: WhiteKnightTwo (pictured in *Figure 1* below) is a four-engine, dual-fuselage jet aircraft capable of high-altitude heavy lift missions, including but not limited to fulfilling its role as a mothership for SpaceShipTwo (shown in *Figure 2*), a suborbital spaceplane designed to safely and routinely transport people and payloads to space and back. SpaceShipTwo will carry two pilots and as many as six spaceflight participants or about 1000 pounds of science and technology payloads to space altitudes, where they will have exposure to 3-4 minutes of a high-quality microgravity environment.



**Figure 1: WhiteKnightTwo Carrier Aircraft, VMS EVE**



**Figure 2: SpaceShipTwo, VSS Unity manufactured by The Spaceship Company**

The current SpaceShipTwo, named the *VSS Unity*, is currently undergoing flight test, and was manufactured in Mojave, California by Virgin Galactic's manufacturing wing, The Spaceship Company. Commercial operations will be based in New Mexico at Spaceport America, the world's first purpose-built commercial spaceport.



**Figure 3: WhiteKnightTwo and SpaceShipTwo in their mated configuration during a test flight in March 2017**

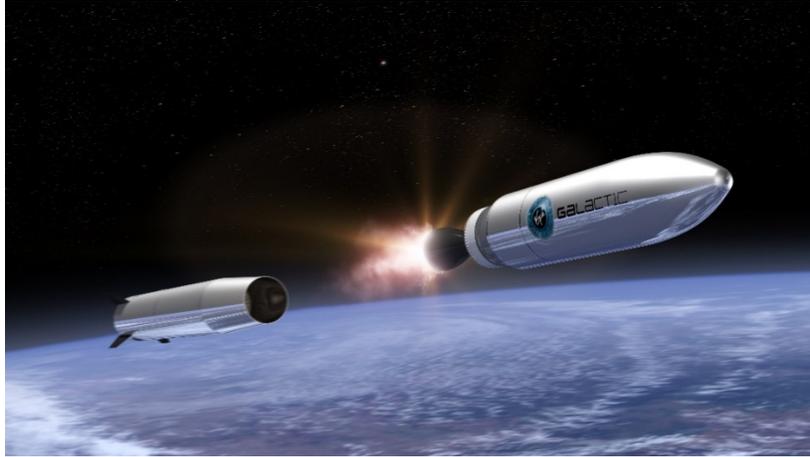
### The Spaceship Company

Virgin Galactic's manufacturing wing is The Spaceship Company, which is made up of an experienced team that designs, manufactures, tests and supports unique and innovative aerospace vehicles. They offer an extensive set of capabilities through the full lifecycle of high and unique performance vehicles through preliminary vehicle design, manufacturing, ground testing, propulsion, flight testing and post-delivery support. They manufacture the fleet of SpaceShipTwos and WhiteKnightTwos for Virgin Galactic, and are currently flight testing VSS Unity.

### Virgin Orbit

In addition to human spaceflight, Virgin Galactic's sister company, Virgin Orbit, will provide dedicated, responsive, and affordable launch services for small satellites. Today, hundreds of companies around the world are developing small satellites for everything from communications to remote sensing applications. To help this small satellite revolution, Virgin Orbit is developing LauncherOne, a flexible launch service for commercial and government-built satellites. The LauncherOne platform is dedicated to the task of lowering the cost and increasing the frequency of space access for payloads in the 150 kg – 500 kg weight range.

LauncherOne (shown in **Figure 4**) is a two stage, liquid propulsion (LOX/RP) rocket launched from a carrier aircraft. The carrier aircraft is a modified 747-400 (shown in **Figure 5**) that will carry the launch vehicle under the port side wing between the fuselage and inboard engine to the appropriate altitude before launch. Once released from the carrier aircraft, LauncherOne will fire its single main stage engine, a 73,500 lbf, LOX/RP-1 rocket engine. After stage separation, the single upper stage engine, a 5,000 lbf LOX/RP-1 rocket engine will carry the satellite (or satellites) into orbit. At the end of this sequence, LauncherOne will deploy our customers' satellites into their desired orbit.



**Figure 4: LauncherOne vehicle**



**Figure 5: Modified Boeing 787-400 carrying the LauncherOne rocket**

Currently, Virgin Orbit is working towards initial test flights of the LauncherOne system. Virgin Orbit will operate LauncherOne under a FAA AST license and will initially launch from Mojave Air & Space Port, but will eventually operate from other licensed sites.

### [The Regulatory Environment](#)

Virgin Galactic, The Spaceship Company, and Virgin Orbit are a part of a robust and growing domestic commercial space industry. This U.S.-based space sector is made up of companies with private financial backing working on a myriad of missions from rocket launch, human spaceflight, satellite constellations, to beyond Low-Earth Orbit (LEO) operations such as asteroid mining, lunar landers, and in-space habitats. The commercial space industry is well underway and poised to continue its growth.

The Commercial Space Launch Act as amended and re-codified at 51 U.S.C. Ch. 509, §§ 50901-23, authorizes the Department of Transportation, and by delegations the Federal Aviation Administration's office of Commercial Spaceflight (AST), to oversee, authorize, and regulate commercial launch and reentry vehicles. FAA AST's regulatory authority over commercial launch and reentry is expansive when it comes

to protecting public safety, national security and U.S. foreign policy interests, but is limited outside of those areas. This is significantly different than how the FAA regulates aviation activities today. However, this regulatory approach is necessary to encourage the emerging commercial space industry while prioritizing the safety of the uninvolved public. Recognizing the importance of these principles for the development of the commercial space industry, we applaud Congress for reaffirming them in the Commercial Space Launch Competitiveness Act of 2015.

As we look to the future, Congress has an opportunity to build on the success of the Commercial Space Launch Competitiveness Act (CSLCA) in several areas:

#### *The Regulatory Learning Period*

Congress has long recognized that the commercial spaceflight industry is too dynamic and too early in its development cycle for the kind of full-scale regulation that characterizes air travel. Congress also recognized that it is impossible for regulators to know enough yet, about how to regulate a group of vehicles as diverse and innovative as our industry is developing. The solution was to create a statutory regulatory learning period, during which AST may regulate for the safety of the uninvolved public, or in response to an incident, but not prospectively otherwise.

This learning period was initially enacted in 2004 to allow the commercial space industry to create a sufficient database of knowledge on which to base future commercial space regulations. However, due to technical and economic challenges and industry's emphasis on safety, commercial space companies did not progress as quickly as was once envisioned. Congress correctly acknowledged that the learning period had not yet accomplished its intended purpose and extended the learning period to 2023 in the CSLCA. The learning period gives AST the opportunity to collaborate with industry so that both AST and industry better understand how to operate safely. The learning period also enables commercial spaceflight companies to innovate for safety more quickly than they could if regulations were in place. Any update of CSLCA should maintain the learning period.

#### *Indemnification*

Since 1988, U.S. law has included a third-party risk-sharing regime for FAA-licensed commercial space launches and reentries that allows U.S. companies to compete more effectively with their foreign competitors. Passed by multiple Congresses, this "indemnification" regime requires companies to buy commercial insurance or demonstrate available financial resources to cover any third-party damages up to the Maximum Probable Loss, which is calculated by the FAA pursuant to federal regulation (and which is calculated to be exceeded in only one in a million launches). In exchange, the Secretary of Transportation commits to seek funds to pay third-party claims above that level, up to a statutory cap –which would require another separate action by Congress. However, no claim to date has ever been triggered. Without these means of limiting catastrophic risk, both the industry and the federal government would be subject to significant legal risk. The CSLCA extended indemnification to 2025. We encourage this Subcommittee to study and consider a permanent indemnification regime for the U.S. launch industry. The Congressional Budget Office has scored indemnification as no cost to the government. The government receives the benefit of indemnification for all claims up to the Maximum Probable Loss.

The current regulatory regime should continuously adapt as the industry continues to grow and deploy new technologies. While we appreciate and applaud Congress' tremendous efforts on the CSLCA of 2015, there are still outstanding regulatory issues facing our industry today – such as:

#### *Cross-waivers*

Under the Commercial Space Launch Amendments Act (CSLAA), Commercial human spaceflight operators operate under an informed consent regime, requiring them to inform spaceflight participants of

the inherent risks of space flight and the specific safety record of the vehicle type for their flight. In general, spaceflight participants must state in writing that they understand that the U.S. Government has not certified the space launch or reentry vehicle as safe and they must be informed of the risks of the vehicle they are boarding. Six states, each home to existing or proposed spaceports, have passed varying levels of informed consent requirements to protect vehicle operators from claims from spaceflight participants. All state laws exclude injuries sustained by spaceflight participants that are the result of gross negligence or intentional misconduct. While these statutes all require that a licensee obtain informed consent from each spaceflight participant, state courts have yet to discuss and interpret the application of this statute to their current body of law. As a result, it is possible that different jurisdictions will arrive at different interpretations of these rules.

This lack of legal consistency between the CSLAA and local state law could undercut the federal statutory mandate to promote the health of the commercial space transportation industry. To encourage the successful growth of the U.S. commercial spaceflight industry, and its operators, manufacturers, and suppliers, Congress should implement a predictable and consistent national legal environment.

#### *Streamlining Hybrid Regulations*

Virgin Galactic and Virgin Orbit's vehicles form a hybrid launch system involving both an aircraft and a rocket-powered vehicle. WhiteKnightTwo operates under an Experimental Airworthiness Certificate (EAC) issued by FAA's office of Aviation Safety (AVS). When the WK2/SS2 vehicle pair perform test flights where SS2's rocket motor is not used, the pair operates under an EAC. However, if the vehicle pair takes flight with the intention of lighting the rocket motor, they operate under an AST Operator's License. Virgin Galactic received its Operator's License for SpaceShipTwo from FAA AST in July of 2016. The license was the culmination of years of interaction with the AST and required in-depth reviews of the vehicle's system design, safety and flight trajectory. Both AVS and AST have tremendous expertise in their respective fields and in our case, have been willing to work with us to meet our flight test schedule. However, while looking to the future as more vehicles and flights come online, streamlining the regulatory environment for hybrid vehicles – in a manner that keeps pace with the industry's rapid tech advancement without overly complex procedures – would be a welcome improvement to the current process.

#### *Space Support Vehicles*

Operating WK2 and SS2 under the EAC for certain flight operations restricts use of the vehicles to flights not for-hire. WhiteKnightTwo's primary purpose is to enable the launch of SpaceShipTwo. However, due to the capabilities of WK2, there has been interest in using the aircraft for spaceflight participant training purposes, and for research payloads as WK2's ceiling is higher than most commercial aircraft. We are currently unable to do those types of commercial activities without filing for a waiver. We recommend Congress address the issue of the use of "Space Support Vehicles" for hire either through streamlining the licensing for these types of vehicles or implementing new regulatory guidelines.

#### *AST/ATO Coordination/Commercial Space Integration into the Air Space*

We represent only two of several different commercial space launch vehicles operating today and while all are different, commercial space operations are not currently a large user of the NAS. Furthermore, because both their speed and their direction of flight are so different from aircraft, rockets and spaceplanes typically occupy the NAS for only a few minutes or even seconds per flight, rather than lingering or passing through the airspace for hours at a time. However, as the industry's launch cadence increases, it drives the need for efficient and streamlined processes for continued seamless integration into the airspace. For example, as part of the AST license issuance, Virgin Galactic coordinated with the FAA Air Traffic Organization (ATO) and the local Air Traffic Control (ATC) to receive Letters of Agreement (LOA) to define operations in the national airspace. The current process used to get a LOA is lengthy and requires conversations with multiple elements within the FAA. A much more streamlined process should be in place for future operations.

The number of commercial launches has been increasing over the past few years and will continue to do so in the years ahead as the industry continues to grow. This drives the need for an efficient, defined process as well as technical tools, like the Space Data Integrator Prototype being developed by the FAA's Tech Center. The Space Data Integrator, when fully developed, will automate the current manual processes used by the FAA to monitor launch and reentry operations and will be able to respond to off-nominal scenarios to ensure the safety of the National Airspace System (NAS). Automated data flow also provides opportunities for more dynamic and efficient airspace management.

The CSLAA built the foundation for a regulatory regime that protects public safety while allowing for rapid innovation and continuous improvements in the launch vehicle industry. The legislation correctly recognized that regulatory uncertainty or over-reach can strangle the American commercial space business. As industry continues to grow, the regulatory environment must allow for continuous improvements and innovations as well. However, to effectively do so, AST needs sufficient resources to support increased commercial space launch activity as well as incorporate next-gen technologies for ever increasing safety of operations. Virgin looks forward to continuing our work with the FAA to keep the skies ever safer while reaching new heights for commercial space operations.

#### [Public Private Partnerships/Use of Commercial Services](#)

As the Government seeks to develop new and innovative space capabilities, whether for civil or defense purposes, it should encourage partnership with the commercial space sector through firm-fixed price contracts and efficient acquisition strategies. The success of public private partnerships was recently exemplified through the achievement of NASA's Commercial Cargo Resupply Program. Public private partnerships and the use of commercial services will be key in furthering our space exploration program to reach new destinations.

The Government should refrain from using taxpayer dollars to fund programs that directly compete with commercially available or emerging services. In fact, in a tight budgetary environment, the U.S. government should strive to use commercial services wherever possible. NASA is already doing this in its programs such as the Flight Opportunities Program that purchases capacity on commercial reusable suborbital vehicles for technology development and research payloads, as well as its Venture Class Launch Services program that uses commercial small launchers to place cubesats in orbit to conduct research for the Science Mission Directorate in which Virgin Orbit was awarded a launch. This allows the government to leverage already invested private sector capital to meet their agency goals while supporting the U.S space industrial base. We strongly support both programs.

However, current acquisition processes and requirements are seen by the commercial space sector as contributing to increased costs, extended mission timelines and reduced capability due to heavy requirements that prefer reducing risk at all cost. The Government should review and revise acquisition processes for commercial services with an emphasis on rapid procurement of innovative capabilities for both civil and national security purposes.

#### [Damaging Impact of Potential Commercial ICBM Use](#)

Finally, to continue the growth of U.S. domestic launch capability, the Government should maintain its longstanding policy forbidding the commercial use of excess ICBM assets. Releasing ICBMs for use as commercial launch vehicles would have an adverse impact on the U.S. launch industrial base and would undermine national security and civil space objectives. Since multiple, new, privately developed vehicles will be entering the marketplace over the next two years, there is no reason to change this longstanding policy.

## International Competitiveness

Financing from export credit agencies is often a critical competitive factor in international satellite sales and launch service deals. Many countries that are active in the global launch and satellite marketplace offer this kind of financing in some capacity. In 2014, financing support for the space industry started becoming the fastest-growing sector at the Export-Import Bank of the United States (Ex-Im). Ex-Im helped to level the international playing field for U.S. companies, and the Bank's prudent lending practices have led it to consistently be a net positive contributor to the U.S. Treasury. However, since July of 2015, the Ex-Im bank has been unavailable to U.S. exporters due to delayed congressional reauthorization and currently, vacancies on the Bank's Board of Directors. International competitors have access to credit that U.S. companies do not without the Ex-Im bank, which essentially tips the playing field in favor of our foreign competitors to the detriment of the U.S. space industrial base.

Finally, I would be remiss if I did not mention the importance that export control, and more importantly, export control reform, has on our competitiveness overseas. The commercial spaceflight industry recognizes the important national security interests at stake, but overly restrictive export control regulations can obstruct an industry from capturing global market share while failing to prevent proliferation. As technologies continue to develop and enter the commercial marketplace, the International Traffic in Arms Regulations must be reviewed and updated to adequately control the flow of technology and information without stifling American innovation or business. This includes modernizing the Missile Control Technology Regime regulations to accommodate 21st century space systems such as commercial space tourism.

Our companies are dedicated to providing frequent, reliable, and safe transportation to space for humans and payloads. Our vehicles, along with other commercial space companies working to provide services in LEO and beyond will continue to push Earth's economic sphere outward. This Subcommittee is helping to ensure that the United States continues to play a leading role in exploring and democratizing the next great frontier. We look forward to working with you on these and future issues.