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‘God has no intention of setting a limit to the efforts of man to conquer space.’
- Pope Pius XII, 1876-1958
The dawning space economy

Governments and private companies are going all-out in what amounts to a new space race, and this region has a foot in both worlds.

Sometime next year at a site in South Mississippi, four RS-25 engines and the core stage of NASA's Space Launch System will roar to life in a teeth-rattling spectacle during a static test at the historic B-2 test stand.

With a combined 2 million pounds of thrust, the engine core test at Stennis Space Center (SSC) will be loud, a testament to the power being held in place at the stand and the blast coming out of the trench. For old timers, it will bring back memories of the Saturn V tests during the Apollo era.

But the event also will underscore the importance of the I-10 region's space-related activities. The RS-25 engines all were tested at SSC, and the core stage was built at Michoud Assembly Facility (MAF), some 40 miles to the southwest.

As impressive as it will be, the test is just one event in dynamic new 21st century space age, where government and commercial players are all vying for a piece of the action. And there’s plenty of that, from launch services to satellite production, and from space tourism to building space habitats.

For established space companies there’s money to be made, and for start-ups there are opportunities to find a niche activity that could be the start of something big.

Goldman Sachs, in its Profiles in Innovation series, recently highlighted the state of the industry, calling space the “next investment frontier.”

“Rocket launches are being privatized, the most ambitious satellite constellation ever is being deployed, man is looking back at the Moon and Mars, and militaries are vying for the ultimate high ground,” the report said, adding, “technological advances and necessity are creating a wave of opportunity as business and governments invest in a new Space Economy.”

What is clear to anyone following the space industry is that it’s in a state of transition with more players worldwide coming aboard. The industry operates at the cutting edge and requires a highly skilled, highly trained workforce to build, launch, and utilize space assets. It’s a field any region would love to have.

And this region has a huge foot in the door. The Gulf Coast is in the exclusive club of locations with NASA centers. SSC is where NASA has tested large rocket engines since the

Chapter highlights

- Gulf Coast is part of an exclusive club of areas with NASA centers
- Stennis Space Center most capable of four NASA sites that test rocket engines
- Michoud Assembly Facility building Orion and core for Space Launch System
- Stennis Space Center testing two engine types for Space Launch System
- Eglin home to a powerful space observation radar

Photo page 33: Artist’s illustration of NASA’s Space Launch System, designed to take astronauts into deep-space.
1960s, and MAF in New Orleans is where huge aerostructures have been built just as long.

Both SSC and MAF have roles in the current NASA deep-space program, the Space Launch System (SLS), designed to send astronauts farther into space than ever before. SSC is where the SLS launch vehicle engines, the RS-25, and the currently mothballed J-2X are tested. MAF is where the four-engine launch vehicle core stages are being built. It’s also where the Orion crew capsule is assembled.

In addition, both facilities are involved in commercial space ventures, a field that was supercharged during the Obama administration and the push to have private companies take over low-orbit resupply missions. SSC tests three types of commercial rocket engines, and MAF is where the composite structure for a winged commercial space vehicle is built.

Having a stake in both the federal and commercial sides of the multibillion-dollar space enterprise bodes well for the region. While NASA’s programs rely on funding provided by Congress, the commercial field is more open-ended and can venture into activities that are not necessarily on NASA’s agenda. It can include everything from traditional satellite launches to the still-developing space tourism industry. On top of all that, both SSC and MAF are actively courting commercial ventures to take advantage of under-utilized NASA facilities.

“Considering the advancements in commercial efforts in space travel and space-related services, NASA Stennis Space Center has capacity to support those efforts - like the rocket engine test stands and engine component test facilities,” said Robbie Ingram, executive director of the Mississippi Enterprise for Technology, the incubator and technology transfer office at SSC.

“Mechanisms exist to allow commercial space enterprises access to that same infrastructure so these type facilities do not have to be replicated,” he said.

**NASA and the South**

The South’s love of space flight goes back to the early 60s, when President Kennedy issued a challenge to beat the Soviets and get a man on the moon before the end of the 1960s. Newly established NASA launched a program to establish manufacturing, test and launch facilities needed to get there, and the South was the big winner.¹

It became the home to key NASA facilities because of the availability of large tracts of land and interconnected waterways needed to transport large space vehicles. Longer periods of fair weather flying, the same thing that attracted the military, also played a role. In addition, powerful, senior Southern politicians recognized the economic benefit the space program would bring.²

Huntsville, Ala., Houston, Cape Canaveral, Fla., Bay St. Louis, Miss., and New Orleans formed the “Space Crescent” in the South. In “Way Station to Space,” Mack R. Herring cited a story in the July 20, 1964 issue of *U.S. News & World Report* that described the space program as a new industry in the South worth “billions.” Money for facilities was being spent at the rate of “one-million dollars every two hours.”

That the South benefited when NASA dominated the space program is clear. What is less certain is how well the South will do in an age
Indeed, the U.S. military now sees it as a possible area of contention. In a strategic shift, the Air Force is no longer treating space as a benign domain used to monitor, senses and report, but instead as a warfighting domain where it would fight, should war start or extend into space.³

“It’s obvious, but it’s probably worth repeating, that the U.S. is heavily dependent on space, and (our adversaries) know it is a vulnerability,” said Air Force Secretary Heather Wilson during a May 17, 2017 Senate subcommittee hearing. “In any conflict, space will be contested – and we haven’t always assumed that in the past. There’s been a change in culture – a change in planning and training going on in the United States military because we cannot take space dominance for granted.”⁴

More than 80 percent of the Defense Department’s space actions are handled by the Air Force, and the service views space as one of its core missions. “We have to acquire at a pace that allows us to be faster than our adversaries who are all investing in ways to take away our advantage,” said Air Force Chief of Staff Gen. David L. Goldfein during the Senate subcommittee hearing.⁵

There’s already a lot of money involved in the field. In 2015, the global space economy totaled $323 billion, according to The Space Foundation’s The Space Report 2016. That’s down from $329 billion in 2014, due in part to the strengthening dollar, meaning that non-U.S. government budgets and industry revenues appeared smaller even though most experienced growth in their own currencies.

With a total of $246 billion, commercial space activities made up 76 percent of the global space economy. The U.S. government spent $45 billion on defense and non-defense space efforts in 2015, a 3 percent increase from 2014. Non-U.S. government space investment declined by 14 percent in dollar terms, primarily due to exchange rates, to a total of $32 billion in 2015. In reality, most countries increased their budgets for space activities, according to the report.
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The 2016 State of the Satellite Industry Report by the Satellite Industry Association said satellite services revenues increased by four percent globally from 2014 to 2015, reaching $127.4 billion, powered by continued growth in consumer satellite television, satellite broadband and Earth observation services. In addition, satellite manufacturing revenues, reflecting the value of satellites launched in 2015, grew by four percent worldwide to $16.6 billion. There were orders for 17 commercial GEO satellites with 11 orders won by U.S. manufacturers for a domestic market share of 65 percent, up from 57 percent in 2014.

The U.S. has the biggest budget for space exploration, spending over six times more than China, according to Organization for Economic Cooperation and Development figures for 2013. From the first moon landing to the International Space Station, the U.S. government agency NASA has been leading space exploration since its creation in 1958.

According to the Futron Space Competitive Index of 2014, the United States remains the leader in space competitiveness, but is the only nation to decline for seven straight years. As other countries enhance their space capabilities while the U.S. undergoes uncertain transitions, it should not view its unique space agenda-setting power as guaranteed, the report said.

Commercial space

The space race today involves private companies and regions that hope to get a piece of the multibillion-dollar action. And a lot of new players are entering the lucrative field. According to the Goldman Sachs report, $13.3 billion is the total investment in space start-ups since 2000, heavily weighted towards the last 10 years.

The Aerospace Industries Association estimated in 2013 that space was a $45.6 billion enterprise within the then-$223.55 billion aerospace industry. The missile product group accounts for another $21.84 billion in sales during that year.

The Federal Aviation Administration said 21 percent of orbital launch attempts in 2011 were commercial, earning revenue of $1.9 billion.

According to the FAA’s Annual Compendium of Commercial Space Transportation 2016, the size of the global space industry, which combines satellite services (GNSS) and ground equipment, government space budgets, and global navigation satellite services equipment, is estimated to be about $324 billion.

At $95 billion in revenues, or about 29 percent, satellite television represents the largest segment of activity. Following this is government space budgets at $76 billion, or 24 percent,
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and services enabled by GNSS represent, about $76 billion in revenues.

Commercial satellite remote sensing companies generated $1.6 billion in revenues, but the value added services enabled by these companies is believed to be magnitudes larger. Because remote sensing value added services includes imagery and data analytics from other sources beyond space-based platforms, only the satellite remote sensing component is included in the global space industry total.

Global launch services is estimated to account for $6 billion of the $324 billion total.

In 2015, there were a total of 86 orbital launches conducted by service providers in seven countries. Since 2014, U.S. providers have begun to cut into the existing share of commercial launches occupied by Russian providers due to a variety of factors, including the entry of SpaceX into the field and the launch failures that have plagued the Russian space industry. In the meantime, Europe’s Arianespace remains a steadfast provider, according to the FAA.

Commercial interests have, of course, been involved in the federal space program from day one. NASA needed the companies to develop systems, and in many cases those companies established operations close to NASA centers to be near the customer. That’s one reason NASA centers are economic engines.

But in the new age, NASA might wind up being simply one customer. Space flight companies are cropping up in multiple places nationwide, including Washington and Colorado. Still, the South has some of the most unique capabilities in the world that can be a lure for the new breed. SSC, for instance, is the most capable of NASA’s sites where rocket engines are tested, the last place in the country where NASA can test full-scale engines or whole rocket stages 24/7.

The industry, whether a huge aerospace company that’s worked in the field for years or one of the startups backed by the deep pockets of billionaires, still needs the same things NASA has built up over 60 years. For some companies it makes sense to tap into what’s already available through NASA.

Finding new uses

It was big news when a NASA facility at Kennedy Space Center that faced an uncertain future with the end of the Space Shuttle program got a new lease on life when Boeing decided to use it to build the company’s CST-100. Space Florida, an aerospace economic development agency, took over the Space Shuttle Main Engine Processing Facility and Processing Control Center and is leasing it to Boeing to build its Crew Space Transportation spacecraft.

A writer in a Time magazine story likened the lease to an aristocrat selling off parts of the family estate. But Florida officials saw it as a chance to attract the commercial space flight industry.

Both SSC and MAF have excess capacity that can be offered to private companies. And with space flight costs so high, that could provide a savings hard to pass up. In addition to idle facilities, SSC and MAF both have thousands of acres available for development.

Patrick Scheuermann, former director of Stingis Space Center, once pointed out that there are a lot of companies with great ideas that are in
the laboratory or subscale version. Success with those smaller versions will force them to make an investment in their own back yard or search for a location to test the larger scale.

“Rather than them duplicating infrastructure somewhere or putting their capital dollars somewhere, they’re basically using resources that the taxpayers already paid for once,” Scheuermann said in 2011 when still at SSC.

SSC has been looking for a company interested in partnering with NASA or leasing the E-4 site originally designed to test propulsion systems for a now-defunct program. E-4 has concrete-walled test cells and hard stand, a high-bay work area with a bridge crane and adjacent work area, control room space and personnel offices, as well as road and barge canal access.

Work on E-4 was never finished, but NASA says it could be expanded to include Ram Air test capability to support the testing of power packs and engine systems up to 500,000 lbf thrust. Priority will be given to users that support space exploration for the government or those involved in commercial space.

While it may be uncomfortable seeing parts of the family estate being “sold,” it’s far better having them used by commercial companies than sitting around collecting dust.

Southern politicians realized long ago that the nation’s space activities would be crucial to developing the South. And that has proven to be true. According to The Space Report 2016, the global space industry appears to be going through a period of “reinvention.”

“Efforts to reuse launch vehicles are beginning to bear fruit, and more efficient launch vehicles are being designed and developed, all of which may help to bring launch costs down. The satellite industry is seeing rapid growth in the number of small satellites, as vast constellations consisting of hundreds of satellites for Earth observation and telecommunications are being ordered and built. Large satellites are taking advantage of more efficient propulsion systems that may help increase their usable lifespan. These are but a few examples of how the industry is making space more affordable and consequently more accessible to a broad swath of public agencies, industries, and individuals.”

If that’s not a field with growth potential, it’s hard to know what is.

- David Tortorano

2 Herring, citing Swenson, p. 388
3 “Senior leaders discuss US space posture,” AFNS report in Space War, May 19, 2017
4 ibid.
5 ibid.
Profile: John C. Stennis Space Center

John C. Stennis Space Center, north of Interstate 10 in South Mississippi, is a 14,000-acre secure complex surrounded by a unique 125,000-acre heavily wooded buffer zone.

It’s where some of the most powerful rocket engines in the world have been tested, including 27 first- and second-stage boosters for the Saturn V. In 2008 the American Institute of Aeronautics and Astronautics named SSC an historic aerospace site.

Today SSC, which has more than $2 billion in assets, provides test services for NASA, the Department of Defense and the commercial sector. It’s home to NASA’s Rocket Propulsion Test Program, which manages all the agency’s propulsion test facilities.

Over the years, SSC’s activities expanded to include other organizations that set up shop. It now has more than 40 resident agencies and over 5,000 employees. SSC has hundreds of scientists and technicians working in fields as varied as propulsion, geospatial technologies and underwater research. It has the world’s largest concentrations of oceanographers.

The largest tenant is the Navy, which operates its oceanographic research community from SSC as well as one of the world’s largest supercomputers. It’s also the location of the National Data Buoy Center and NASA Shared Services Center. SSC also has data centers, geospatial and earth sciences work and activities of five universities and one community college. It’s also the location of several university cooperative programs.

It’s also a manufacturing center, where Lockheed Martin builds satellite components and Aerojet Rocketdyne assembles RS-68, AR1 and in the future AR-22 engines.

SSC is close to three interstates and two commercial and one general aviation airports, and has access to water and rail transportation.

SSC is one of just four NASA facilities that can test large rocket engines. A former director once pointed out that there’s no other place in
the United States where the government or commercial companies can test 24 hours a day, seven days a week, 365 days a year with no fear of encroachment on surrounding communities.

SSC can test everything from engine components to full-scale engines and rocket stages at its vertical firing A-1 and A-2 test stands, the duel position, vertical-firing B-1/B-2 test stand and three-stand E complex, which includes seven separate cells capable of various tests activities. The stands can be used for both acceptance and developmental testing.

The 300-foot-tall A-3 test stand will let engineers simulate conditions at altitudes up to 100,000 feet. SSC will be the only facility in the country capable of testing J-2X engines fully in simulated high-altitude conditions.

SSC tests two engines that will be used in NASA’s Space Launch System: the J-2X, which will power the upper stage, and the lower stage’s RS-25. But SSC is also involved in commercial test programs.

The Aerojet Rocketdyne RS-68 is tested on the B-1/B-2 stand for United Launch Alliance’s Delta IV, and the Aerojet AJ26 was tested for Orbital Science Corp. on the E-1 stand until Orbital dropped the engine in the wake of a malfunction on the launch pad. Blue Origin’s BE-3 engine thrust chamber assembly, the engine’s combustion chamber and nozzle, is also tested on the E-1 Test Stand.

In 2010, officials at Stennis Space Center identified 3,900 acres along existing roadways with existing utilities as prime locations for aerospace companies. Called the Stennis Space Center Technology Park, the site already has Lockheed Martin, Aerojet Rocketdyne, and Rolls-Royce North America, which tests its largest commercial jet engines at an outdoor facility.

SSC also has additional acreage that could be put on the table in the future. In addition, just outside SSC there are other efforts to provide acreage to aerospace and technology companies. The similarly named, privately owned Stennis Technology Park, near Stennis International Airport, is 100 acres but has another 900 to develop.
Profile: Michoud Assembly Facility

Some 40 miles to the southwest of SSC in an area known as New Orleans East is the massive Michoud Assembly Facility. It’s one of the world’s largest manufacturing facilities, with 43 acres under one roof.

Originally established in 1940 to built plywood cargo planes and landing craft for the military, it became part of NASA in 1961 because the agency needed a plant that could manufacture large aerospace structures, and ship them out aboard barges.

MAF is one of the few manufacturing facilities owned by NASA. Traditionally one of the largest employers in Louisiana, the numbers dropped with the end of the Space Shuttle program, but are slowly recovering.

MAF sits on an 832-acre site and has a port with deepwater access. Manufacturing capabilities include 2.2 million square feet of manufacturing space with high bay areas, full complement of plant equipment, tooling and skills. Testing capabilities, component and full scale, include hydrostatic and load testing.

Michoud was used to make the first stage of the massive Saturn V rockets, and later built all the external fuel tanks for the Space Shuttle program. That work ended in 2010 with the end of the Space Shuttle program.

NASA chose MAF as the site where the next generation of space vehicles for the Constellation program would be built. The plan was to give MAF a multifaceted mission: manufacturer of the upper stage of the Ares I launch vehicle, components of the Orion crew vehicle and stages of the heavy lift Ares V launch vehicle.

When the Constellation program was killed by the Obama administration and work shifted to commercial companies, NASA replaced Constellation with a program to build a heavy-launch system and crew vehicle to take astronauts to deep space. Michoud was chosen to assemble portions of the Space Launch System, as well as the Orion crew capsule.

Even before Constellation was killed, MAF had excess space and was working on a business model that involved attracting other public and private entities, as SSC did years earlier.

MAF already has several federal agencies, including the Department of Agriculture’s National Finance Center, the Defense Department’s Contract audit agency and Defense Contract Management Agency and the U.S. Coast Guard Integrated Support Command.

While MAF is heavily involved in NASA programs, there’s also room for commercial space activities. At MAF, Lockheed Martin assembled for Sierra Nevada the composite structure for the first space-bound Dream Chaser vehicle.

Michoud’s is for advanced manufacturing businesses, aerospace or otherwise. It has more than a million square feet of space in a self-contained facility equipped with established infrastructure.
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and services. Louisiana’s low-cost manufacturing environment, regional transportation network and experienced regional workforce add to the site’s attributes.

One of Michoud’s key assets is the National Center for Advanced Manufacturing, a partnership dating to 1999 that involves NASA, the state, academia and industries. Louisiana committed $20 million through the University of New Orleans on key pieces of equipment, including welding machines.

At Michoud Assembly Facility, one of the little-publicized ideas is NASA’s interest in using the under-utilized acreage around MAF for an advanced manufacturing research park. As far back as 2008 the former transition chief first mentioned the idea, saying the acreage could form the nucleus of something along the lines of Cummings. The agency said as recently as 2010 that it’s still interested.

- David Tortorano

Profile: Eglin’s Site C-6

The U.S. Air Force has been keeping its eye on space for the past 40 years from a remote location in the eastern portion of the Eglin Air Force Base complex.

Some 35 miles east of the main gate is an area called Site C-6, home to one of the most powerful phased array radar systems in the world. The site has a 13-story structure with 250,000 square feet of floor space and keeps an eye on man-made objects in near and deep space around the clock.

The 20th Space Control Squadron tracks more than 16,000 near-Earth and deep-space objects. The squadron is under the 21st Space Wing, Peterson Air Force Base, Colo.

The 20th operates the AN/FPS-85 Phased Array Radar, the only phased array radar dedicated to tracking near-Earth and deep-space objects. It’s one of 29 sensors that comprise the global Space Surveillance Network (SSN).

It collects more than 16 million observations each year, 30 percent of the SSN’s workload. Phased array allows near simultaneous tracking of multiple targets in the area of coverage. The AN/FPS-85 can detect, track and identify up to 200 satellites. It can track an object the size of a basketball at a distance of more than 22,000 nautical miles.

Construction of the radar began in October 1962 and space operations started in February 1969. For a while the radar’s mission moved to the more immediate concern of tracking submarine launched ballistic missiles. Keeping an eye on space became a secondary mission. But it returned to its original mission in 1987, and became deep-space capable in 1988.

- David Tortorano