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# A System to Track Aerospace & Aviation Research (STAAR)

Research and Development Opportunities in  
Aerospace and Aviation within Florida  
Universities and Commercial Companies



SPACE FLORIDA

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## A System to Track Aerospace & Aviation Research (STAAR) Project:

### Project Objectives

Space Florida has engaged FSU's Center for Economic Forecasting & Analysis (CEFA), to collect data on the types of research being performed in Aerospace & Aviation, (including A&A training programs), by Florida universities and commercial entities. This information will enable Space Florida to anticipate future aerospace-related demands for Florida universities' researchers. The STAAR dataset comprises two components.

- University dataset, including public and private universities in Florida.
- Commercial dataset, including companies located in Florida.

### Florida Universities Aerospace-Research Database

- Types of Research in Space Florida Market Horizons - The 10 Market Sectors (The Pyramid)

Figure 1: Space Florida Pyramid



Source: Space Florida 2012

### Core Competencies:

1. Space Transportation and Technologies Support Systems
2. Satellite Systems and Payloads

### 3. Ground and Operations Support Systems

#### **Applications:**

4. Agriculture, Climate, and Environmental Monitoring
5. Civil Protection and Emergency Management
6. ISS and Human Life Sciences
7. Communications, Cyber Security, and Robotics
8. Adventure Tourism
9. Clean Energy
10. Advanced Materials and New Products

#### **Foundation of Enabling Technologies:**

11. Workforce
12. Education
13. Partnership
14. Business Environment
15. Influence and Advocacy
16. International

Florida public universities and other relative educational institutions have prioritized investment in aerospace and aviation-related research and development (R&D) as a path to boost the economic development of the state through, a fulcrum for job creation and a transition to quality of lives. The huge investment in this industry has led to continual discoveries in the field. The state of Florida has 11 public universities termed the State Universities System (SUS) of Florida. For the purpose of this project, the 11 SUS institutions in addition to the University of Miami, Florida Institute of Technology, and Embry Riddle will be examined.

Table 1 below indicates the list of universities conducting value added research relating to Space Florida's 10 market horizons. These research areas provide a guide to achieving vision 2020 of the Space Florida as well.

**Table 1: Types of Research in Florida Universities**

<b>University</b>	<b>Ownership</b>	<b>Types of Research relating to 10 market Horizons.</b>	<b>Sectors Covered</b>
Embry-Riddle Aeronautical University	Private	Aerospace Engineering; Aviation; Airline Operations; Flight Training; Upper Atmosphere Science; Uninhabited Air Vehicles and Systems Research	1,2,3,7
Florida A&M University	Public	Physical, Chemical, Biological Sciences; The Food and Agriculture Industry; Environmental Health and Safety; Engineering (Biomedical, Chemical, Civil, Electrical, Mechanical, Industrial)	4,5,6,10
Florida Atlantic University	Public	Biomedical Sciences; Technology Development; Environmental Sciences; Marine Science; Neuroscience; Alternative Energy; Engineering (Civil, Environmental, Ocean); Marine Biotechnology; Medicine	3,4,5,6
Florida Gulf Coast University	Public	Marine science and conservation; Environmental Science; Environmental Sustainability; Engineering	4,9
Florida Institute of Technology	Private	Aviation Human Factors; Engineering (Mechanical, Aerospace, Marine and Science, Electrical, Civil); Computer engineering (Communications, Spacecraft Systems, Information Processing); Computer Science; Biological Science, Physics (Astronomy and Astrophysics, Lightning Research, High Energy Particle)	1,2,3,5,6,7,10
Florida State University	Public	Biomedical Toxicological; Antarctic Marine Geology; Digital Information and Science; Energy Systems/Sustainability; Storm risk; Geophysics; Marine and Coastal Science; Future fuels; High performance materials; Engineering; Robotics; Systems control; Information use management; Human performance	1,2,3,4,5,6,7,10
University of Central Florida	Public	Communication Sciences and Disorders; Biomedical Science (Cardiovascular, Cancer, Neurodegenerative, Infectious Disease); Nursing; Optics and Photonics (Semiconductor, Fiber Optics, Lasers, Imaging Sensing and Display); Biology; Nanotechnology; Hospitality; International Tourism; Engineering (Aerodynamics, Systems Engineering, Computer Science, Environmental); Communication Systems; Solar Energy	1,2,3,5,6,7,8,9,10

**Table 1Continued**

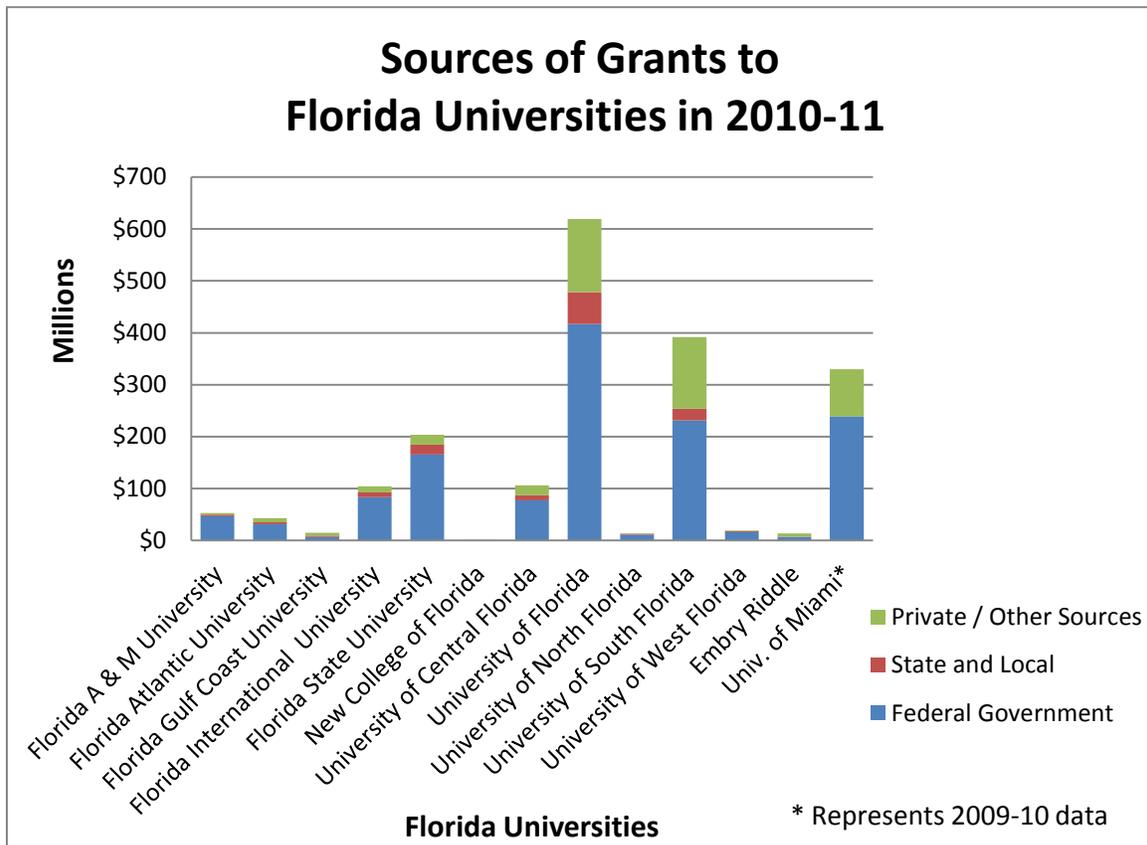
University of Florida	Public	Dentistry; Engineering (Computational Science, Energy, Healthcare and Biotech, Information Tech, Nano/Microtech Materials, Sustainability, Security, Complex Systems, Engineered Systems and Manufacturing); Biology; Medicine; Nursing; Pharmacy; Veterinary medicine	1,2,3,4,5,6,7,10
University of Miami	Private	Biology (Behavioral Ecology, Conservation, Development and Neuroscience, Tropical); Computer Science (Algorithm Engineering, Automated Reasoning, Computational Complexity, Data Mining, Molecular Computation, Robotics, Wireless and Mobile Computing); Physics (Astrophysics, Biological, Condensed Matter, Elementary Particle, Optics, Plasma); Engineering (Sustainable Systems, Informatics and Risk, Health and Tech.); Marine Science; Medicine; Nursing and Health Studies	1,2,3,4,5,6,7,10
University of North Florida	Public	Biology; Engineering (Fuel Cell Research, Manufacturing Innovations, Environmental Sciences); Robotics	3,4,6,7,9,10
University of South Florida	Public	Biotechnology; Conservation Biology; Renewable Energy; Cancer Research; Materials Science; Neuroscience; Nanotechnology; Life Sciences; Medicine; Engineering (Civil and Environmental, Mechanical, Electrical, Biomedical); Physical Science; Sustainability; Marine science; GI Science and Spatial Analysis	1,2,3,4,5,6,9,10
University of West Florida	Public	Environmental Studies; Psychological and Behavioral Sciences; Biology; Computer Science	4,6

Among the universities listed above, the University of Miami (a private university) and University of Central Florida (a public university) appear to be conducting the most “value added” research in Space Florida’s classified sectors. Other universities, with such “value added” research, include, University of South Florida, Florida State University, University of Florida, Florida Institute of Technology, etc.

## Information on Grants Sources

Universities, both public and private, depend entirely on grants from different sources which are broken down into three major agencies. These include the federal government, state and local government, and private/other entities. Figure 2 below represents the dollar value of grants in research from each source to Florida's Universities in 2010/2011.

**Figure 2: Florida Universities' Sources of Grants**



**Source: BOG (SUS), AUTM (Private: University of Miami), Annual reports (Embry Riddle)**

The grants in research to each University can as well be broken down according to awarding sources as indicated in Table 2 below. UF appears to be the largest recipient of all the three sources in 2010/2011 and its share represents 31.3% of the total federal government funds, 44.8% of the state and local government funds, and approximately 32% of the total private sources.

**Table 2: Total value and proportion of grants from each source to each university in 2010 and 2011**

<b>Sources</b>	<b>Total value of grants (\$) 2009/2010</b>	<b>Total value of grants (\$) 2010/2011</b>	<b>% of Total grants 2009/2010</b>	<b>% of Total grants 2010/2011</b>
Federal Government	1,228,557,187	1,094,130,740	73.6	69.1
State Government	136,546,359	136,555,646	8.2	8.6
Private	304,268,262	353,187,956	18.2	22.3
Total	1,669,371,808	1,583,874,342		

In year 2009/2010, the source of grants from the federal government, state and local government, and private sources to Florida’s universities (excluding University of Miami, Florida Institute of Technology, and Nova Southeastern University) was \$1,228,557,187, \$136,546,359 and \$304,268,262, respectively. Federal government grants represents 73.6%, state and local government represent 8.2% while private sources represent 18.2% of the total grants in research. In year 2010/2011, the total value of research grants from the federal government, state and local government, and private industry to Florida’s universities (excluding University of Miami, Florida Institute of Technology, and Nova Southeastern University) was \$1,094,130,740, \$136,489,496 and \$353,187,956, respectively. The grand total of year 2010/2011 research grants was \$1,583,874,342. Federal government research grants decreased from 73.6 % in year 2009/2010, to 69.1% in year 2010/2011, but state and local government grants increased from 8.2% to 8.6%, and private funding sources also increased from 18.2% to 22.3% during those years. Federal government remained the largest R&D financier for both years but its share or contribution was reduced by 10.9% in year 2010/2011, while the private share increased its support by approximately 16.1% during year 2010/2011.

For a better understanding of the roles and responsibilities of the federal government, state and local governments, and private entities in creating knowledge-based development, there is a need to evaluate the contributions of each source to the economic development through research and developments (R&D) at Florida universities. Table 3 below provides succinct information on each source funding capacity to Florida universities.

**Table 3: 2010/2011 Source of Research Grants to Florida's Universities**

University	Federal Gov't (%)	State & Local Gov't (%)	Private and Others (%)
Florida A&M University (FAMU)	3.5	2.26	0.8
Florida Atlantic University (FAU)	2.4	2.5	1.8
Florida Gulf Coast University (FGCU)	0.5	1.6	1.25
Florida International University (FIU)	6.3	6.8	2.64
Florida State University (FSU)	12.4	14.1	4.2
New College of Florida University (NCFU)	0.02	0	0.12
University of Central Florida (UCF)	5.8	7.5	4.25
University of Florida (UF)	31.3	44.8	31.8
University of North Florida (UNF)	0.9	1.3	0.13
University of South Florida (USF)	17.3	16.9	31
University of West Florida (UWF)	1.2	1.4	0.3
Embry Riddle Aeronautic University (ERAU)	0.5	0.6	1.3
University of Miami (UM)	17.9	n/a	20.4
Total	100	100	100

**Table 3 Continued**

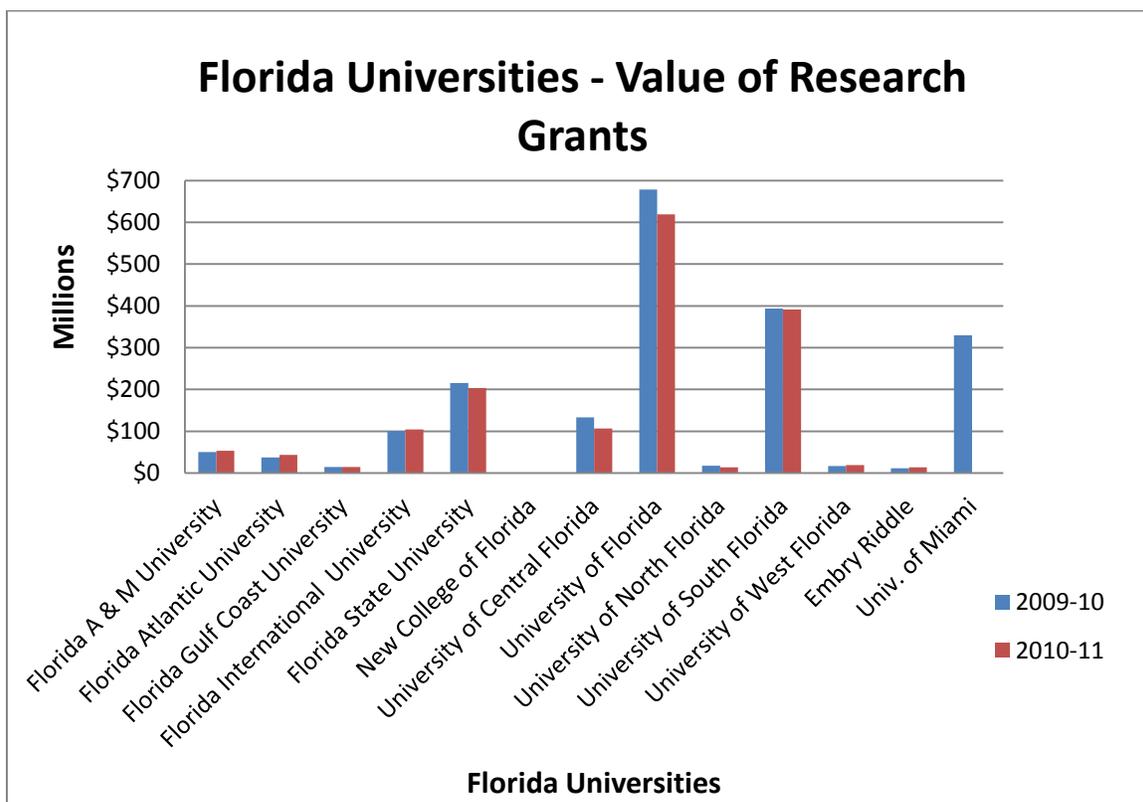
University	Federal Gov't (%)	State & Local Gov't (%)	Private and others (%)	% Total
Florida A&M University (FAMU)	87.7	5.8	6.5	100
Florida Atlantic University (FAU)	73.1	7.9	19.0	100
Florida Gulf Coast University (FGCU)	47.9	14.6	37.5	100
Florida International University (FIU)	79.8	8.9	11.2	100
Florida State University (FSU)	81.3	9.5	9.2	100
New College of Florida (NCF)	33	0	67	100
University of Central Florida (UCF)	72.6	9.9	17.5	100
University of Florida (UF)	67.2	10	22.8	100
University of North Florida (UNF)	82.2	13.4	4.4	100
University of South Florida (USF)	59	5.9	35.1	100
University of West Florida (UWF)	83.5	10.1	6.4	100
Embry Riddle Aeronautic University (ERAU)	52	6.6	41.4	100
University of Miami (UM)	72.5	0	27.5	100

The universities who received more than 80% of their total research grants from the federal government include FAMU, FSU, UNF and UWF while universities with less than 60% are FGCU, NCFU, USF and ERAU. State and local governments supports is incredibly small compared to private support; USF and FAMU respectively received 5.9% and 5.8% of their total research grants from state government. 4 universities received at most 14.6% (with the highest being 14.6%) of their total research grants from the state and local governments and these include FGCU, UNF, UWF, and UF. 4 universities (NCFU, ERAU, FGCU and USF) received at least 30% of their total research grants

from the private while 4 universities received less than 10% of their total research grants from the same source (private).

Apparently, in 2009/2010, the three universities with the highest recipients of grants in research was the University of Florida (UF), University of South Florida (USF) and University of Miami (UM,) while Florida Gulf Coast University (FGCU), Embry Riddle Aeronautical University (ERAU) and New College of Florida (NCF) were the lowest three recipients of grants in research. In the 2010/2011 fiscal year, the same universities retained the top three with highest recipients of grants in research while University of North Florida (UNF), ERAU and NCF were the three universities with lowest recipients of grants in research.

**Figure 3: The Value of Research Grants**



**Source: BOG<sup>1</sup> (SUS), AUTM (Private: University of Miami), Annual reports (Embry Riddle)**

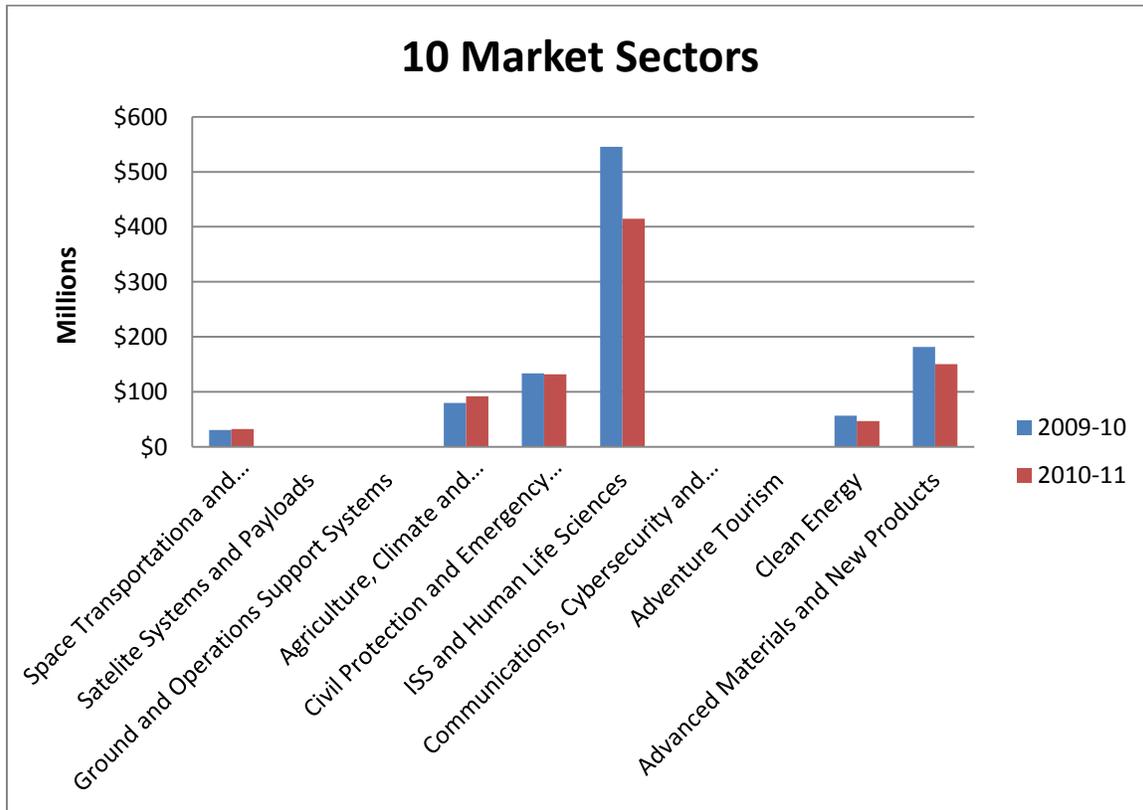
In year 2009/2010, the total research grant to Florida’s Universities (excluding FIT and Nova Southeastern University (NSU)) was approximately \$1.99 billion. In year 2010/2011, the total research grant to Florida universities (excluding UM, FIT, and NSU) was \$1.58 billion. The total value of research grants to the top three universities represent 70% of the total research grants to all the universities in 2009/2010 and 70.1% of the total in 2010/2011; this decrease is approximate to be 3.6%. This rate is lower than the rate observed for all the universities.

<sup>1</sup> Board of Governors

The three universities with the highest recipients of grants in research wield more influence in the R&D of Florida’s Universities.

### Federal Government grants by Aerospace 10 Market Sectors

Figure 4: Federal Government Grants to the 10 Market Sectors<sup>2</sup>



Source: BOG

One of the major goals of this project is to have the grants broken down into Space Florida’s 10 Market Horizons, same as 10 market sectors. The total grants awards classified on the 10 sectors decrease from approximately \$1.03 billion in 2010 to \$868.7 million in 2011. This indicates a 15.8% decrease in federal government grants allocated to the 10 sectors in 2011. The sector with the highest grants allocation in both years is ISS and Human Life Sciences followed by Advanced Materials and New Products. Civil Protection and Emergency Management; Agriculture, Climate, and Environmental Monitoring respectively receive next highest grant allocations as shown by Figure 4 above. To be more precise about the extent of the sector funding priority to government, Table 4 below presents the percentage breakdown of the grant allocations to each sector in 2010 and 2011.

<sup>2</sup> Space Florida Pyramid

**Table 4: The proportion of Federal government grants to each sector**

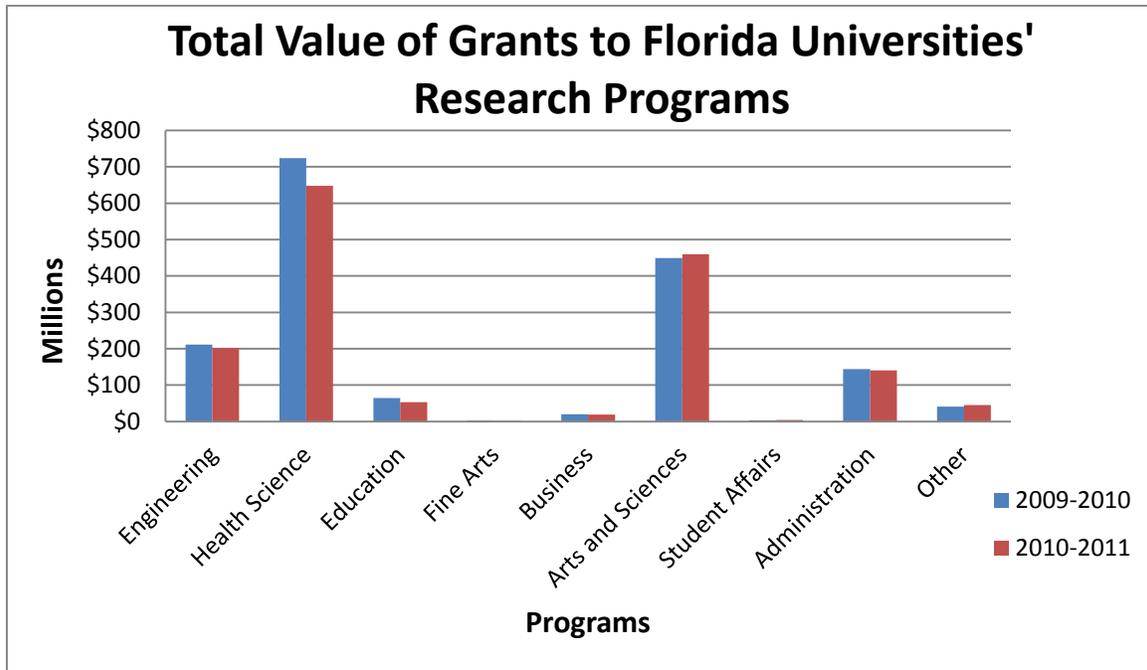
<b>Aerospace Sectors</b>	<b>2010(%)</b>	<b>2011(%)</b>
Space Transportation and Technologies Support Systems	3.0	3.75
Satellite Systems and Payloads	0	0
Ground and Operations Support Systems	0	0
Agriculture, Climate and Environmental Monitoring	7.74	10.59
Civil Protection and Emergency Management	13	15.17
ISS and Human Life Sciences	53.07	47.77
Communications, Cyber security and Robotics	0.031	0.02
Adventure Tourism	0	0
Clean Energy	5.51	5.42509
Advanced Materials and New Products	17.7	17.28

ISS and Human Life Sciences allocations were 53.07% and 47.77% of the total grants in 2010 and 2011, respectively, while Advanced and Materials of New Products was allocated 17.7% and 17.28%, respectively. While federal government increased funding to Satellite Systems and payloads; Agriculture, Climate, and Environmental Monitoring; and Civil Protection and Emergency Management in 2011, Clean Energy; Communications, Cyber security and Robotics; and Advanced Materials and New Products have not received a lot of supports from federal government within the same year.

## Research Grants by programs

Grants by programs provide information on the strength and focus of these universities; it creates a pattern of innovative skills subsisting in these universities. It also provides relevant information on the latent potentials in different technological areas of each of the university including the research strengths and capacities of the state at large. Below in Figure 5 is the graph showing the grants awarded to respective research programs in the state of Florida.

**Figure 5: Research Grants Awarded to Florida Universities' Research Programs in 2010 and 2011**



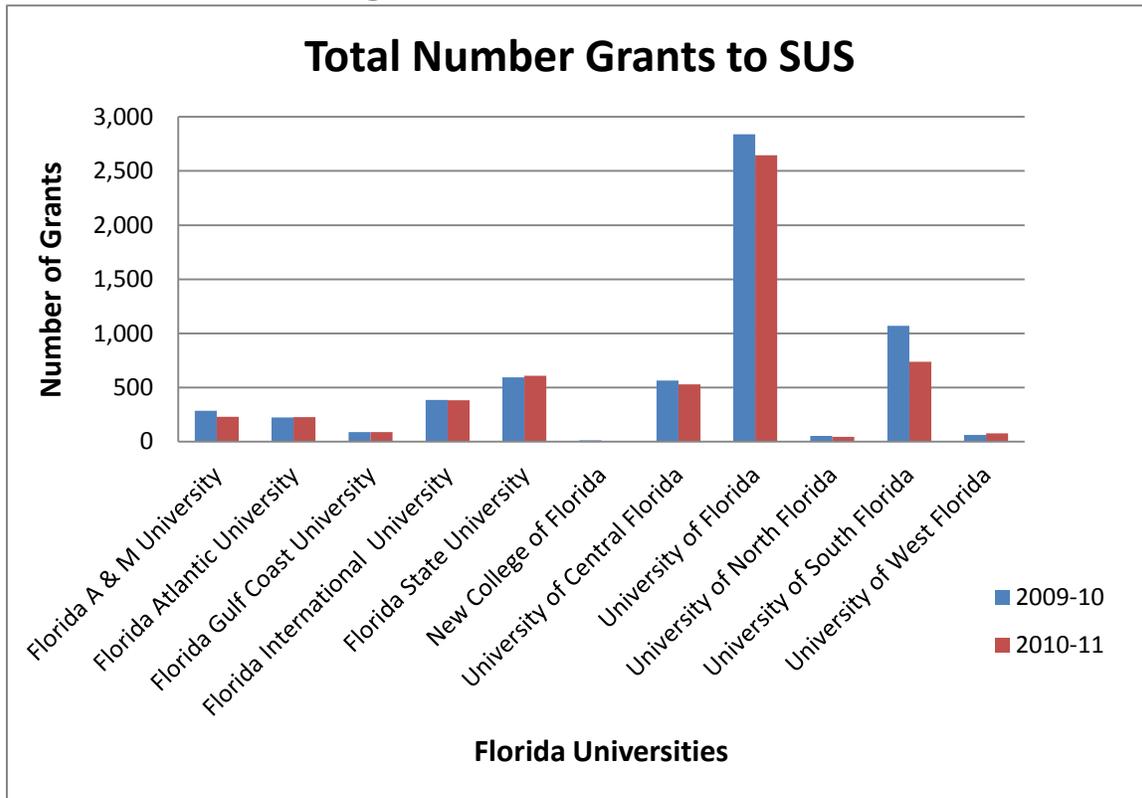
Source: BOG (The data excludes University of Miami ,FIT, ERAU, and NSU)

The top three research programs by grants within the two years are health sciences, art and sciences, and engineering while the lowest three are business, student affairs, and fine arts. The percentage decrease in health sciences programs went from 43.7% of research grants in 2009/2010 to 41.17% in 2010/2011. But research grants to arts and sciences and engineering programs increased within the two years. Arts and sciences programs grants increased from 27.08% in 2009/2010 to 29.2% in 2010/2011, while engineering grants increased from 12.7% in 2009/2010 to 12.85% in 2010/2011.

## Number of Research Grants Awarded to SUS Institutions

Total grant awards received by each university is represented in Figure 6 below. The total awards in 2009/2010 were 6,170, while 5,566 grants awards were made in 2010/2011 by all of the three sources. UF received 2,645 alone in 2010/2011, representing approximately 47.5% of the total awards in that year.

**Figure 6: Total Grant Awards to SUS**



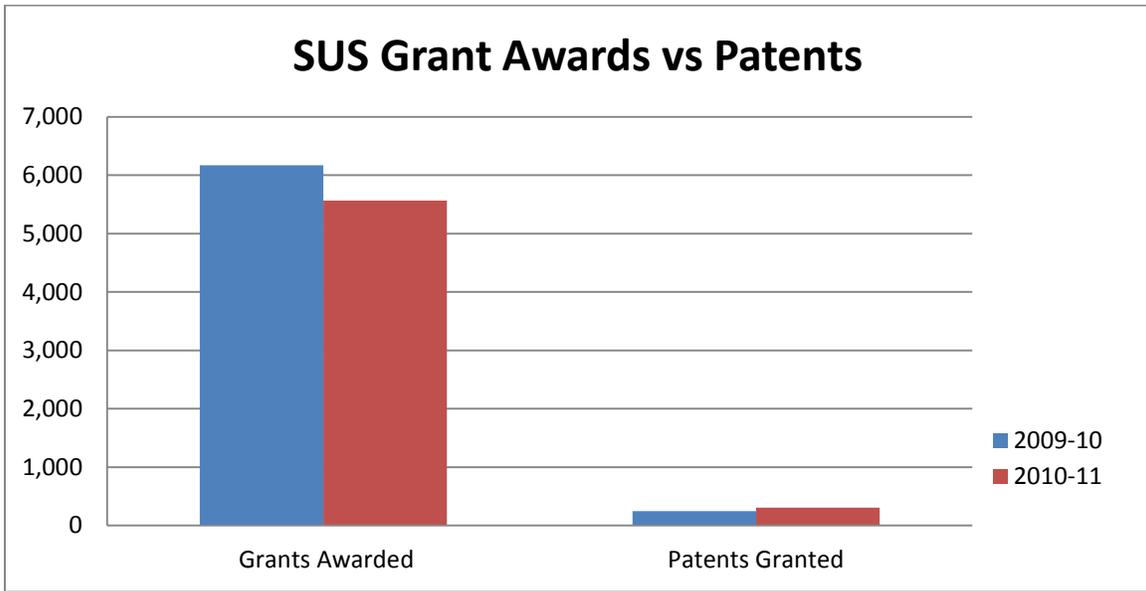
**Source: BOG (The data excludes UM, ERAU and FIT)**

The percentage decrease in total grants awarded to all the universities in 2010/2011, when compared with 2009/2010, is 9.8% but the percentage decrease in grants awarded to the top three recipient's universities is 11.35%. This percentage decrease is higher than what is obtainable for all the universities.

Universities have numerous potential opportunities which can be transformed to enhance the economic development of Florida. These opportunities cannot only be realized in the patenting and licensing of the innovative work existing in these universities but also measured in the success rate of the research work conducted in these universities. Patent net earnings from licenses and royalties are divided between the inventor, the inventor's academic department or center, and university's intellectual property. In Figure 7 below, despite the decrease in the research grants awarded to universities in Florida between 2009/2010 and 2010/2011, research patents increased by 24.9%. Therefore, while the success rate of the grants decreased from 50% in 2009/2010 to 49% in 2010/2011, the success rate of the patents increased from 31% in 2009/2010 to 40% in

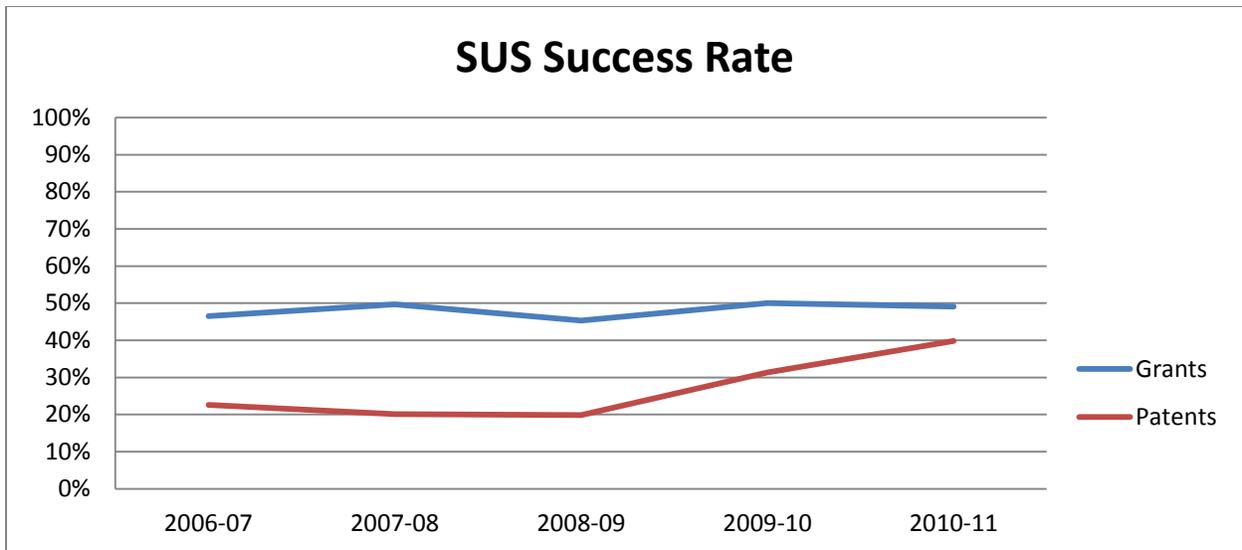
2010/2011. An example of a good patent is 'Gatorade' discovered by University of Florida. This single patent has fetched the university millions of dollars and creates hundreds of jobs for the state.

**Figure 7: Total Grant Awards and Patents to SUS**



Source: BOG (The data excludes UM, ERAU and FIT)

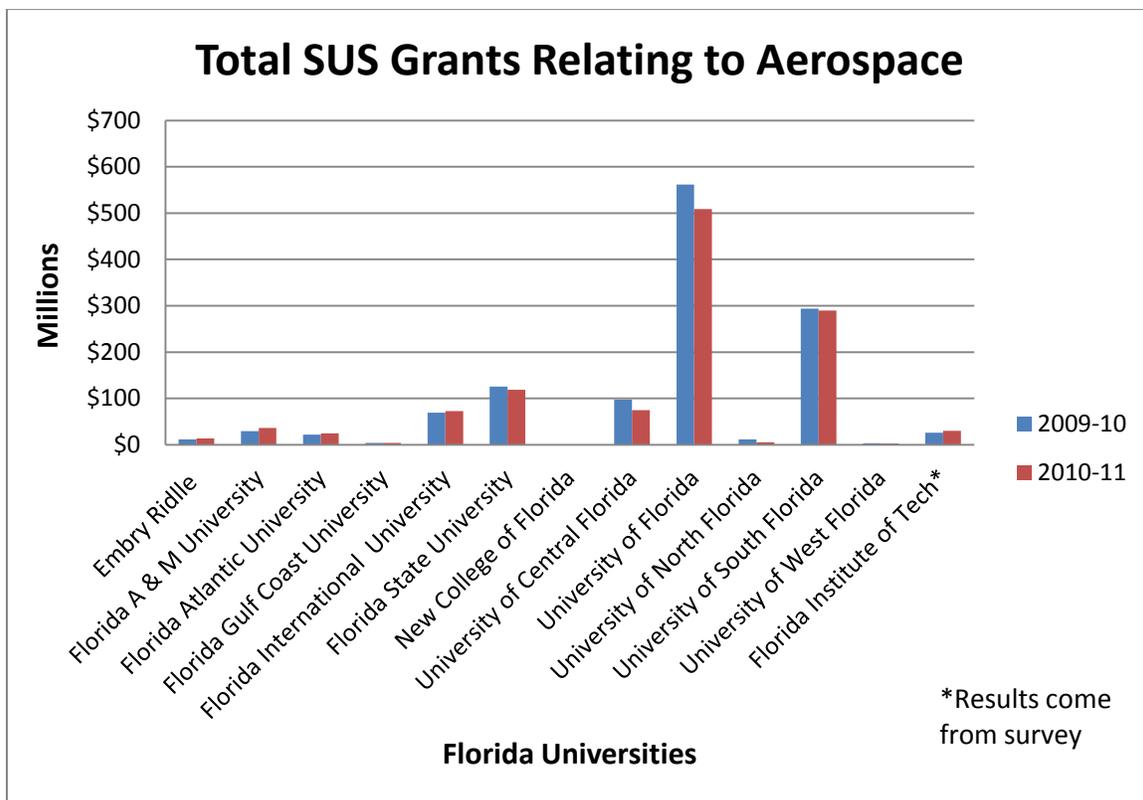
**Figure 8: SUS Grant Awards and Patents Success Rate**



Source: BOG (The data excludes UM, ERAU and FIT)

Since awarded grants to only aerospace programs is so minute and negligible when compared with aerospace related programs, reporting grants in only aerospace programs will underestimate the total awards to aerospace related research programs in each university. Figure 9 below reveals information on the dollar amount in grants received by each university on aerospace related research programs. UF received the highest dollar amount in grants in aerospace related research programs in both years, followed by USF. Increase in grant awards in aerospace related research provides Florida with the intellectual and economic commitment to the aerospace and aviation industry. Moreover, UF, USF, UM and FSU remains the hub through which research development revolves because these 4 universities shoulder a larger proportion of these research grants. There was a 6.3% decrease in research grants in aerospace -related programs between 2009-10 and 2010-11.

**Figure 9: Total Value of Research in Aerospace Related Programs**

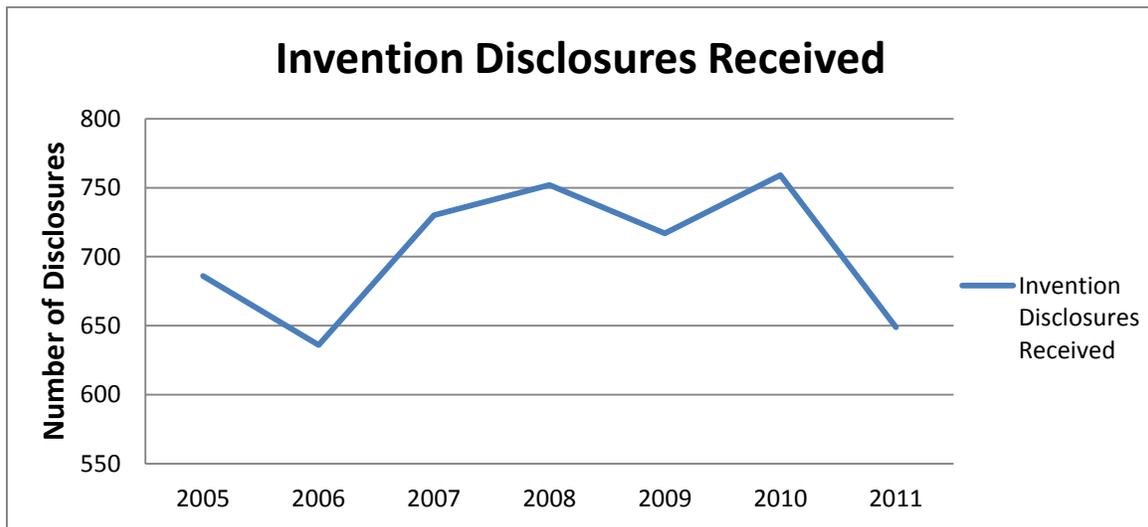


Source: BOG (The data excludes UM)

## Florida University Technology Transfers and Intellectual Property Licensing

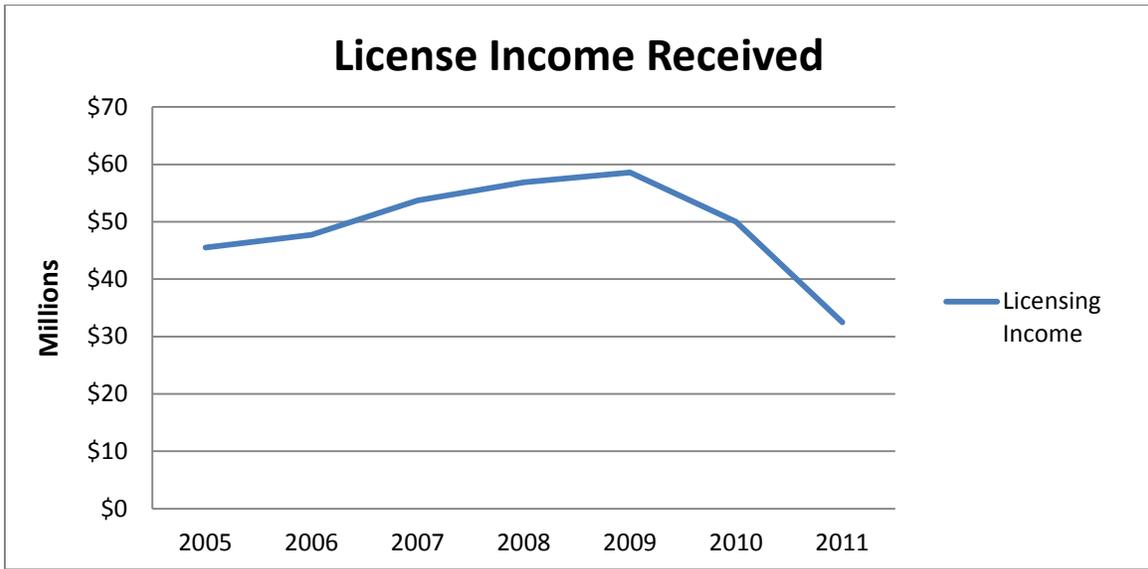
University technology transfer, the very essence of a research university, involves transmitting the creative knowledge to present and future generations and it can as well be described as transmitting and communicating newly created discoveries and technology in numerous disciplines to the world. The office of technology transfer helps bridge the gap between universities' researchers and commercialization partners by facilitating the smooth and fast transfer of intellectual property created at the respective university. Intellectual Property (IP) and licensing activity provides another way of generating income from commercializing inventions. The full commercialization of IP frequently demands a commitment of significant financial investments and the assumption of risks beyond what may be appropriate for the institution. Intellectual property in this context refers to patents, copyrights, trademarks and trade secrets. IP is transferred to the private sector under licensing agreements that allow companies to improve on or develop new products and services for the enhancement of the quality of life not only in the state, but in the country as a whole. Successful transfer of technology from the university therefore requires partnerships with the private sector. The state of Florida has 13 of such viable offices responsible for bringing its universities' inventions to the markets. To put things in perspectives, Figures 10, 11, and 12 below provides more information on the technology transfer and IP and licenses activities in Florida.

**Figure 10: Total Invention Disclosures Received**



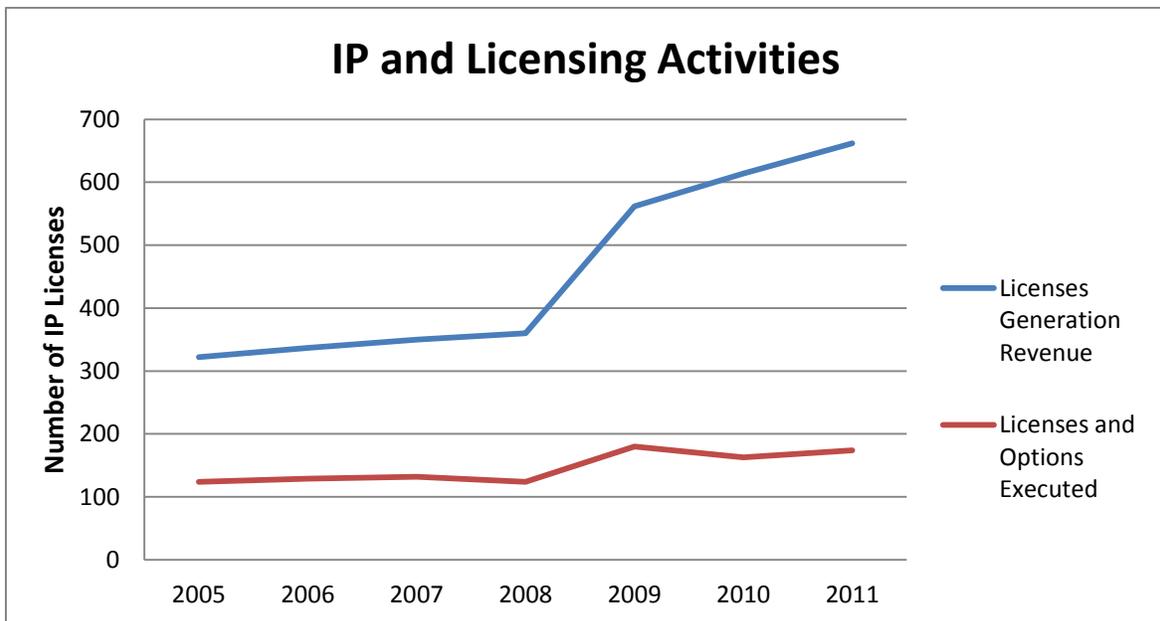
Source: <http://www.research.fsu.edu/techtransfer/aggregate.html>, excluding ERAU but including Nova Southeastern University.

Figure 11: License Income Received



Source: <http://www.research.fsu.edu/techtransfer/aggregate.html>, excluding ERAU but including Nova Southeastern University.

Figure 12: Total Intellectual Property (IP) & Licensing Activities



Source: <http://www.research.fsu.edu/techtransfer/aggregate.html>, excluding ERAU but including Nova Southeastern University.

There has been fluctuating aggregate invention disclosure in Florida universities. From Figure 10, in 2005, Florida universities had 686 invention disclosures that were received, 759 in 2010, and 649 in 2011, representing a 14.5% decrease between 2010 and 2011. The main issue is that not all inventions are reported and not all reported inventions are received, delay in due process may cause some inventions to be received at the later date.

License income received followed a normal distribution as displayed by Figure 11. The two skewed years are 2005 and 2011 while the peak year is 2009. \$50 million in 2010 and \$32.5million in 2011 indicates a 35% decrease in license income received in year 2011 when compared to 2010. No doubt, invention disclosure affects license income received.

IP and licensing activities, as mentioned earlier, play a major role in income generation. The number of licenses is not positively related to income generated from such licenses. CEFA (2011) reports that one license may lead to more licenses and further income. From Figure 12 above, despite a marginal increase in licenses and option executed between 2010 and 2011, the licenses generation revenue increases at an increasing rate.

**Table 5: Licenses and Options Executed and Generating Revenue**

<b>Year</b>	<b>Licenses Generating Revenue</b>	<b>Licenses and Options Executed</b>
2005	332	124
2006	337	129
2007	350	132
2008	360	124
2009	562	180
2010	614	163
2011	662	174

There is 6.7% growth rate in licenses and options executed between 2010 and 2011 shown in Table 5 above. This consequently created a 7.8% growth in licenses generation revenue within the same year. In 2010 and 2011, the ratio of licenses generating revenue to licenses and options executed is approximately 4:1. Therefore, 1 license and option executed by Florida universities will provide 4 licenses generation revenue to both university communities and Florida at large.

## Florida Universities Research Strengths and Capabilities

University strengths and capabilities will report salient view points of the research analysis of each university. It is in no sense exhaustive but it will be instructive to identify some institutional economic driven potentials of the state of Florida. Table 6 below highlights some research strengths and capabilities of Florida Universities.

**Table 6: Florida Universities Strength and Research Capabilities**

<b>University</b>	<b>Indicated Strengths</b>
Florida A&M University*	Nanotechnology, photonics/optical technology, advanced materials.
Florida Atlantic University**	Marine and Coastal Issues, Biotechnology Contemporary Societal Challenges
Florida Gulf Coast University*	Sonic Energy, Creating Viral envelope protein
Florida International University*	Alternative Energy, Nanotech and Aging
Florida State University*	Alternative Energy, biotech, cancer, magnetic fields, nanotechnology, aging and advanced materials.
University of Central Florida*	Cancer, Nanotechnology, photonics/optical technology and advanced materials.
University of Florida**	Health Sciences, Engineering, Public Health Veterinary Medicine, Food and Agricultural Sciences, Life Sciences, Liberal Arts and Sciences Health and Human Performance, Design, Construction and Planning, Education.
University of North Florida*	Alternative Energy, aging
University of South Florida*	Alternative Energy, biotechnology, bioterrorism, cancer, nanotechnology, aging and advanced materials.
University of Miami*	Alternative energy, cancer and aging.
Florida Institute of Technology**	Fuel Cell Technology Sensors Science & Technology Coastal Science
New College of Florida **	Cell Biology, Biopsychology, Physical Chemistry, Optics Excellent Undergraduate Research experiences

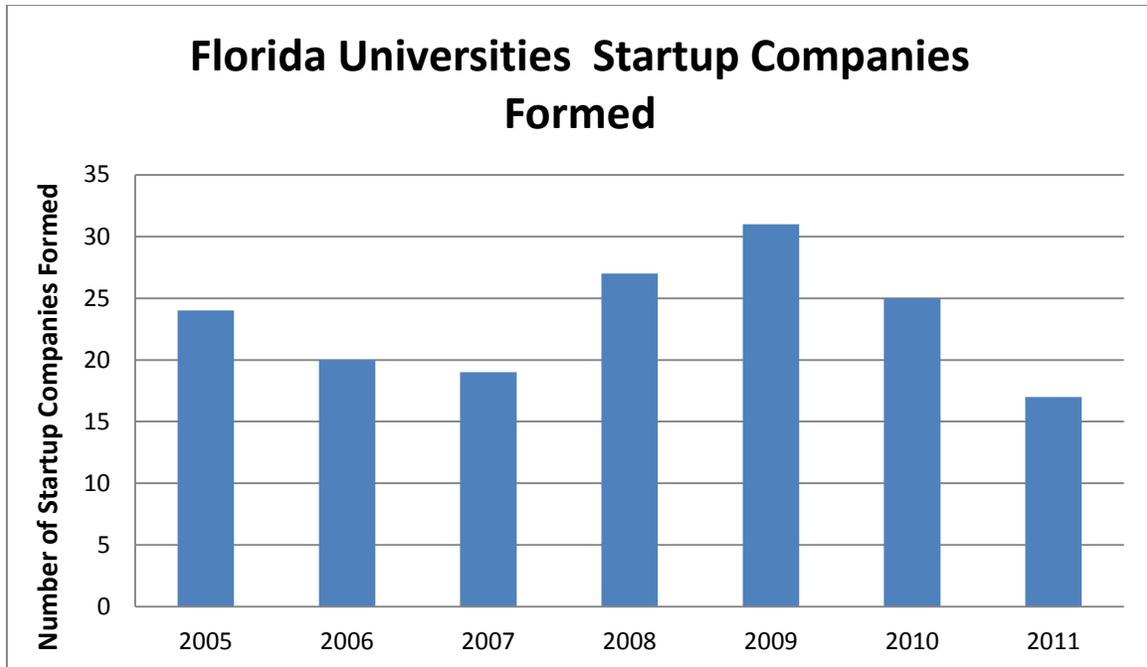
**Source: \* FSU CEFA (2011); \*\* Survey Responses**

## Florida Universities Commercialization

### The Startup Companies of Florida's Universities

In addition to providing exceptional educational opportunities, the university engages in and drives startup formation, which subsequently boosts job growth and tax revenue. The startup companies serve as the end product of the universities' inventions commercialization process and procedures. They are companies that were started at the time of the institutes technology licensing.

**Figure 13: Florida Universities Startup Companies Formed**



**Source:** <http://www.research.fsu.edu/techtransfer/aggregate.html>, excluding ERAU but including Nova Southeastern University.

In 2009/2010 and 2010/2011 alone, 25 and 17 companies were respectively formed but since year 2000, over 220 Startup Companies have been formed in the state of Florida; so far FSU has created 35, UF has created 69 while UCF has created 64 startup companies. Small startup companies are positioned to create the most new jobs in the United States because many institutions, especially universities, have incubation programs that aid the development process of these businesses. Last year alone, the University of Central Florida's Business Incubation Program produced about 20 companies that are now successful with further assistance from the university's programs. Consequently, numerous job creations have emerged from such programs. Over the last 10 years, the UCF Business Incubation Program has helped more than 200 client companies which have resulted in creating about 1,600 new jobs.

Other related examples of these companies include:

- FSU
  - High Performance Magnets Inc.
  - The company is building a perfect mile-long superconducting wire, created with millions of fine wires, each spliced and operating near absolute zero. This is a tiny component of a device in France which will mimic the power of the sun. The company won a \$5 million competitive contract. According to the Magnet Lab economic impact report, in an 11 year-time the Florida investment in the Magnet Lab will generate about \$1.66billion in output and \$689 million in income, while creating about 15,554 jobs within The State of Florida alone.
- UF
  - RAPID Genomics Inc.
  - In the traditional genotyping technology, DNA is analyzed through a costly, lengthy and low-throughput process on a specialized device or “chip.” RAPID Genomics has shortened this process to less than a day. The overall market for genotyping is estimated to grow 20 percent annually: Revenue projections for 2013 total \$2.2 billion, up from just \$625 million in 2007.
  - Below Table 7 depicts the picture of the status of the startup companies formed by Florida universities.

**Table 7: Florida Universities Startup Companies**

<b>Year</b>	<b>Number of Startup Companies</b>
2005	24
2006	20
2007	19
2008	27
2009	31
2010	25
2011	17

Despite several roles the startup companies have played in boosting the job creations and revenue generation of the universities’ communities and the state of Florida at large, 2011 appears to be the worst year so far in the formation of the startup companies formed (this data excludes the companies formed by USF) by Florida universities. The startup companies were reduced by 32% in 2011 when compared to 2010. Moreover, the economic meltdown of 2008/2009 also has a negative impact in the formation of these startup companies; there was little support in grants for these universities in research and this consequently, affects innovative potentials of the universities.

## Licensing Opportunities

Licensing opportunities involves the licensing of new technologies before it can be used or commercialized. The research Florida universities has led to the creation of 641 new opportunities in the U.S. market place in the past two decades. While about 68 companies were licensed alone between 2009/2010 and 2010/2011 and these companies have products that support jobs.

Examples of these opportunities include:

- FGCU
  - Method for Delivering Materials into Biological Systems Using Sonic Energy
  - This technology uses focused acoustic energy to introduce materials into cells, tissues, and multi-cellular organisms. Applications are performed isothermally in a controlled manner reducing cytotoxicity normally associated with physical or mechanical delivery methods such as electroporation or particle bombardment.
- UF
  - Breakthrough Approach to Carbon Nanotube Production
  - Functionalized fullerenes, when irradiated with electromagnetic radiation in an oxygen-free environment or under vacuum, undergo molecular reconstruction to form carbon nanotubes, onions and schwarzites. This novel method can be utilized for in situ generation of carbon nanotube-reinforced polymers, aligned carbon nanotubes with controlled length and number of walls, catalyst-free synthesis and welding of nanotubes. This unique approach to carbon nanotube development utilizes low-power lasers and low-intensity electrical currents, providing a more efficient and less expensive method of production.

## Potential Companies

Potential Companies are commercially-viable technology opportunities around which companies will be formed, that will be paired with experienced management and investors for further development. Universities in Florida have created over 300 potential of such companies.

Examples of these potential companies include:

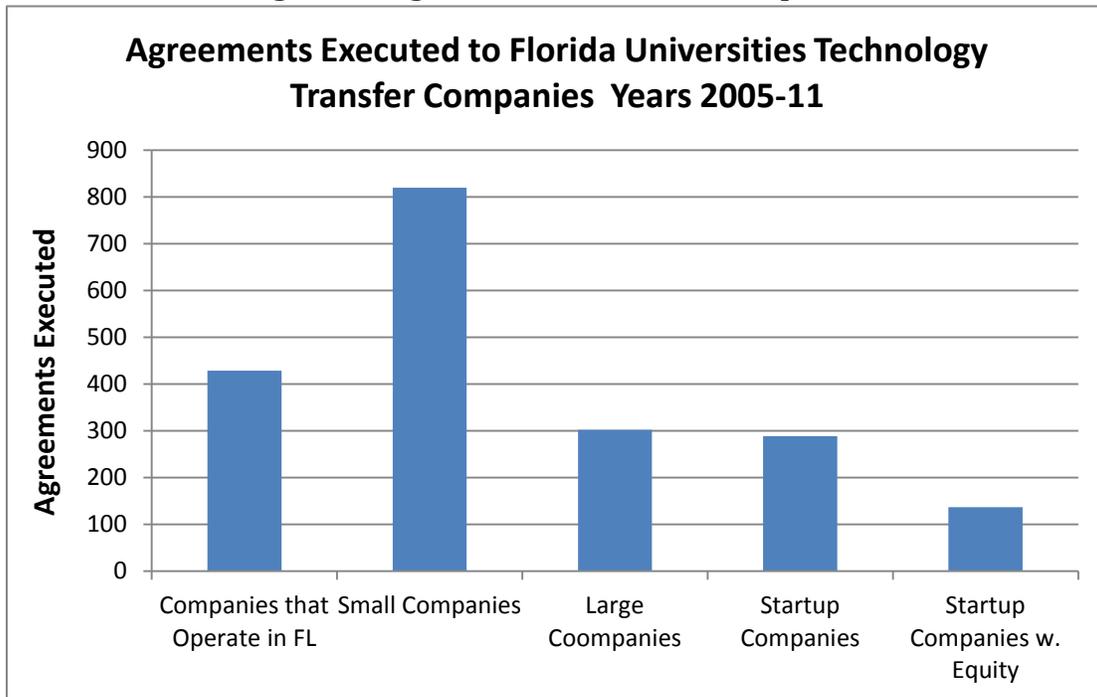
- UCF
  - Carbon Nanotube with a Graphitic Outer Layer
  - Carbon nanotubes are one of the strongest and most robust materials currently under investigation. Through a proprietary process, a “graphitic outer layer” defined as carbon material comprising one or more distinct structures allowing for better manipulation. This novel configuration of carbon nanotubes can be utilized as tips for an atomic force microscope (AFM), and as electron emitters for field emission electron microscopes and flat panel displays.
- USF
  - Alz Software Newco
  - Researchers at the University of South Florida have developed a device-system to prevent persons with dementia from getting lost, using advances in wireless communications and GPS technology. The system works on the basis of input from

user / guardian regarding starting and ending points and the system would keep track of the patient using GPS location signal provided by the cell phone, and become activated when it is determined that the patient is wandering away from the vicinity of the location that they should be in.

- UM
  - A Novel Immune Enhancing Peptide, IEP11
  - Cancer is the second leading cause of death in the U.S., responsible for over 500,000 deaths per year. The 11 amino acid peptide can be used as a vaccine adjuvant to enhance in vivo immune responses, to induce the production of cytokines, as a mitogen of one or more cell subpopulations, or to enhance cellular cytotoxicity.
- FIU
  - DNA Sensors Using Single-Walled Carbon Nanotubes
  - The properties of DNA that enable it to self-replicate and self-assemble have also been used in recent years to detect sequences of DNA that identify specific genes. Through a process of hybridization, a single strand of DNA can be used as a probe to find a complimentary section of DNA that identifies a gene. This group of technologies is based on a novel process of functionalizing carbon nanotubes so that they may be used as electrodes to directly measure the difference in electrical conductivity between a single strand of DNA and a completed double helix formed through hybridization. The core discovery uses Nano gaps in single-walled carbon nanotubes (SWNTS) to create an effective platform for DNA sensing and recognition.

The licensing opportunities and potential companies provide information on the technological areas that are classified under the 10 market sectors of the Space Florida.

**Figure 14: Agreements Executed to Companies**



**Source:** <http://www.research.fsu.edu/techtransfer/aggregate.html>, **excluding ERAU but including Nova Southeastern University.**

There were indicated agreements executed to Florida university tech transfer companies in 2011. Out of these executed agreements were 116 small companies, 30 large companies, 25 startup companies and only 7 were startup companies with equity while 48 of these companies were companies that operate in the Florida. The total of these agreements executed to Florida Universities tech transfer companies from 2005-11 are identified in the Figure 14 above.

## Aerospace and Aviation (A&A) Training Programs

This project also aims at categorizing the relevant university aviation programs located in the Florida. Such training programs with respect to each of the university are captured in the Table 8 below.

**Table 8: Florida Institutions' A&A Training Program**

Schools with A & A Programs	Programs
Embry-Riddle Aeronautical University	Aeronautical Science, Air Traffic Management, Applied Meteorology, Aviation Maintenance Science, Homeland Security, Safety Science, Private Pilot Single-Engine, Instrument Pilot Single-Engine, Commercial Pilot Single-Engine, Commercial Pilot Multiengine Add-On, same for Multiengine, Flight Instructor Rating, Airline Flight Crew Techniques and Procedures
Florida Institute of Technology	Aviation, Aviation Human Factors, Airport Development and Management, Aviation-Aviation Safety Online, Private Pilot, Instrument Rating, Commercial Pilot, Multi-Engine Rating, Flight Instructor (CFI), Flight Instructor - Instrument (CFII), Flight Instructor - Multi-Engine (MEI), JAA Training/Conversion, IACRA
Jacksonville University	Airline Management Track, Airport Management Track, Air Traffic Control Track, Commercial Pilot Track, Military Navy Track, Military Marine Track
Lynn University	Aviation Management, Private Pilot Certificate, Instrument Pilot Rating Certificate, Commercial Pilot Rating Certificate, Professional Commercial Pilot Certificate, Certified Flight Instructor Certificate, Boeing B-727 Familiarization Certificate, Airline Transport Pilot (ATP) Certificate, Recurrent Flight Training Certificate
Broward College	Air Traffic Control, Aviation Maintenance Technology, Airport Operations Management and Aviation Operations, Aerosim Flight Academy, Professional Pilot Technology
Everglades University	Aviation Science, Aviation Management, Aviation Technology
Florida Memorial University	BS in Airway Science, BS in Aeronautical Science, Flight Safety (Minor), Homeland Security (Minor), BS Airway Science (Airway Science Management)
Florida State College at Jacksonville	Associate in Science in Aviation Maintenance Management, Aviation Operations, Professional Pilot Technology
Miami Dade College	Aviation Administration, Aviation Maintenance Management, Professional Pilot Technology, Air Cargo Agent, Airline / Aviation Management, Airport Management, Certified Flight Instructor, Passenger Service Agent

## **The Florida Center for Advanced Aero-Propulsion Achievements (FCAAP)**

The center was formed to meet the needs of a fast growing and very competitive aerospace industry. The center objectives are to help train and sustain the much needed, highly skilled workforce; to design and develop new technologies and products required to help sustain the Aerospace industry; and to transition the technology to applications in a timely and efficient manner. FCAAP has a partnership with four Florida universities including FSU, UCF, UF and ERAU. FCAAP's primary research areas include: active flow, noise and vibration control, advanced propulsion and turbo machinery, sensor and actuator development, advanced diagnostics, aerothermodynamics, aero acoustics, high performance computation, and smart materials, systems and structures. Table 9 below gives a description of what each of these 4 universities projects are in the respective research areas.

**Table 9: Universities and FCAAP Research Areas**

<b>Research Areas</b>	<b>FSU</b>	<b>UCF</b>
<b>Active Flow and Noise Control</b>	Active and Adaptive Control of Supersonic Flow Using High Bandwidth Pulsed Micro-Actuators; Active Flow Control to Improve Aerodynamic Performance of Turbo machinery Systems; Characterization and Control of Impinging Jets at Realistic Flow Conditions; Airfoil Aero acoustics: Simulation and Modeling; Biosynthesis of Aerodynamics Microsystems and Structures.	Intelligent Controlled High Temperature Shape Memory Alloy (SMA) Actuators.
<b>Advanced Propulsion and Power</b>	Active Flow Control to Improve Aerodynamic Performance of Turbo machinery Systems; Advanced Aero-Propulsion-Fuel Cells / Energy Storage and HTS Electric Propulsion,	Development of Prime Reliant Thermal Barrier Coatings via Phase Field Modeling and Experimental Validation; Development of 3D Fiber Reinforced Polymer Matrix Nano composites for Next Generation Aero-Engine; An Automated and Integrated Routine for Prediction of Life of Aero-components (AIRPLANE); Study of Vaporization Characteristics of Pure and Blended Bio-Fuel Droplets; Detailed Study of Flow Interaction and its Impact on Aerodynamic Performance and Heat Transfer in Turbo machinery Passages.
<b>Next Generation Air-Vehicles and Systems</b>	Thermal Insulation System for Future Space Vehicles; Microstructure Evolution in Thermal Barrier Coatings for Advanced Aero-Propulsion Applications; Nano engineered Thermal Barrier Coatings; Biosynthesis of Aerodynamics Microsystems and Structures; Advanced Numerical Methodology to Quantify and Reduce Uncertainty in Aircraft Trajectory Planning; Acoustic Simulation and Directional Self Assembly.	Development of 3D Fiber Reinforced Polymer Matrix Nano composites for Next Generation Aero-Engine.
<b>Education, Training, and Outreach</b>	Several symposia have been held	Several symposia have been held

Source: FCAAP Homepage

**Table 9 Continued**

<b>Research Areas</b>	<b>UF</b>	<b>ERAU</b>
<b>Active Flow and Noise Control</b>	Grazing Flow Incidence Tube (GFIT); Characterization of Aero acoustic Noise Sources for Future Aircraft Design; Plasma Actuated Flow Management; Massively Parallel Higher-Order Method for Turbulence and Aero acoustics Simulations.	Nothing reported
<b>Advanced Propulsion and Power</b>	Characterization of Alternative-Fueled Flameless Combustion for Future Aero-Propulsion Systems.	Nothing reported
<b>Next Generation Air-Vehicles and Systems</b>	Characterization of Alternative-Fueled Flameless Combustion for Future Aero-Propulsion Systems; Characterization of Aero acoustic Noise Sources for Future Aircraft Design.	Nothing reported
<b>Education, Training, and Outreach</b>	Several symposia have been held	Several symposia have been held

Source: FCAAP Homepage

## Commercial Aerospace-Related R&D

The array of industry activities in Florida includes airplane component manufacturing, advanced aerospace research, flight training, and space exploration. The aerospace industry alone, according to a recent FSU CEFA (2012) report, directly employs over 74,000 Florida workers with 3,891 companies, and about \$9,163,193,758 in sales and revenues. Florida will continue to flourish and maintain acumen as a leader in aerospace and aviation if it continues to tap its comparative advantages: e.g., state government support, top notch educational and research institutions conducting cutting edge research in aerospace and aviation, a highly skilled, trained and specialized work force, a high ranked business environment for aerospace and aviation commercial activities, and an ideal location.

**Table 10: Types of Research Conducted by Aerospace-Related Companies in Florida**

<b>Company name</b>	<b>Types of Research</b>
LOCKHEED MARTIN CORPORATION	Aeronautics, Space systems, Military combat aircraft, Logistics support, UAV
HONEYWELL INTERNATIONAL INC	Algorithm design, Analysis and parallelization, Large scale complex system design and implementation, Model based development, Modeling and simulation of networks and performance analysis, Computation systems with a primary focus on wireless system design, Unmanned Air Vehicles, Mining, Agriculture, Smart transportation systems, Robot vehicles, Marine vessels, navigation, Perception sensing, X-by-wire controls, Multi-sensor fusion, Fault tolerance and reconfiguration, Smart communication and computing platforms with competencies ranging from multi-sensor fusion to algorithms, Pattern Recognition, Machine Learning to Vision sensor processing techniques
NORTHROP GRUMMAN SYSTEMS CORP	Micro gyro technology, Cooling electron modules, Nitride-based high power transmit/receive modules, Navigation systems, Thermal management of electrons
EMBRAER SERVICES INC	Product strategy services, primarily in the commercial aviation segment, Creation of new technologies that may be applied to aircraft in the future
RAYTHEON COMPANY	Advanced robotic systems, Unmanned ground vehicles, High performance computing, Systems and software management and monitoring infrastructure, Data visualization and modeling animation, Radar development, design, production and advancements., Space sensors, Weather, climate and environmental monitoring, Missile defense, Electro-optical and radio frequency sensors
L-3 COMMUNICATIONS SECURITY	High reliability microwave power, RF radiation detection, Deep space communication systems, Particle accelerators, Satellite communication systems, Defense radar systems

<p>DRS TACTICAL SYSTEMS INC (Subsidiary of Finmeccanica)</p>	<p>Materials for electro-optical applications, Man-portable applications, Avionics products ,Multi-sensory solutions based on visible and infrared band imaging for detecting IED threats, Night-vision products, Distributed radar, Electro-optical sensors, Sonar and unguarded ground sensors, Integrating high-performance computers on networking and on signal processing capacity within an intelligence communications sub-system for air and land applications and for troops</p>
<p>BOEING COMPANY</p>	<p>Biofuels, Global strike systems including fighters, bombers, combat rotorcraft systems, weapons and unmanned systems, Global mobility systems including transport and tanker aircraft, rotorcraft transport and tilt-rotor systems, Airborne surveillance and reconnaissance aircraft including command and control, battle management and airborne anti-submarine aircraft, Network and tactical systems including information and battle management systems, Intelligence and security systems, Missile defense systems, Space and intelligence systems including satellites and commercial satellite launching vehicles, Space exploration</p>
<p>HEICO</p>	<p>High-reliability parts and components, such as aircraft, spacecraft, defense equipment, medical equipment, and telecommunications systems, electro-optical, Microwave and other components found in aviation, broadcast, defense, homeland security, medical, space, telecom and other complex equipment</p>
<p>PALL AEROPOWER CORPORATION (Subsidiary of Pall Corporation)</p>	<p>Filtration and fluid monitoring equipment, Hydraulic protection products</p>
<p>PRATT/WHITNEY/ROCK ETDYNE (Subsidiary of United Technologies Corporation)</p>	<p>Large commercial, business and military aircraft, Turboprop engines for regional airline, business, utility and military aircraft, Turbo shaft engines for commercial and military helicopters, Land-based gas turbine, Biomass, Solar thermal and geothermal power, Liquid space propulsion Pratt &amp; Whitney's ultra-efficient Pure Power PW1000G systems for military and commercial applications</p>
<p>BAE</p>	<p>Commercial aircraft avionics, Biofuels, Survivability and targeting, Tactical identification, Sensing and intelligence exploration system for maritime, Land and space based applications, Electronic combat</p>
<p>HARRIS CORPORATION</p>	<p>Communications, Electronic systems, RF communications, Integrated network solutions and government communications systems</p>
<p>GENERAL DYNAMICS</p>	<p>Gulf stream's product enhancement and development programs</p>

ASTROTECH SPACE OPERATIONS	Satellite and spacecraft pre-launch processing, Payload processing and integration, Space hardware design and manufacturing, Third party space access acquisition and integration, Microgravity commercial drug development, Space technology product commercialization for earth applications
THALES COMMUNICATIONS INC-	Software-defined radio (SDR) technology, Innovative communications systems for warfighters and first responders, tactical communication systems, Multiband airborne radios
JACOBS ENGINEERING GROUP INC	Next-generation Airbus A350, CAE Tropos-6000 image generator, Airport visual database web portal, High-fidelity interactive air traffic simulation, CAE offers a range of simulation-based solutions for land forces
CAE	Next-generation Airbus A350, CAE Tropos-6000 image generator, Airport visual database web portal, High-fidelity interactive air traffic simulation, CAE offers a range of simulation-based solutions for land forces
INDRA SYSTEMS	Touch sensitive surfaces: Hardware and Software, Artificial intelligence: Bayesian networks and other behavior simulation and prediction systems, Advanced Interfaces: Augmented Reality, object tracking and recognition, active environments, sensor environments and multimodal interaction interfaces, localization and positioning technologies
SPIRIT AIRLINES INC	
IHMC.US	Biologically inspired robots, Computational and philosophical foundations, Distributed computing, Human centered displays, Knowledge discovery and data mining, Knowledge modeling and sharing, Security and information assurance

**Source: Firms' Homepage**

Of these companies, 16 firms have operations in Unmanned Aerial Vehicle (UAV) including: Lockheed Martin Inc, Honeywell International Inc, Northrop Grumman Systems Corp, Raytheon Company, Boeing Company, DRS Tactical Systems, L-3 Communications Security, BAE, Harris Corporation, General Dynamics, Astrotech Space Operations, Pratt/Whitney/Rocketdyne, CAE, Indra Systems, Heico, and IHMC.US

### **Florida Assets in A&A**

- Infrastructure is already in place as well as an experienced, skilled labor force.
  - According to the year 2012 FSU CEFA study, there were 3,851 companies in aerospace and aviation, with more than 74,232 employees, accounting for over \$9.1 billion in total wages.
  - There is rental/lease space currently available in industrial airparks.
  - There are 19 commercial airports in Florida.

- Florida is host to the 3<sup>rd</sup> largest space industry state and 4<sup>th</sup> largest in space based employment.
- Figure 15 depicts the concentration of aerospace employment in Florida for year 2011<sup>3</sup>. The bulk of aerospace employees work in central Florida on the Atlantic Coast, followed by South Florida's Tri-County area, with Jacksonville and Fort Walton Beach having aerospace concentration
- Figure 16 represents the concentration of aviation employment in Florida for year 2011. The majority of aviation employment takes place in South Florida's Tri-County area. This could be due to the presence of Miami International Airport and Ft. Lauderdale Airport, both major air traffic facilities. There is also a heavy concentration of aviation employment in the Orlando and Tampa areas.

### A&A Incentive Programs Available in Florida

- Space Florida Sub-Orbital Flight Incentive Program
  - Provides partial reimbursement for customers to fly research payloads from Florida, equal to one-third of the published list price of an approved flight provider, up to a maximum of \$10,000. Ends December 31, 2013.
- Space Florida International Space Station Research Competition
  - Space Florida and NanoRacks have partnered to provide a Competition in which up to eight (8) winners will have an opportunity to fly research payloads to the ISS and have scientific research conducted on board the National Lab. Program period; September 5, 2012 – December 31<sup>st</sup> 2014.
  - SB634- "Launch Support Facilities"
  - Enables funding to more appropriately allocated projects and infrastructure dealing with launch operations, not just space launch operations.
- HB873- "Space Business Incentives Act"
  - This bill includes \$10 million in space business tax credits both to enable the state to attract new and expand existing space-related businesses. Specifically, the bill includes corporate income tax credits and transferrable net operating loss tax credits.
  - Companies applying must do the following within 5 years: Create a minimum of 35 jobs and invest \$15 million in infrastructure.
- SB942- "Research and Development Tax Credits "
  - Included **\$7.1 million** in tax credits for research and development work done in Florida.
- HB143- "Aerospace Jobs Retention Credit"
  - Tax incentive for job creation in aerospace sector; tax credit for tuition reimbursement to stimulate high wage jobs in aerospace.

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<sup>3</sup> Space Florida provided the map of concentrations for both aerospace and aviation employment in Florida for 2011.

# Concentration of Aerospace and Aviation Employment in Florida

Figure 15: Aerospace Employment

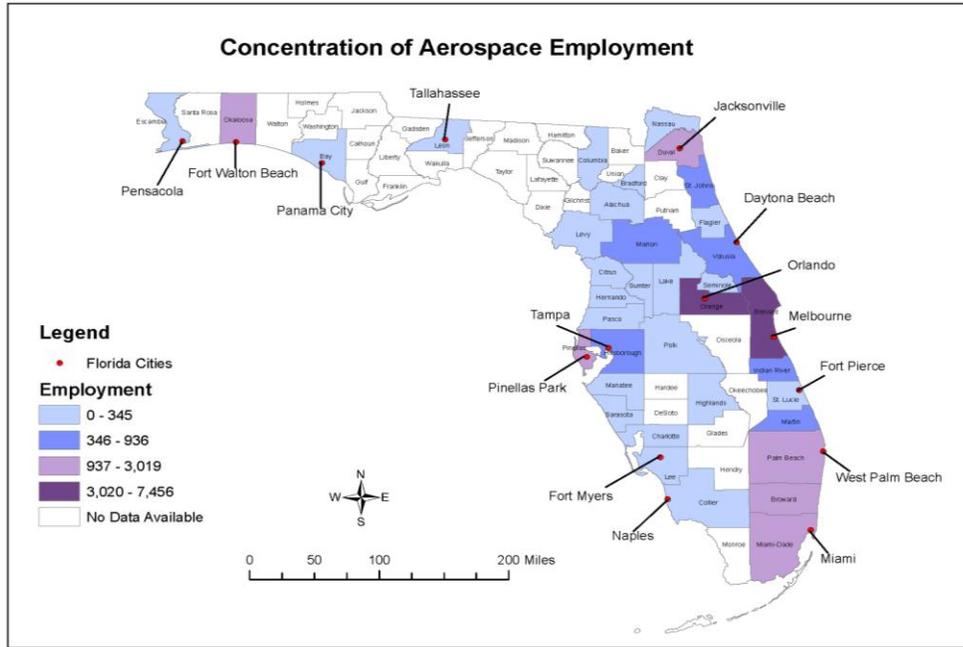
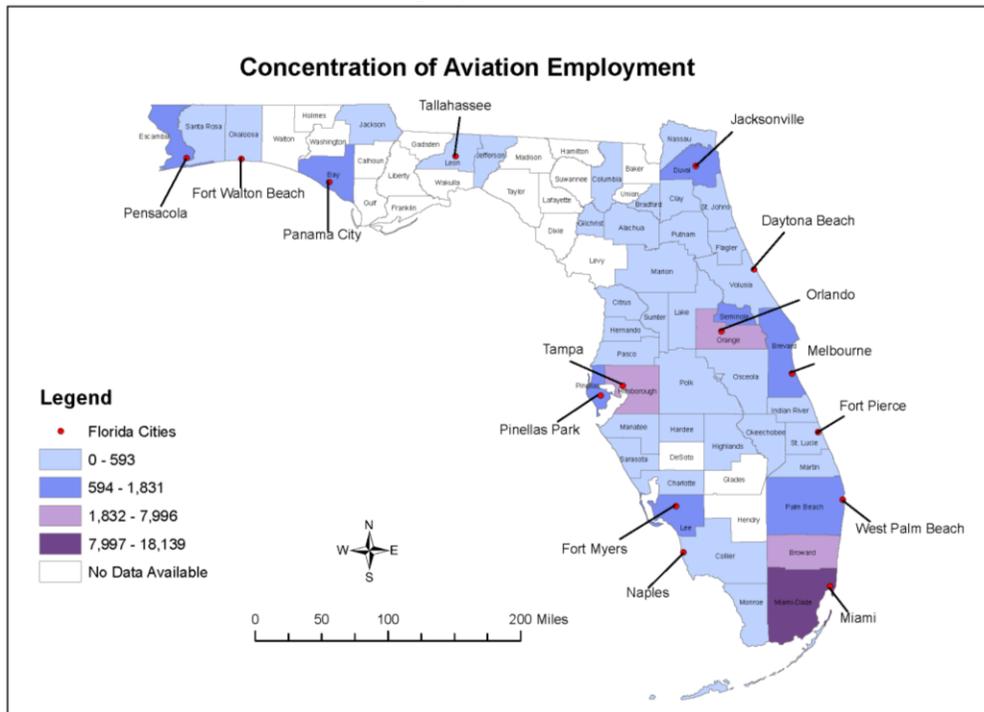


Figure 16: Concentration of Aviation Employment



## Sales and Revenues of A&A Companies

Figure 17: Net Sales and Revenues of Aerospace and Aviation (A&A) Companies

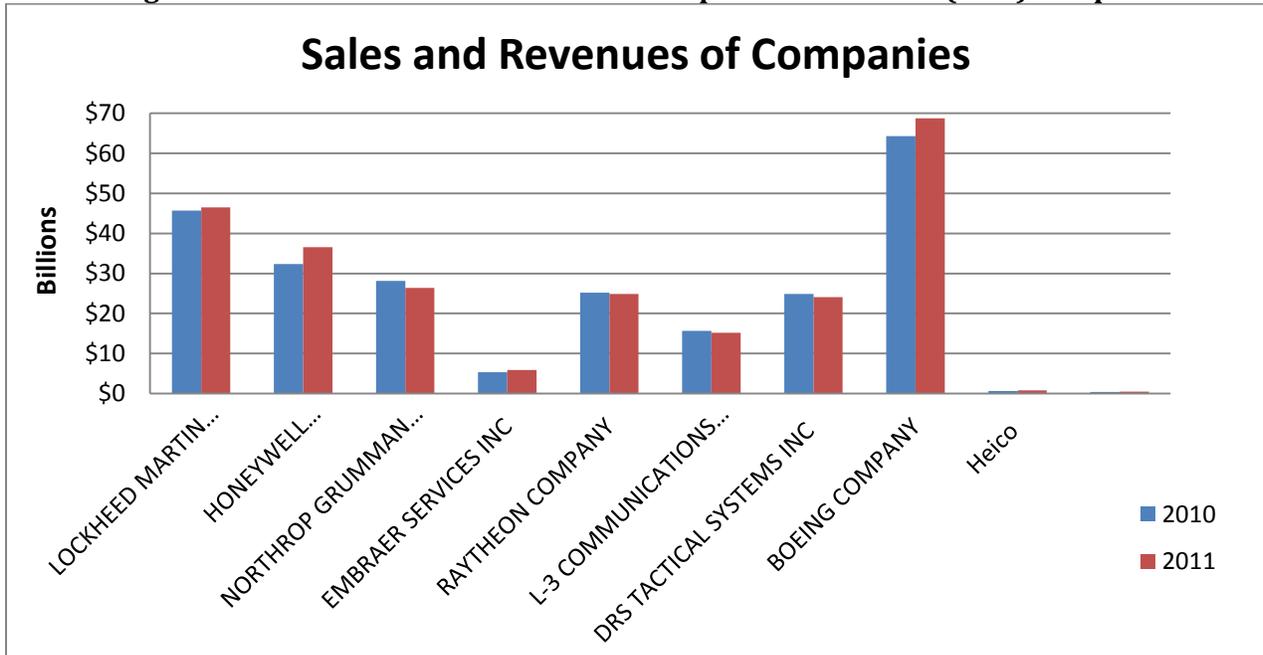
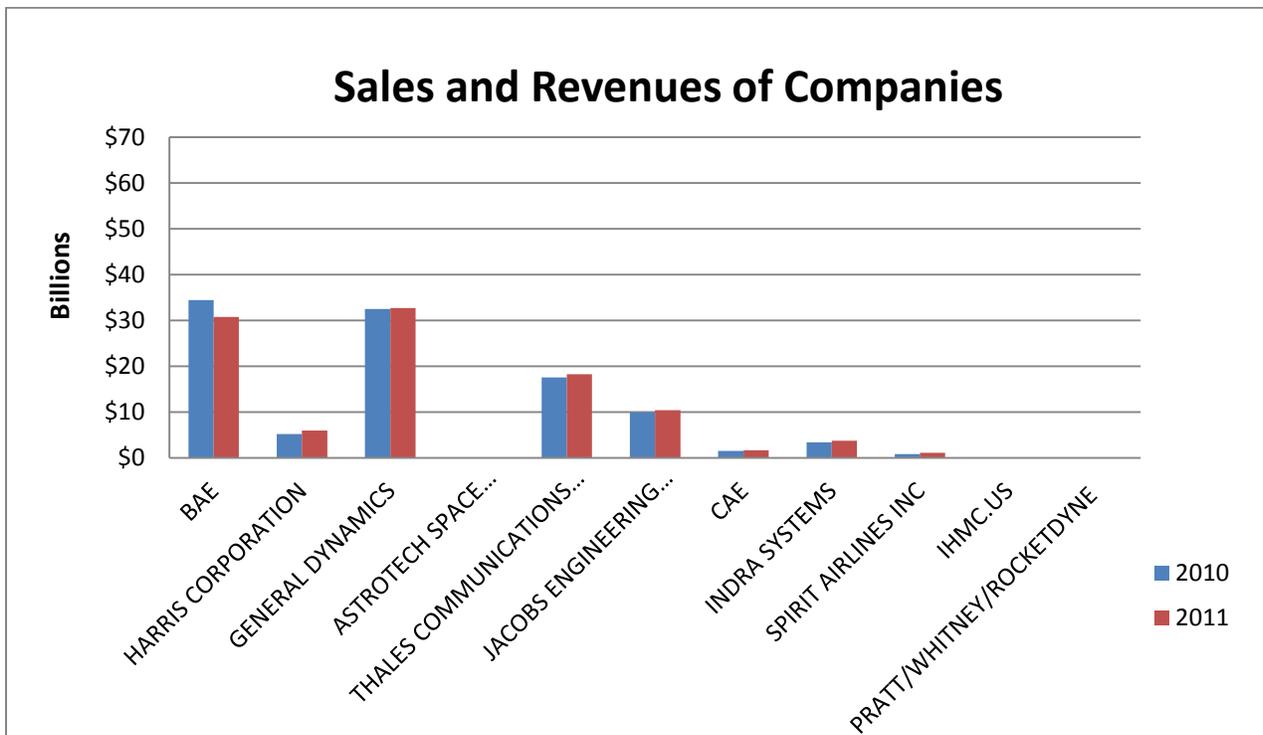


Figure 17 Continued



Source: Firm's Annual Reports and NETS (Dun and Bradstreet Florida data for Year 2010)

The 20 companies presented in Figure 17 above represent the firms that conduct research in aerospace and aviation related programs and such A&A firms are represented in The State of Florida. The sales presented in the graph are the net sales of the group and not the subsidiary. In 2010, the total net sales of the firms increase from \$347,875,251,618, to \$353,929,820,000 in 2011, representing a 1.7% increase in sales & revenues for those two years. The table below provides information on the size of each firm.

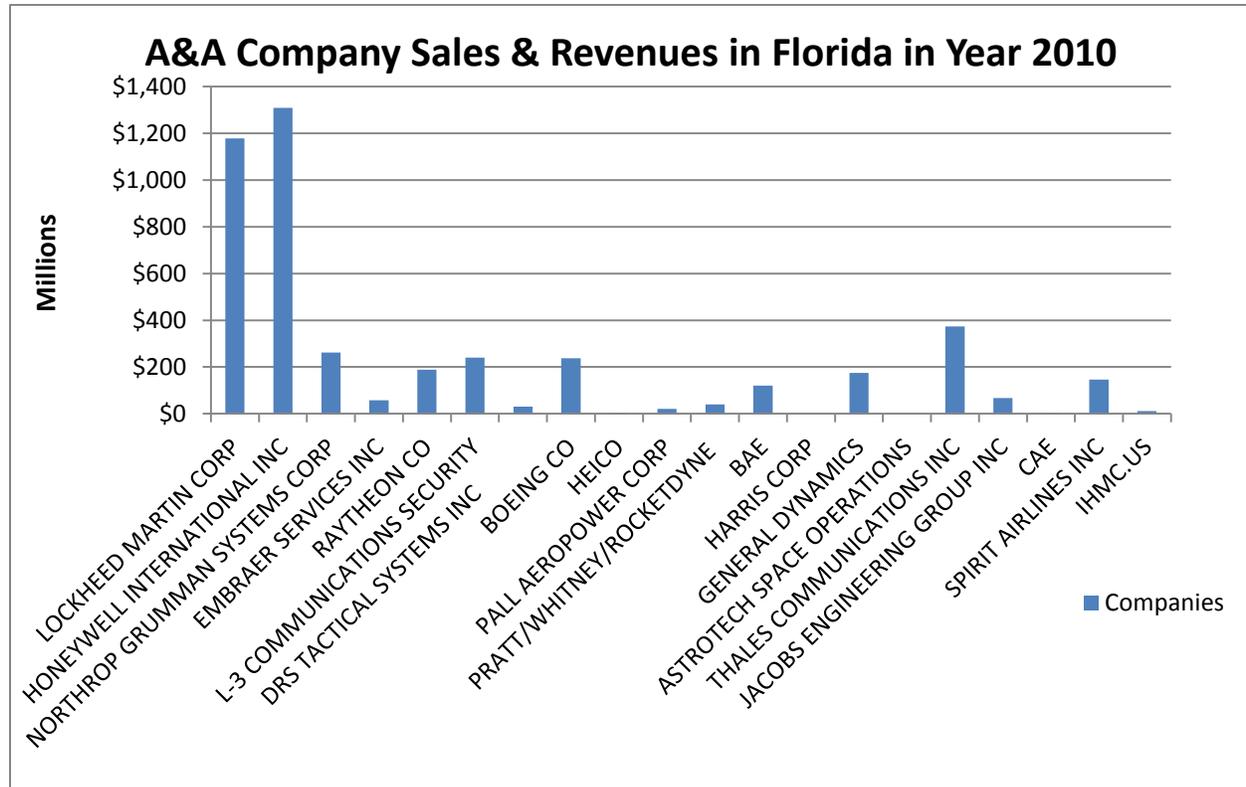
**Table 11: The Value of the Firms' Net Sales and Revenues.**

<b>Company</b>	<b>2010 (\$)</b>	<b>2011 (\$)</b>
LOCKHEED MARTIN CORPORATION	45,671,000,000	46,499,000,000
HONEYWELL INTERNATIONAL INC	32,350,000,000	36,529,000,000
NORTHROP GRUMMAN SYSTEMS CORP	28,143,000,000	26,412,000,000
EMBRAER SERVICES INC	5,347,170,000	5,916,000,000.00
RAYTHEON COMPANY	25,183,000,000	24,857,000,000
L-3 COMMUNICATIONS SECURITY	15,680,000,000	15,200,000,000
DRS TACTICAL SYSTEMS INC	24,864,350,000	24,072,020,000
BOEING COMPANY	64,310,000,000	68,740,000,000
HEICO	617,020,000	764,890,000
PALL AEROPOWER CORPORATION	418,203,000	475,000,000
PRATT/WHITNEY/ROCKETDYNE	12,935,000,000	13,430,000,000
BAE	34,414,875,000	30,723,016,000
HARRIS CORPORATION	5,210,000,000	5,920,000,000
GENERAL DYNAMICS	32,466,000,000	32,677,000,000
ASTROTECH SPACE OPERATIONS	27,979,000	19,746,000
THALES COMMUNICATIONS INC-	17,537,357,760	18,256,696,920
JACOBS ENGINEERING GROUP INC	9,915,517,000	10,381,644,000
CAE	1,526,300,000	1,629,000,000
INDRA SYSTEMS	3,400,810,000	3,736,320,000
SPIRIT AIRLINES INC	781,265,000	1,071,186,000
IHMC	11,404,858	13,459,033
Grand Total	<b>\$347,875,251,618</b>	<b>\$353,929,820,000</b>

Source: Firm's Annual Reports

Figure 18 below provides more information on the total net sales and revenues specific to Florida-based A&A companies in year 2010.

**Figure 18: The Total Net Sales and Revenues of A&A<sup>4</sup> Companies Specific to Florida**



Source: NETS 2010 database

The total net sales of the A&A companies specific to Florida was \$4.46 billion in 2010. This amount represents, approximately, 1.3% of the companies’ total sales in 2010. Honeywell Int’l Inc, Lockheed Martin Corp, Thales communications Inc, Northrop Grumman Systems Corp and L-3 Communications Security are the top largest firms, by sales, among these A&A companies in Florida. The net sales of these five firms represent 75.3% of the total net sales specific to Florida. Honeywell and Lockheed Martin’s net sales respectively represent 29.4% and 26.5% of the total net sales specific to Florida. Moreover, about 2.6% of Lockheed Martin total sales in 2010 were realized in Florida while about 4.1% of the total sales of Honeywell International Inc were made in Florida in 2010.

<sup>4</sup> Aerospace and Aviation

The top 10 companies in the aerospace and aviation industries are identified in Table 12 below

**Table 12: The Top 10 A&A Companies<sup>5</sup> by Size**

<b>Company name</b>	<b>Sales 2010(\$)</b>	<b>Company name</b>	<b>Sales 2011(\$)</b>
BOEING COMPANY	64,310,000,000	BOEING COMPANY	68,740,000,000
LOCKHEED MARTIN CORPORATION	45,671,000,000	LOCKHEED MARTIN CORPORATION	46,499,000,000
BAE	34,414,875,000	HONEYWELL INTERNATIONAL INC	36,529,000,000
GENERAL DYNAMICS	32,466,000,000	GENERAL DYNAMICS	32,677,000,000
HONEYWELL INTERNATIONAL INC	32,350,000,000	BAE	30,723,016,000
NORTHROP GRUMMAN SYSTEMS CORP	28,143,000,000	NORTHROP GRUMMAN SYSTEMS CORP	26,412,000,000
RAYTHEON COMPANY	25,183,000,000	RAYTHEON COMPANY	24,857,000,000
DRS TACTICAL SYSTEMS INC	24,864,350,000	DRS TACTICAL SYSTEMS INC	24,072,020,000
THALES COMMUNICATIONS INC-	17,537,357,760	THALES COMMUNICATIONS INC-	18,256,696,920
L-3 COMMUNICATIONS SECURITY	15,680,000,000	L-3 COMMUNICATIONS SECURITY	15,200,000,000

The Boeing Company, in terms of sales and revenue volume, remains the largest A&A company in Florida. The company increased its sales by 6.9% in 2011 when compared with a marginal increase of 1.04% of the 10 largest companies in A&A in Florida. The 1.04 % growth is lower than the total industry growth.

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<sup>5</sup> The sales of the A&A companies are the value of the total sales of the firms and these are not peculiar to Florida

## A&A Industry Customers

As outlined in Table 13 below, the federal government provides the largest customer base to these companies. For years 2010 and 2011, the federal government increased its purchases on A&A products by 3.34%.

**Table 13: A&A Firms' Customers**

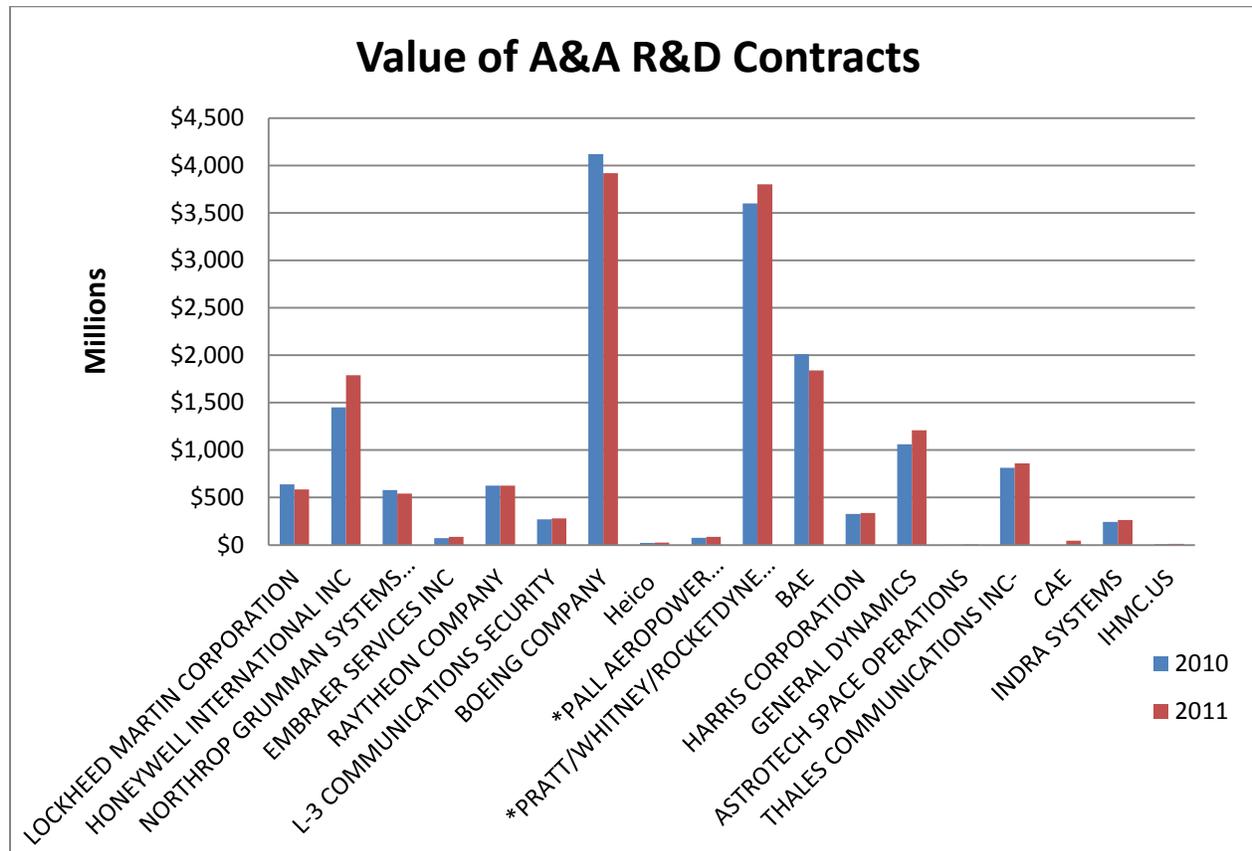
Company name	Percent in 2010		Percent in 2011	
	Government	Private/ others	Government	Private/ others
LOCKHEED MARTIN CORPORATION	23.19	6.681	22.02	8.36
HONEYWELL INTERNATIONAL INC	2.67	27.29	2.42	30.42
NORTHROP GRUMMAN SYSTEMS CORP	15.5	2.749	14.07	2.5
EMBRAER SERVICES INC	0.42	4.54	n/a	n/a
RAYTHEON COMPANY	13.55	2.95	10.89	6.12
L-3 COMMUNICATIONS SECURITY	8.73	1.38	8.10	1.44
BOEING COMPANY	9.05	38.88	15.46	32.53
HEICO	0.115	0.45	0.11	0.43
HARRIS CORPORATION	2.395	1.27	2.52	1.57
GENERAL DYNAMICS	14.30	5.70	13.35	6.5
ASTROTECH SPACE OPERATIONS	0.01	0.01	0.01	0.005
THALES COMMUNICATIONS INC	8.041	4.28	9.04	4.82
JACOBS ENGINEERING GROUP INC	1.541	2.90	1.5	3.73
CAE	0.491	0.70	0.51	0.72
INDRA SYSTEMS	0.0	0.24	0	0.84
IHMC.US	0.0041	0.005	0.005	0.005

Lockheed Martin Incorporation represented 23.19% and 22.02%, in 2010 and 2011 respectively, of the total federal government purchases on A&A products; whereas Boeing garnered 9.05% and 15.46%, of the total federal government purchases in 2010 and 2011, respectively. In comparison, 38.88% of the total private sales were obtained by Boeing Company in 2010, and 32.53% in 2011. Indra Systems remains solely a private customer base.

## Research and Development in Aerospace and Aviation Contracts

Florida is home to a number of nationally recognized firms that conduct varied research in aerospace and aviation-related activities. These firms earn the huge support of federal government and other customers in their contributions and enhancement of the economic development goals of the state through R&D. Figure 18 below depicts the most recent sources of sales to respective firms.

**Figure 19: A&A Value of Research and Development in Florida for Years 2010 and 2011**



Source: Firm's Annual Reports

The Boeing Company remains the highest recipient of federal government contract awards in R&D in years 2010 and 2011.

**Table 14: Breakdown of Federal Aerospace-Related R&D Contracts in 2010 and 2011**

<b>Company</b>	<b>Sales 2010 (\$)</b>	<b>Sales 2011 (\$)</b>
LOCKHEED MARTIN CORPORATION	638,000,000	585,000,000
HONEYWELL INTERNATIONAL INC	1,450,000,000	1,790,000,000
NORTHROP GRUMMAN SYSTEMS CORP	580,000,000	543,000,000
EMBRAER SERVICES INC	71,877,000	86,136,000
RAYTHEON COMPANY	625,000,000	625,000,000
L-3 COMMUNICATIONS SECURITY	270,000,000	280,000,000
BOEING COMPANY	4,120,000,000	3,920,000,000
HEICO	22,700,000	25,400,000
*PALL AEROPOWER CORPORATION (Subsidiary of Pall Corporation)	74,944,000	86,805,000
*PRATT/WHITNEY/ROCKETDYNE (Subsidiary of United Technologies Corporation)	3,600,000,000	3,800,000,000
BAE	2,011,900,000	1,838,400,000
HARRIS CORPORATION	325,800,000	335,600,000
GENERAL DYNAMICS	1,060,000,000	1,210,000,000
ASTROTECH SPACE OPERATIONS	2,800,000	3,800,000
THALES COMMUNICATIONS INC-	814,359,000	860,688,000
CAE	0	44,500,000
INDRA SYSTEMS	244,720,000	262,710,000
IHMC.US	10,164,625	11,711,954
<b>Total</b>	<b>\$15,922,264,625</b>	<b>\$16,308,750,954</b>

**Source: Firm's Annual Reports**

The total R&D in aerospace-related contracts in 2011 was \$16.3 and \$15.9 billion in 2010. This figure indicates a 2.43% increase in federal government expenditures in R&D for those two years and underscoring the federal government commitment in boosting industry's output and services. Its increasing support corresponded to 6.9% growth in sales of the industry. Hence, increased expenditure in A&A-related R&D increased the bottom line, and job creation, of the industry. The total expenditure in R&D represented 4.57% of the total net sales in 2010, and 4.61% of the total net sales in 2011; the ratio of sales to R&D was 22:1 for both years. The seven firms with the highest recipients of federal government awards in R&D in A&A industry in years 2010 and 2011 are identified in the table below.

**Table 15: Top Research and Development in Aerospace and Aviation Industry**

<b>Company</b>	<b>R&amp;D 2010(\$)</b>	<b>R&amp;D 2011(\$)</b>
BOEING COMPANY	4,120,000,000	3,920,000,000
*PRATT/WHITNEY/ROCKETDYNE (Subsidiary of United Technologies Corporation)	3,600,000,000	3,800,000,000
BAE	2,011,900,000	1,838,400,000
LOCKHEED MARTIN CORPORATION	638,000,000	585,000,000
GENERAL DYNAMICS	1,060,000,000	1,210,000,000
THALES COMMUNICATIONS INC-	814,359,000	860,688,000
LOCKHEED MARTIN CORPORATION	638,000,000	585,000,000

The contract awards in R&D of these seven companies amount to \$12.88 billion in 2010, and \$12.80 billion in 2011, which represented a decrease of 0.64 million in R&D. Additionally, the total value of the contracts awards of these firms represented 80.9% and 78.5% of the total contracts in R&D awarded to all the firms in 2010 and 2011, respectively. However, it should be noted that the contracts award in R&D is not proportional to the size of the firm; for instance, Pratt/Whitney/Rocketdyne.

### **Companies that Partner with Universities in Florida**

As a research land mine for economic growth and development, Florida is home to 11 SUS institutions and a private institutions, among which are, FIT, UM, and ERAU that are involved in aerospace-related research. It is important for universities located in the state to establish and develop cohesive, working relationships with industrial and manufacturing sectors in the promotion of advanced study and research. This collaboration will serve as a conduit through which rapid dissemination and transformation of knowledge from universities to industry will be processed into productivity, and economic development. A company can collaborate with universities through sponsoring a research project with a particular faculty or group of faculties, giving donations in a form of a gift to the university for various research projects conducted by or in the university, etc. Whatever form of support or companies find convenient depends on the corporate need, company's objectives and the level of longstanding tradition of investment and any other form of interests. Such collaborations between aerospace industries and universities in the Florida are identified below.

**Table 16: Collaboration Among Universities and Firms**

<b>Company name</b>	<b>Partnership with Universities</b>
LOCKHEED MARTIN CORPORATION	UF,FSU, FAU, ERAU, UCF
HONEYWELL INTERNATIONAL INC	UF, FSU
NORTHROP GRUMMAN SYSTEMS CORP	UCF, FSU, FIT, ERAU
RAYTHEON COMPANY	FAU,FSU, UCF, FIU
L-3 COMMUNICATIONS SECURITY	UCF, FIT, ERAU
DRS TACTICAL SYSTEMS INC (Subsidiary of Finmeccanica)	FIT
BOEING COMPANY	UCF, FSU, FAMU
Heico	ERAU
BAE	UCF
HARRIS CORPORATION	UCF, UF, FIT,FSU, FIU, FAU
GENERAL DYNAMICS	FSU, UCF, FIT
JACOBS ENGINEERING GROUP INC	FIU
CAE	USF, UCF
IHMC.US	UWF, FIU, UCF, USF, FAU

### Survey Methodology, Analysis and Results

The STAAR project also included another task that involved a survey questionnaire pertaining to the aerospace-related university and commercialization sectors in Florida. A survey questionnaire was designed by the project team and implemented through a web based survey software package, Survey Monkey, in order to capture anecdotal information not readily obtained or available from other information or data sources. A cover, or invitation letter, was initially distributed to the participating universities informing them about the STAAR project and associated objectives, and soliciting their cooperation regarding the survey. There were 18 universities invited to participate in the survey, however, only 10 universities, which represented a success response rate of 56%, responded with insightful information. Each questionnaire contained the following seven questions relating to A&A-related research:

- What dollar amount in Grants/Awards (you might give a specific amount), did your university receive in 2010-11 for Aerospace/Aviation research?
- What is/are your perceptions on the current level of research in Aerospace/Aviation?
- Is Aerospace/Aviation-related value-added research occurring in some/several of the following categories at your university? Please mark as many research areas as may apply?
- What areas would you identify as the key strength(s) of your university's research (including Training Programs), in the State of Florida?
- What areas of research would you identify as the major commercial opportunities in your university's research programs for the State of Florida, the U.S and Internationally?

Of all the universities FSU CEFA team included in the survey, the 11 SUS universities and four private universities were the primary respondents as they are actively engaged in research in A&A programs. There were seven (UNF, UF, FAU, FSU, NCF, FIT and FIU) out of 10 universities that were of interest to our project though, three other universities provided their perceptions and feedback on the A&A industry in Florida but were not included in the final analysis as they are currently

participating in little to no research relating to A&A projects. Meanwhile, to date, UM, FAMU, ERAU, USF, FGCU, and UWF haven't provided their survey responses to FSU CEFA. The results of the survey are presented below:

**Table 17: Universities that Responded to the Survey**

<b>Universities</b>	<b>Grant Value of Aerospace and Aviation Research</b>	<b>Current Level of Research in Aerospace/Aviation:</b>	<b>Aerospace-Related Value Added Research</b>
<b>UNF</b>	Less than \$2 million	Underfunded	Agriculture, Climate and Environmental Monitoring
<b>UF</b>	above \$6 million	Underfunded	All the 10 market sectors
<b>FAU</b>	Less than \$2 million	Underfunded	Clean Energy (Ocean), Other: Advanced propulsion concepts
<b>FSU</b>	No response	Underfunded	No response
<b>NCF</b>	Less than \$2 million	Underfunded	No response
<b>University of Tampa</b>	Less than \$2 million	Sufficiently funded	Agriculture, Climate and Environmental Monitoring, Communications, Cyber Security and Robotics, Clean energy, Advanced materials and new products
<b>Lynn University</b>	Less than \$2 million	Underfunded	Communications, Cyber Security and Robotics
<b>St. Thomas University</b>	None	Sufficiently Funded	None
<b>FIT</b>	\$30 million	Underfunded	The International Space Station and Human Life Sciences, Communications, Cyber Security and Robotics Clean energy
<b>FIU</b>	Less than \$2 million	Underfunded	Civil Protection and Emergence Management, Advanced materials and new products

**Table 17 Continued**

<b>Universities</b>	<b>Key Strengths</b>	<b>Opportunities</b>
<b>UNF</b>	Fuel Cell Technology Sensors Science & Technology Coastal Sciences	Same as strengths
<b>UF</b>	Health Sciences, Engineering, Public Health, Veterinary Medicine, Food and Agricultural Services, Life Sciences, Liberal Arts and Sciences, Health and Human Performance, Design Construction and Planning, Education	Engineering: Mechanical, Material Sciences. Health: Medical Devices, Therapeutics, Diagnostics, Drug Delivery
<b>FAU</b>	Marine and coastal issues, Biotechnology, Contemporary Societal Challenges	Same as strengths
<b>FSU</b>	No response	No response
<b>NCF</b>	Fundamental research in the areas of: Cell Biology, Biopsychology, Physical Chemistry, Optics Excellent Undergraduate Research experiences	Summer Undergraduate Research activities across all disciplines; Establishing research labs for ongoing research programs (rather than using the teaching labs); collaborating more with industry; creating 3+2 programs for students.
<b>University of Tampa</b>	No response	No response
<b>Lynn University</b>	Location	NextGen implementation
<b>St. Thomas University</b>	No response	No response
<b>FIT</b>	The diversity of the faculty and their expertise	The talent FIT has in oceanography, space and communications research.
<b>FIU</b>	STEM education and research, HIV/AIDS and Substance abuse research (both behavioral and biomedical), Environmental research (climate change, coastal and Everglades), Child mental health, with particular strengths in ADHD and autism, Disaster-related research, Nuclear Environmental Management, Biomedical engineering, Computer Science, Cancer	Same as Strengths

80% of the respondents received less than \$2 million grant in research relating to A&A in year 2010-11 while 20% had above \$6 million in the same research programs. Additionally, 80% of the respondents perceived current level of research in the State of Florida to be underfunded while only 20% believed it is sufficiently funded, but a number of the respondents do value-added research in aerospace-related sectors.

On the commercial side, a composite approach involving telephone and questionnaire surveys was used to reach the research and development department of these firms, but unfortunately, these companies, except Florida Institute for Human and Machine Cognition (IHMC), who responded to the administered questionnaire, refused to divulge information regarding the firm's R&D either through the telephone or questionnaires. Thus, FSU CEFA resorted to annual reports for more information. The FSU CEFA research team was able to collect data regarding the pertinent research information of IHMC (the only Aerospace-related firm that responded to our survey).

IHMC is a not-for-profit research institute of the state university system of Florida that investigates a broad range of topics related to understanding cognition in both humans and machines. Particular emphasis is placed on building computational tools to leverage and amplify human cognitive, physical and perceptual capabilities. Current active research areas include: agile computing, knowledge modeling and sharing, adjustable autonomy, advanced interfaces and displays, communication and collaboration, computer-mediated learning systems, intelligent data understanding, software agents, expertise studies, computer and network security, work practice simulation, knowledge representation, biologically-inspired robotics, and other related areas.

Research in general spans the range from basic research to prototype development. It was discovered that IHMC has 2 sites for their R&D and located in Pensacola and Ocala, Florida. The firm has spent above 40% on R&D in Florida in years 2010 and 2011, and out of this amount, the federal government has financed greater than 40%, while private entity only accounts for about 6%-10%, with research comprising a portion of this percentage.

Apart from multiple collaborations the firm has with SUS, the value-added research the firm brings to the A&A industry include the provision of enabling technologies that help humans and aerospace platforms better understand each other's performance state and intent, with the goal of maximizing the overall human-machine team performance. Examples include human-centered flight displays, measures for trust in the human-machine relationship, and human-centered design of autonomous system technologies. The firm's suggestions for enhanced research opportunities with Florida-based aviation/aerospace industries include attraction and investment in high tech organizations in geographic areas traditionally grounded in tourism, fishing and other conventional Florida industries. These regional areas will offer significant opportunity to increase economic diversification and expand the network of statewide technical partnerships.

## **University Research Commercialization Parks in Florida**

University research commercialization parks focus on research and commercialization activities which enable partnerships involving research and development between universities, research institutions, and companies. The main goal of parks is to translate university research innovation into tangible goods and services, and to develop further opportunities with new and existing university based companies and to further foster economic development and market-driven technologies. With 13 university technology transfer offices, 7 research commercialization parks and 109 aerospace-related companies subsisting in these university's parks, there exists a significant amount of research commercialization activity, with associated job creation, in Florida.

ERAU is in the process of creating a 140 acre research park while UF is in the final stages in building its *Innovation Square* but presently UF has a spinout of companies in Progress Corporate Park called Sid Martin Biotechnology Incubator. UF's Innovation Square will be home to the Sid Martin Biotechnology Incubator Program, RTI Biologics, UF Center of Excellence for Regenerative Health Biotechnology (CERHB), Florida Biologix, among others<sup>6</sup>.

Table 18, 19, and 20 below identifies the 10 aerospace-related SF market sectors and associated codes, and percentage participation, within each of the university research commercialization parks in Florida.

**Table 18: The Breakdown of Space Florida 10 Market Sectors and Number of Companies in University Research Commercialization Parks in Florida.**

<b>Space Florida Sector Number</b>	<b>Aerospace-Related Space Florida 10 Market Sectors</b>	<b>Total Number of Companies</b>
1	Space Transportation & Technologies Support Systems	5
2	Satellite Systems and Payloads	3
3	Ground Operations Support Systems	13
4	Agriculture, Climate & Environmental Monitoring	4
5	Civil Protection & Emergency Management	5
6	ISS & Human Life Sciences	47
7	Communications, Cyber security & Robotics	20
8	Adventure Tourism	1
9	Clean Energy	5
10	Advanced Materials & New Products	6
	<b>Total</b>	<b>109</b>

**Table 19: The Aerospace-Related University Research Commercialization Parks in Florida.**

<b>University</b>	<b>Name of Research Park</b>
FAMU/FSU	Innovation Park
FAU	FAU Research Park
FIT	Florida Tech Research Park
UCF	Research Park- Acudyn
UF	Progress Corporate Park
USF	Research Park of Tampa Bay
UM	Life and Science Technology Park

<sup>6</sup> See: <http://progresscorporatemark.com/>

**Table 20: The Share of the Space Florida 10 Market Sectors in University Research Commercialization Parks in Florida.**

Space Florida 10 Market Sectors	Number	University Research Commercialization Parks						
		FAMU /FSU	FAU	FIT	UCF	UF	USF	UM
Space Transportation & Technologies Support Systems	1	20%	20%	20%	40%			
Satellite Systems and Payloads	2			33%	67%			
Ground Operations Support Systems	3		8%	69%	23%			
Agriculture, Climate & Environmental Monitoring	4	25%			75%			
Civil Protection & Emergency Management	5	20%	20%	40%	20%			
ISS & Human Life Sciences	6	4.25%	8.5%		2.1%	59.6 %	19%	6%
Communications, Cybersecurity & Robotics	7	15%		30%	55%			
Adventure Tourism	8			100%				
Clean Energy	9	40%		20%		40%		
Advanced Materials & New Products	10	33%	17%		50%			

UCF's Acudyn is currently involved with about 40% in space transportation and technologies support systems-related activities, while FAMU/FSU Innovation Park, FAU Research Park and Florida Tech Research Park each are involved in 20% in space transportation and technologies support system-related research. About 19% of ISS and Human Life Sciences activities in these research parks are performed at the USF Research Park of Tampa Bay, with 8.5% and 6% of ISS and Human Life Sciences research occurs in FAU's Research Park and UM's Life and Science Technology Park, respectively. UCF's Acudyn Research Park has a very strong focus in Satellite Systems and Payloads, and in Agriculture, Climate and Environmental Monitoring, with 67% and 75%, respectively of the research park activity in those two sector categories.

Communication, Cyber security & Robotics research occurs in three parks with 55%, and 30%, respectively, to UCF's Acudyn and FIT's Florida Tech Research Park. FSU-FAMU's Innovation Park, UF Sid Martin Biotechnology Incubator companies located in Progress Corporate park and FIT's Florida Tech Research Park are the three major research parks in clean energy, with 40% of the research activities located in Innovation and Progress Corporate Park. The only research park that features adventure tourism-related activities is FIT's Florida Tech Research Park.

The research parks with research commercialization activities in the Advanced Materials and New Products area at 50% and 33%, respectively, are UCF's Acudyn and FAMU-FSU's Innovation Park. The table confirms, in relation to the aerospace-related SF 10 market sectors, that UF's Sid Martin Biotechnology Incubator companies located in Progress Corporate park and USF's

Research Park of Tampa Bay focus on ISS and Human Life Sciences, FSU-FAMU's Innovation Park has strength in clean energy and advanced materials, UCF's Acudyn has strengths in Agriculture, Climate and Environmental Monitoring, and Satellite Systems and Payloads, FAU's prime areas currently are in ISS & Human Life Sciences, Space Transportation and Technology Support Systems, and FIT's current strengths lie in Adventure Tourism, Ground Operations Support Systems and UF has strength in biotechnology which include ISS and Human Life Sciences and clean energy.