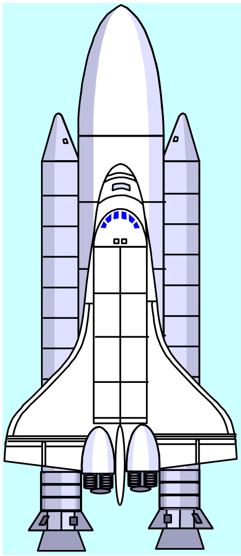


Building on Florida's Strength in Space:

A Plan for Action

Final Report

Prepared by:
The John A. Volpe National Transportation Systems Center
Research and Special Programs Administration
U.S. Department of Transportation
Cambridge, MA

December 1999

ACKNOWLEDGEMENTS

This report was conducted at the Volpe National Transportation Systems Center under the leadership of John O'Donnell. Key research and analysis was provided by Dr. Aviva Brecher, Suzanne Sloan, Krishna Jain, Maureen Luna-Long, Jim Rust, Stewart Butler, Cassandra Callaway, Elizabeth Deysher, and Cynthia Maloney.

Table of Contents

Section I: Introduction 1

Section II: Background 3

II.A: Why Is Space Important to Florida? 3
II.A.1 Florida's Economy Benefits from Space 3
II.A.2 The Space Industry Stimulates Science and Research and Technology Development 6

II.B: What Are Florida's Strengths? 7
II.B.1 Florida is the Hub of the Nation's Space Transportation System 7
II.B.2 Florida has Established a Prestigious Reputation in the Space Industry 8
II.B.3 Florida's Space Transportation Infrastructure is a Unique National Asset 8

II.C: Why Take Action Now? 9
II.C.1 The Space Market is Evolving Rapidly 9
II.C.2 A Call to Arms 9

Section III: Market Assessments 11

III.A: What Is the Space Market? 11
III.A.1 Definition of the Space Market 11

III.B: The Launch-Related Market 13
III.B.1 Background 13
III.B.2 The Launch Services Market 18
III.B.3 The Launch Vehicles Market 26
III.B.4 The Satellite Manufacturing Market 36
III.B.5 The Ground Equipment Systems Market 39

III.C: The End-User Services Market 42
III.C.1 Background 42
III.C.2 The Telecommunications Market 43

III.C.3 Remote Sensing and Imaging Market 46
III.C.4 The Navigation and Location Services Market 48

III.D: Future Markets 50
III.D.1 Background... 50
III.D.2 Spaceport Technologies Market.. 50
III.D.3 International Space Station-Based Market 52
III.D.4 The Space-Based Manufacturing Market 52
III.D.5 The Space Tourism Market.. 54
III.D.6 The Market for Long-term R&D 55

Section IV: A Course of Action.. 59

IV.A: Leadership in Space Transportation.. 59
IV.A.1 Improve Communications and Strategic Planning................................ 60
IV.A.2 Incrementally Invest in the Cape Canaveral Spaceport......................... 61
IV.A.3 Address Institutional Impediments to Commercial Launches 62
IV.A.4 Partner with Stakeholders in Developing New Vehicle and Spaceport Concepts.. 63

IV.B: Diversify the State's Commercial Space Economy.............................. 64
IV.B.1 Conduct Strategic Market Assessments.. 65
IV.B.2 Align Florida's Key Economic and Technology Sectors with the Space Economy 66
IV.B.3 Strategically Partner with NASA.. 67
IV.B.4 Support the Florida Space Research Institute and the Florida Space Institute... 68

Appendix A: Interview Highlights A-1

Appendix B: Interviewees and Contributors.. B-1

Appendix C: Remarks to Florida State Legislature C-1

List of Figures

Figure II-1: Distribution of Florida's Space Industry 3
Figure II-2: Space Industry Incomes in Florida 5
Figure II-3: Florida's Involvement in Telecommunications Manufacturing 6
Figure III-1: Worldwide Commercial Space Revenues 11
Figure III-2: Historical Demand for Launches 15
Figure III-3: Florida's Historical Demand for Launches 16
Figure III-4: Projected Demand for Launches 17
Figure III-5: Launch Services Revenue, 1996-1998 18
Figure III-6: Launch Breakdown by Mission 23
Figure III-7: Eastern Range Capacity 24
Figure III-8: Future Medium, Intermediate, and Heavy Launch Vehicles to Enter Service, 2000 to 2004 28
Figure III-9: Florida Space Vehicle Manufacturing 35
Figure III-10: End-User Services Market Breakdown 42

List of Tables

Table II-1: Estimated Economic Impacts of Space on Florida 4
Table II-2: Florida launches in comparison to worldwide competitors 7
Table III-1: Current Active Commercial Global Launch Sites 20
Table III-2: Most Likely Future Domestic Spaceports 21
Table III-3: Potential Future International Launch Sites 21-22
Table III-4: U.S. Launch Vehicle Manufacturers 27
Table III-5: Reusable Launch Vehicle Developers 30-31
Table III-6: ELV Manufacturers and Production Sites 34
Table III-7: Satellite Uses 36
Table III-8: GEO Satellite Manufacturers 37
Table III-9: LEO Satellite Manufacturers 37
Table III-10: Florida Companies Involved in Satellite Data Transmission 40

Table III-11: Florida Companies Involved in Communications Services 41
Table III-12: Fixed Satellite Service Providers 44
Table III-13: Mobile Satellite Companies 45
Table III-14: Examples of R&D and Commercialization in Florida 56
Table III-15: National Research Council Recommendations to NASA 57

SECTION I: INTRODUCTION

Access to space in the 21st century is a more vital and significant issue than ever before. Over the past 40 years, space research and exploration have created products, services, and new technologies that have radically altered the quality of our lives, how we think of ourselves, and what we, as a global community, can accomplish. Countless technologies have contributed to our nation's wealth and security. These enormous societal benefits are likely to pale, however, in comparison to the magnitude of impending technological advancements.

The state of Florida has long been active in space. Since the beginning of the space era, Florida has been uniquely positioned as the hub of our nation's space transportation system. Most of the space-related innovations left the earthbound phase of their development by way of Florida's space infrastructure. Recently, the state has been looking at ways to expand its involvement in space-related commerce to capitalize on the burgeoning commercial opportunities in the space industry.

While new commercial space markets appear to have great potential, there is great risk and great uncertainty associated with them. It is important to separate "the hype and the hope" from the reality of developments in this sector, in order to make prudent investment and policy decisions. Investors, companies, and public sector partners must consider the best available data, information, and objective market assessments before committing resources.

Recognizing these risks and uncertainties, and realizing that the space industry and market are transitioning — with the commercial sector positioned to play a greater role — Governor John Ellis "Jeb" Bush appointed Lieutenant Governor Frank Brogan as the state's lead on Florida's space policies and investment decisions. The Governor and Lt. Governor asked the Office of Tourism, Trade, and Economic Development (OTTED) to explore what role the state of Florida should undertake to achieve two important goals:

- **Maintain and strengthen Florida's leadership position in space transportation.**
- **Diversify Florida's space economy**.

OTTED asked the U.S. Department of Transportation's John A. Volpe National Transportation Systems Center (Volpe Center) to review where the space industry and the space-related activities in Florida were heading, and to provide insight into how Florida can develop strategies to achieve its goals.

The result is this report. It is based on information gathered from interviews conducted with a broad range of public and private stakeholders at the national and local levels over the months of August through November 1999. In addition, the report and its recommendations are supported by secondary research, an environmental scan of the space marketplace, and an assessment of the roles of federal and private sector stakeholders.

The report is structured as follows:

- **Section II provides background information on the role of the space sector in Florida.** It is presented to help the reader understand:
  - Why space is important to the current and future economy of Florida.
  - The advantages Florida has that provide a foundation for its continued leadership in space transportation.
  - How the space market is in transition and why it is important for Florida to act now.
- **Section III is an assessment of the various segments that comprise today's space market.** This section begins with a definition of the space market and then presents information on 12 market sub-segments. This structure is used as a means of exploring the constantly changing dynamics of the space sector and for identifying market opportunities that the state of Florida could consider.
- **Section IV presents a course of action for the state with a set of strategic recommendations**. After considering the dynamics of the space market and the strengths, weaknesses, and status of the space industry in Florida, a series of recommendations are presented. The recommendations are aligned with the two key goals for Florida to achieve: retaining leadership in space transportation and diversifying Florida's space economy.

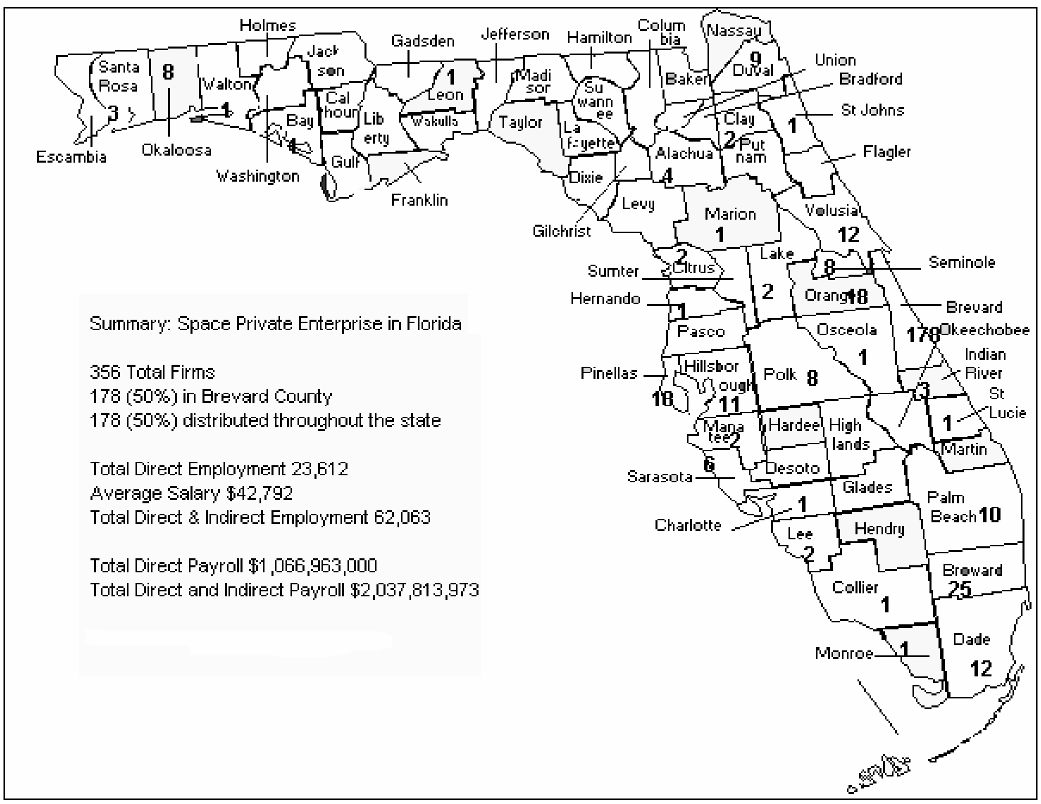
SECTION II: BACKGROUND

II.A Why Is Space Important to Florida?

II.A.1 Florida's Economy Benefits from Space

Florida has benefited greatly from past federal government and private sector investments in space. Over the last 50 years, the federal government has invested $8 billion in infrastructure at Cape Canaveral. This investment has stimulated the growth of space-related enterprise throughout the state. In addition, it has supported the continued growth of high-tech industry within the state. Figure II-1 is a map that shows the number and distribution of companies directly involved in space commerce in Florida.

Figure II-1: Distribution of Florida's Space Industry[1]



[1] SMART Enterprises database, September 1999; *Economic Census, 1997*, U.S. Census Bureau.

The benefits of the space industry do not accrue exclusively to the space coast. Not surprisingly, space related industries cluster around Cape Canaveral and Brevard County. However, approximately 50 percent of space businesses are located outside of Brevard County and are distributed throughout the regions of the state. Over $61 million in sales taxes generated by the payrolls of space businesses are redistributed statewide. These figures do not include the over $2 billion NASA and the Department of Defense (DOD) spend annually in Florida. In addition, by comparison to many of the manufacturing industries, the space industry is a relatively clean, high-tech industry — an issue of growing importance given Florida's unique environment.

Table II-1 is a breakdown of the space related industry's impact on Florida's economy. (It does not include the $2 billion indirect spending and payrolls of NASA and DOD.)

Table II-1: Estimated Economic Impacts of Space on Florida[2]

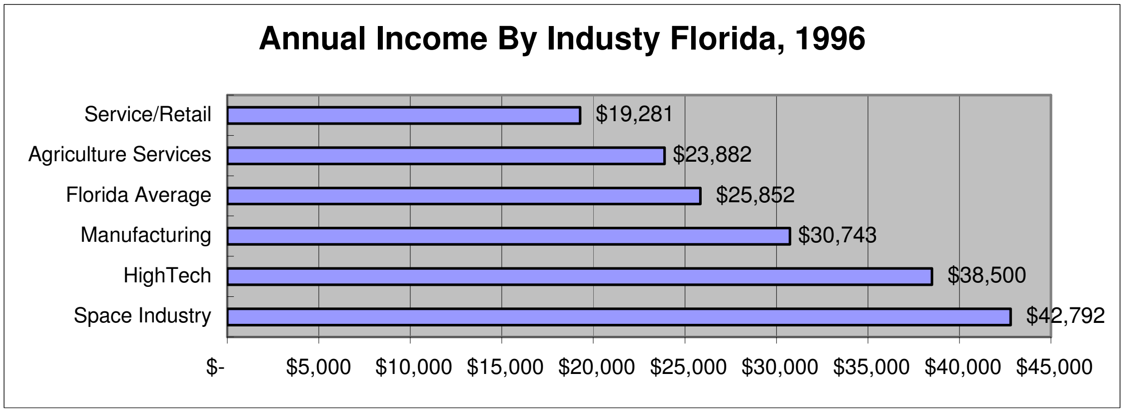
Estimated Economic Impacts of Space	**1996**	**As a % of FL Total**
Direct Jobs Created	23,612	0.44
Indirect Jobs Created	38,451	.70
Total Indirect and Direct Employment	62,063	1.1
Direct Annual Wages	$1,066,963,000	.83
Indirect Annual Wages	$970,850,973	.75
Total Direct and Indirect Wages	$2,037,813,973	1.6
Sales Tax Generated (Direct and Indirect)	$61,134,419	.38

While the table above reveals that Florida's space industry does not represent a large percentage of the overall Florida economy, the high-wage, skilled jobs this industry generates, combined with the potential for future expansion, positions this industry as vital to Florida's economy.

Figure II-2 shows that wages in the space industry outpace not only the average per capita wage in the state, but also are significantly higher than the average high-tech wage in Florida.

[2] Compiled using the *Economic Census 1997*. U.S. Census; Enterprise Florida; Florida Department of Labor and Employment Security; Bureau of Labor Market Information; U.S. Department of Labor.

Figure II-2: Space Industry Incomes in Florida[3]



Software Technology, Inc. and **Command and Control Technologies (CCT),** are examples of two spin-offs of the launch industry. Software Technology, Inc., located in Melbourne, FL, specializes in command and control applications for ground, flight, test, and process control. It has grown to over 320 employees since 1978 and has surpassed $36 million in revenues. CCT, located in Titusville, FL, directly across from Cape Canaveral, provides high technology computer products and system development services. They specialize in the design and development of highly automated launch vehicle, spaceport, spacecraft, and range control systems.

Florida's space firms include a wide-spectrum of businesses that represent most space-related fields. Major space and defense contractors such as Honeywell, Johnson Controls, Lockheed Martin, Pratt & Whitney, Harris Corporation, and Boeing are doing business in Florida, at least partially due to the existence of the space transportation industry. In addition to these major firms, Florida has many smaller firms that are actively involved in subcontracting to prime contractors.

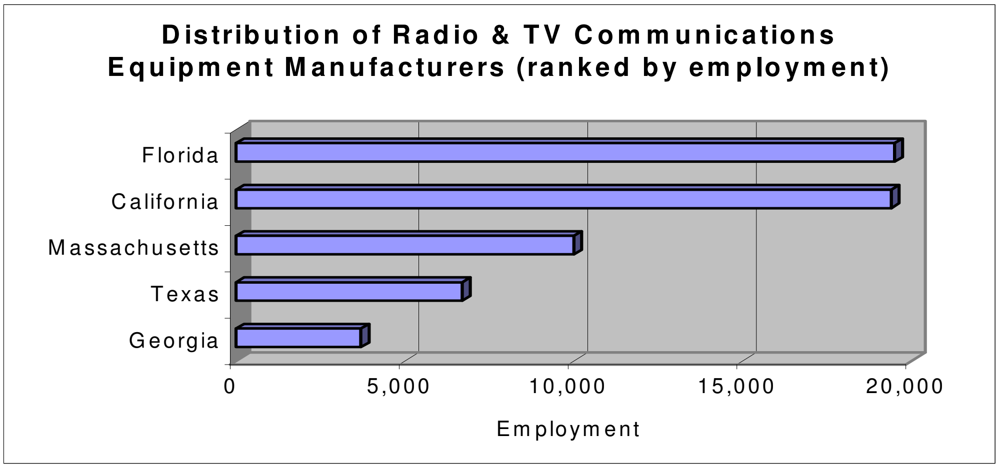
The primary space market segment within Florida is related to launch operations. Overall, this market includes products and services related to launch services, manufacture and assembly of launch vehicles, payload support and processing, spaceport operations, and ground operations equipment and services. This last segment —equipment and services for ground operations — is one of the faster growing market segments, and Florida has a strong economic base of these firms within the state (see text box to the left for two examples).

Even faster growth is occurring, these days, in the "space-enabled" end-user services market. This market is comprised of firms providing consumer (or end-user) services that are dependent on satellite access (or "space-enabled"). For instance, mobile phones or direct-to-home television are two high-growth, space-enabled markets. Florida has a strong economic base of firms in this market segment, holding a leadership position in radio and communications equipment manufacturing. This market segment is expected to grow signifi-

[3] Compiled using the *Economic Census, 1997*, U.S. Census Bureau; Federal Reserve Bank, Atlanta; and Bureau of Economic Analysis, 1997.

cantly as new wireless telecommunications, broadcast, and internet services are introduced in the coming decade. Figure II-3 shows Florida's leadership position in this industry as compared to other leading states.

Figure II-3: Florida's Involvement in Telecommunications Manufacturing.[4]



Importantly, Florida also is experiencing growth in start-up and niche industries that support "space-enabled" end-user services. Many of these businesses are small to medium-sized firms that experts predict will enjoy the fastest growth in the coming years. An example is Vista Satellite Communications, located in Ft. Lauderdale, FL. This firm is a "boutique firm" that services the broadcast, cable, and corporate communities with networking, production services, and videoconferencing, including transmission of such events as the Grammy Awards or the U.S. Open. Started in 1988, the firm has developed a fully-integrated range of satellite communications services with revenues growing dramatically to over $25 million.

II.A.2 The Space Industry Stimulates Science and Research and Technology Development

In addition to the direct wage and tax revenue economic benefits, Florida's access to the space transportation system at Cape Canaveral provides numerous opportunities to be part of the critical research and technology development (R&TD) programs supporting the launch industry, the military, and NASA's scientific missions. Numerous products and technologies have resulted from research performed in partnership with the Kennedy Space Center (KSC) and have also resulted in new businesses being established in Florida. This proximity also creates educational opportunities for Florida universities, which traditionally generates commercialization of new ideas and new business development.

[4] *Economic Census, 1997*, U.S. Census Bureau.

II.B What Are Florida's Strengths and Advantages?

II.B.1 Florida is the Hub of the Nation's Space Transportation System

Florida has been a national leader in domestic launch operations due to its geographic location and climate. Florida is also home to the most sophisticated and wide-ranging launch infrastructure in the world. Despite facilities and technologies dating back to the 1950s, entrenched operational processes, and growing competition for domestic and global launches, Florida still provides access to space for the largest number and the widest range of launch vehicles in the world. As can be seen in Table II-2, the number of launches at Cape Canaveral rank among the highest in the world, and lead the civil and commercial launch market in competition with Arianespace at Kourou, French Guyana. In addition, since 1988, Florida has successfully launched over 50 commercial payloads. Over the same period of time, less than 10 commercial launches have been supported by other U.S. launch facilities.

Table II-2: Florida Launches in Comparison to Worldwide Competitors

Location	Orbital/ extra-orbital launches (1957 – 1996)	Comments	% Civil and Commercial Launches
Plesetsk	1444	Primarily military launches (approx. 1150 out of 1444)	20%
Baikonur	1007	Primarily military launches (approx. 750 out of 1007)	26%
Cape Canaveral	556	Primarily civil and commercial (401 out of 556)	72%
Vandenberg AFB	520	Primarily military launches (428 out of 520)	18%
Kourou	83[5]	Primarily commercial	60% (est.)[6]

[5] http://www.arianespace.com/about_facts.html.

[6] Arianespace launches from Kourou frequently combine civil/commercial with military missions, thereby making it more difficult to assess their percentage of commercial business. For Arianespace, however, this number is less meaningful than for other sites where military launch requirements can, and do, have an impact on commercial business scheduling. Arianespace's commercial advantage is that it treats all launch missions similarly.

II.B.2 Florida has Established a Prestigious Reputation in the Space Industry

The high visibility and prestige associated with the space program casts the state in a favorable light nationally. This positive image is an intangible but important benefit. When the average citizen thinks about the nation's achievements in space, he or she automatically envisions the awesome power and beauty of a launch from Cape Canaveral.

The Cape Canaveral Air Station and the Kennedy Space Center — now integrated and referred to as the Cape Canaveral Spaceport (CCS) — make Florida the home of both a strategic national asset and an important historic landmark. Florida was the launch site of pioneering space exploration including the Apollo missions to the moon. KSC has been home to the Space Shuttle, the world's first and only reusable launch vehicle (RLV), since the first Shuttle launch in 1981. KSC has also been the place to launch interplanetary missions. In continuation of this tradition, KSC will be the most active launch site from which to build the International Space Station (ISS). Partners from around the world will come to Cape Canaveral to launch their construction equipment and materials.

The calendar year 2000 also ushers in a celebration of a momentous moment in the history of Florida — the 50th anniversary of the very first launch from Cape Canaveral.

II.B.3 Florida's Space Transportation Infrastructure is a Unique National Asset

Florida's space transportation infrastructure positions the state to capture future opportunities within the emerging space industry. Because of this infrastructure, Florida holds a great competitive advantage over other potential spaceport locations. Pads, runways, hangars, payload processing facilities, and other spaceport infrastructures already exist. The workforce needed to operate the infrastructure is already in place, as are the safety and environmental permits and licenses, a major obstacle to any state or country attempting to enter the launch business. As a result, Florida has a significant competitive advantage over other proposed U.S. spaceports and has all the necessary elements in place to evolve into the leading commercial spaceport of the next century.

II.C Why Take Action Now?

II.C.1 The Space Market is Evolving Rapidly

Routine access to space will be a requirement in the space industry if the visions and promises of the future are to be realized. As a result, a new space business paradigm is emerging and being shaped by a complex set of market and technology forces. However, decisions are being made beyond the state of Florida by federal government officials, companies, and institutions that may shape Florida's future in space commerce.

Some examples are:

- **In the public sector**, Federal policy decisions are being made that reflect reduced Federal budgets and the government-wide trend toward downsizing through privatization. Even though there will continue to be national security and scientific research missions driving the government's demand for launch services, there is great uncertainty about the national commitment to support access to space for private enterprise. It is possible that this uncertainty may lead to reduced funding, thereby affect the ability to upgrade the infrastructure and facilities at the Cape, just at a time when the commercial sector is expected to become the largest customer for launch services.
- **In the private sector**, investment decisions are being made in response to emerging markets that will be served by satellite communications systems. While the near-term viability of many of these telecommunications systems is still questionable, new space transportation vehicles and spaceports are being planned around the world to support the expected (though highly uncertain) growth in demand for launches. In the U.S., these developments are placing new operational requirements and cost pressures on existing launch service providers.

II.C.2 A Call to Arms

If Florida accepts the status quo and assumes that no other location will emerge as a viable alternative launch site, ***the state risks losing its commercial launch business***. It is clear, that without evolving the infrastructure and business support services to meet future customer requirements, ***commercial launch customers will seek other sites***.

Despite the Cape's current advantage as a leader in space transportation, its operating environment is not as attractive to commercial launch service customers as it could be. Evidence suggests that given the option, customers will seek other launch site options as they become available, which would result in relegating Florida to a future existence as exclusively a government launch facility. This fate would limit the economic feasibility of sustaining commercial spaceport operations within the state. As the space industry becomes more commercialized the government share of launch demand becomes smaller, leading to smaller budgets, smaller work crews, and a curtailing of improvements to the existing infrastructure. Thus, without evolving the infrastructure and technical support services to meet future commercial customer requirements now, the Cape will almost certainly miss the opportunity to house the next generation of reusable launch vehicles (RLVs) and expendable launch vehicles (ELVs).

Florida appears to be well positioned to respond to these challenges. The state has an economic base of firms and a workforce experienced in space science and operations. It has the launch and supporting infrastructure. As the space industry and related services markets are positioned to grow, Florida is positioned to capture the opportunities and grow its space sector market.

The time is also right for Florida to aggressively pursue strategies to diversify its space economy into non-launch related industries and lay the foundation for a stronger space science research and development community. In partnership with the state, Florida companies can and should more aggressively seek out opportunities that build on their industrial strengths — spaceport technologies and software development, launch processing services, ground support equipment and operations, and satellite telecommunications equipment and services.

However, while the case for Florida to act is clear, any action must be based on solid business fundamentals supported by objective information on the market and on technology evolution. Florida must avoid the risk of moving forward and making investment decisions too quickly and without a sound basis of market information. The costs associated with the risk of over investing (investment in new launch infrastructure without the associated demand) are as great as the costs of under investing (not being able to meet customer needs). Florida will not enjoy the benefits of potential economic development and synergistic business innovation that the new commercial space economy may provide, if it does not respond prudently and strategically.

The remainder of this report is aimed at providing summary information and recommendations for Florida as it moves forward in developing its commercial space market and its space transportation system. Section III of this report provides a high-level assessment of space-related market developments and opportunities for the state of Florida to consider as it formulates its space business development strategies. Section IV puts forth recommendations for actions, programs and investments to consider for retaining leadership in space transportation and diversifying the state's space economy, based on Section III's market assessments.

SECTION III: MARKET ASSESSMENTS

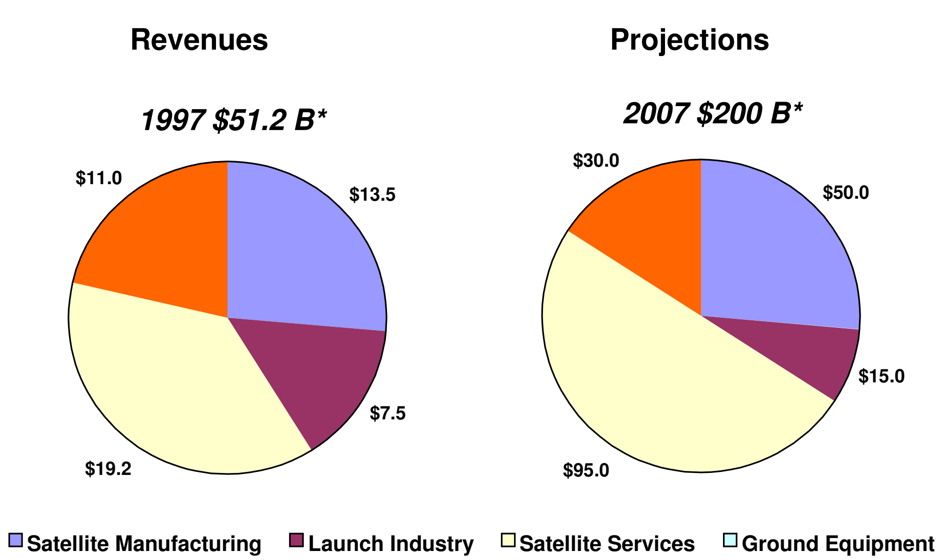
III.A What is the Space Market?

III.A.1 Definition of the Space Market

Space presents a vast and untapped potential for commercial development. Ten years ago, the extent to which our lives would be dependent on satellites was unimaginable. Space-enabled communication and data exchange are playing a greater role in the global economy and in our lives — from worldwide financial transactions to home entertainment, to daily business communications. As a result, new products and services are emerging everyday.

In 1997, commercial and government space revenues and expenditures together totaled $75B.[7] In that same year, the commercial sector worldwide alone realized $51B in revenue.[8] This figure is expected to grow to over $200B by 2007.[9]

Figure III-1: Worldwide Commercial Space Revenues



* Includes payments to subcontractors

Sources - 1997 estimate: Satellite Industry Statistics Survey 1997 (conducted for Satellite Industry Association by Futron Corporation); 2007 estimate: Futron Corporation

[7] 1997 Estimate: *Satellite Industry Statistics Survey, 1997* (conducted for Satellite Industry Association by Futron Corporation); 2007 estimate: Futron Corporation.
[8] Ibid.
[9] Ibid.

Estimating the size of the "space market" is very difficult as space-related revenues and expenditures can be found across a broad spectrum of public and private sector companies and agencies. And, while the dollar amounts in this report should be noted, what is more important for the reader to comprehend, is that space-related markets are considered to be among the fastest growing in the global economy.

Evolving commercial markets are reshaping the space industry and pushing toward a new concept of operations — a space transportation system, wherein launches will no longer be "special events," but a routine form of transporting cargo and passengers to space. This shift in operations is not yet technically feasible, but its evolution is being driven by a dramatic growth in the consumer appetite for services in telecommunications, navigation/location, and remote sensing and imaging. These “end-user” markets have become the predominant generators of space market revenues, far surpassing the traditional base of revenues generated by launch services. The increase in the demand for these end-user products and services is providing the stimulus for the current system of launch events to evolve into a space transportation system.

For Florida to capture a share of the growing space economy, public and private sector decision-makers must understand how today’s market is segmented and which segments are likely to offer opportunities for the future. The space market can be segmented in many different ways. To assess the opportunities for Florida, this report uses three broad market segments:

- **The Launch-Related Market (Section III.B)** This market includes segments for the launch services market, the launch vehicles market with subsystems and components and pre- and post-launch support, the satellite manufacturing market, and the ground support and tracking systems market. These market segments are relatively mature, with high barriers to entry, low profit margins, and increasing competition. Although growth in revenues is forecast over the next 10 years, revenues as a whole are predicted to decline as a percentage of the total space market revenues. One area of growth that is just beginning to be explored is the world of consulting services for spaceport development and operations. Using their years of experience, Florida space companies are providing their expertise throughout the world. However, for this market to show growth, spaceports would need to become as common as airports.
- **The End-User Services Market (Section III.C).** This market includes new and emerging services dependent on satellites in space, such as telecommunications, navigation/location, and remote sensing. Although this market is currently generating some revenue, stronger growth and larger revenues streams are expected in the near future — 5 to 10 years from now.
- **The Future Markets (Section III.D).** This market includes the market segments for spaceport technologies, the market based on the International Space Station (ISS) services and operations, space-based manufacturing,

space tourism, and the market for long-term research and development opportunities. These markets are still years away — estimated at about 20 to 25 years before revenue is generated — and are considered high risk, although also high pay-off if they succeed.

Opportunities exist for the state of Florida, in partnership with private firms, to invest in each of these market segments, although some segments offer more limited opportunities than others. Deciding to invest in some of these opportunities will help the state develop a more diversified and sustainable space economy, one that is less dependent on launch activity and federal budgets.

The nature of Florida's response can be three-fold:

- Some investments will be needed to maintain Florida's position in the market, especially its leadership position in the space transportation market.
- Some investments can be made that will have a more direct and immediate pay-off in the near-term.
- Some investments will position Florida to capture emerging market opportunities.

Opportunities also exist to partner with the federal government to help define and test the next generation of spaceport technologies, operations, and procedures. Investment in this type of partnership positions Florida at the strategic edge of the evolving space industry.

The remainder of this section presents a brief overview of the opportunities and challenges in each of the three broad market segments identified above. However, more in-depth assessments will be needed before the state can develop a comprehensive business development strategy or invest public funds.

III.B The Launch-Related Market

III.B.1 Background

The launch-related market includes four important sub-segments that are of interest to Florida:

- The launch services market (Section III.B.2).
- The launch vehicle market, including current and next generation vehicles (Section III.B.3).
- The satellite manufacturing market (Section III.B.4).
- The ground equipment systems market (Section III.B.5).

The majority of Florida's involvement in space commerce centers around the launch services market, including launch support activities such as pre- and post-launch processing and Shuttle-related manufacturing and ancillary services. Florida also has an industry base of firms in the ground equipment systems market. The state is not well represented in the satellite manufacturing and launch vehicle sectors, but market opportunities to attract or expand businesses in these segments appear to be limited.

Before one can analyze opportunities in the launch-related markets, one needs to understand the factors that drive the demand for a launch.

What Drives Launch Demand

The demand for access to space, and therefore launch, is at the heart of the entire space market. Historically, demand was solely determined by government requirements and the federal government provided funding to build and maintain infrastructure and operations.

With the emerging commercial markets, demand is now more heavily based on consumer desire for satellite-based, end-user services, such as mobile phone or wireless internet access. These markets, however, are just emerging and revenues and the availability of capital are highly uncertain and volatile. This makes the source of revenues for continuous or substantial investments in infrastructure and operations also uncertain.

In general, the demand for launch services, launch vehicles, and ground support equipment is driven by the needs of three end user markets — the consumer market for satellite services and two public sector markets: the military / government market and the civil / scientific market. In summary:

- *Commercial launch demand* is driven by the consumer demand for satellite-enabled services. Ten years ago, commercial demand was virtually non-existent; by 1998, it had risen to 46 launches worldwide. According to most experts, demand for these services will grow rapidly in the coming years. But the consumer satellite services market is full of uncertainty and as a result will create volatility in the demand for launches.
- *Military launch demand* is driven by defense and national security needs. This demand includes a wide range of activities. In the near-term, it includes support for worldwide military operations in the form of military satellites for intelligence and logistics, weather, and data relays and communication. It also includes the testing of new vehicle and missile systems and the deployment of research payloads. In the long-term, it includes space-based weapon and missile defense systems. The military launch demand has decreased over the past 10 years, but is forecast to remain relatively stable, with a possible slight increase to meet testing needs. As a result of national security requirements, these launches are accommodated solely from U.S. launch sites.
- *Civil and scientific demand* is driven by the nation's commitment to science and exploration. Launches include NASA launches for building the International Space Station, interplanetary travel, scientific experiments, and exploration of the outer reaches of space. Civil and scientific launch demand also includes satellite launches for government remote sensing and weather ser-

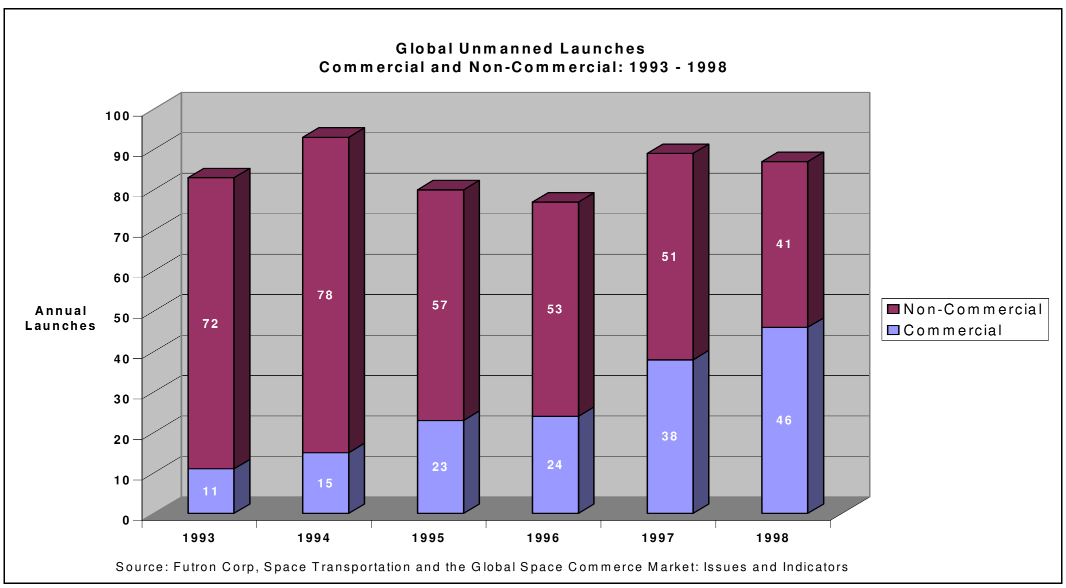
vices, both of which are being privatized. And, it includes launch demand for testing next generation space transportation technologies, such as the X-34 or X-38 programs. As with military launches, the number of civil and scientific launches is predicted to remain stable, and will need to be accommodated from U.S. sites.

This report focuses on developments driving commercial business opportunities. Military and civil launch demand is still quite active with developmental programs and support of ongoing operations. However, this demand is funded based on federal government needs, and the demand and funding appear relatively stable over the next decade.

Recent Demand for Commercial Launches

In 1998, there were 87 launches worldwide – 46 commercial and 41 non-commercial (military and civil).[10] Figure III-2 illustrates global unmanned launch activity over the past 6 years.[11] This figure shows that overall demand for launches has remained relatively flat; however, the number of commercial launches has grown from approximately 10 to 15 percent of the market to over 50 percent of the market.

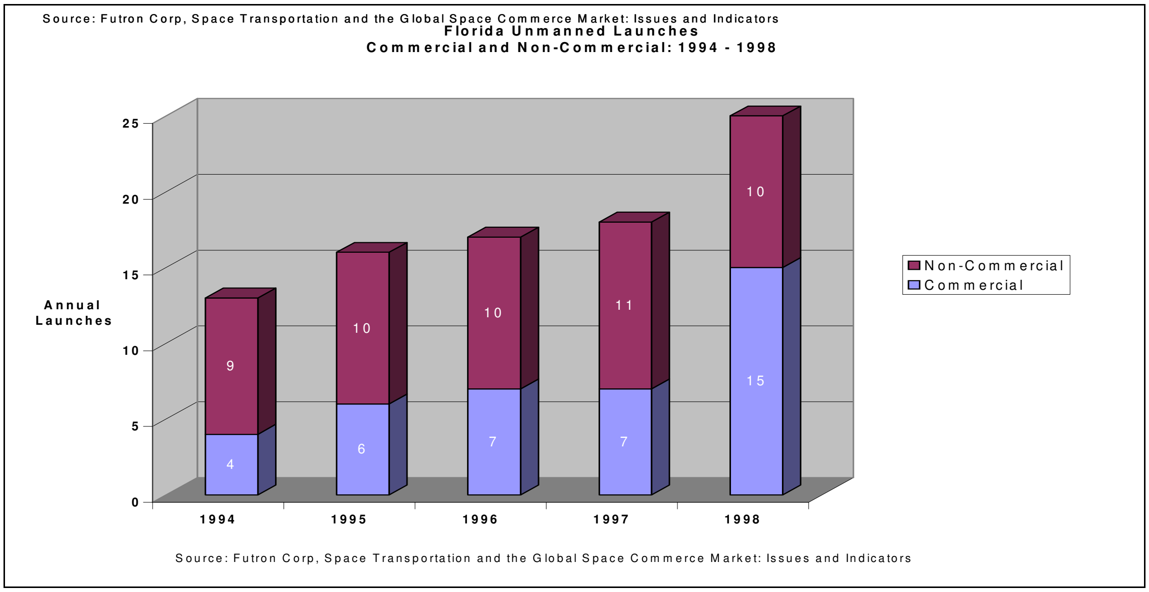
Figure III-2: Historical Demand for Launches



[10] Futron Corporation.
[11] These numbers exclude Space Shuttle flights, and Russian manned flights to Mir.

Over the last five years, Florida has seen its share of the worldwide launch market increase from 15 percent to almost 30 percent, driven by a four-fold increase in commercial launches. Figure III-3 summarizes the Cape's unmanned launch activity over the last six years. This bar chart clearly shows the steady nature of NASA and military launch demand and the dramatic increase in commercial launches.

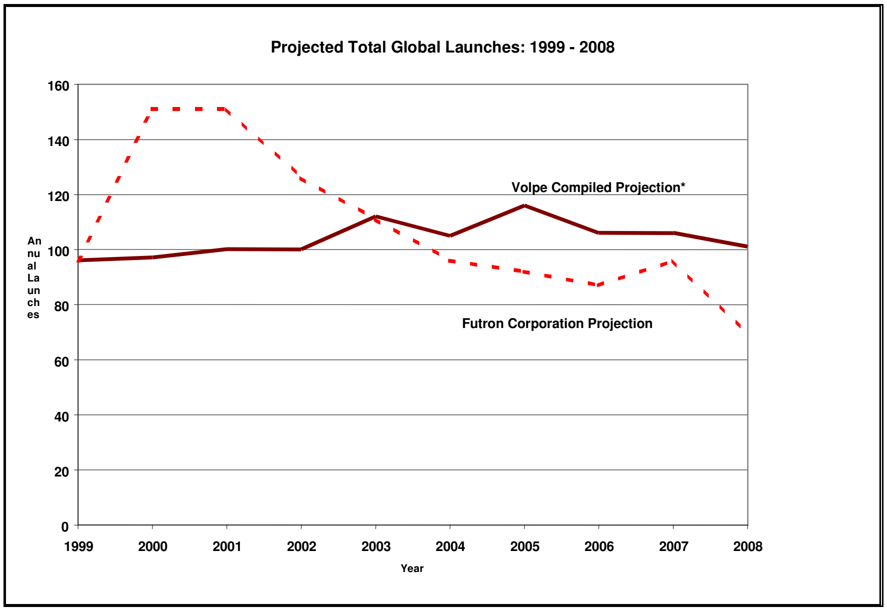
Figure III-3: Florida's Historical Demand for Launches



Future Launch Demand

To predict the future market for Florida launches, one must first look at the predicted worldwide demand for launches. Figure III-4 shows two possible forecasts for worldwide demand.

Figure III-4: Projected Demand for Launches[12]



- The Volpe Center's compiled projection is a consolidation of forecasts from the Federal Aviation Administration (FAA), NASA, Aviation Week, and the mission model compiled by Commercial Space Transportation Advisory Committee (COMSTAC). It includes planned launches as well as trend-based projections for particular launch segments.
- The Futron Corporation projection is based on announced launches. Futron's projection tends to be "front-loaded" for two reasons: first, the launch schedules are for the most optimistic case, and second, because long-range (greater than 5 or 6 years) launch plans are not as well defined. (The drop-off in the Futron projection after 2007 is more indicative of a lack of concrete long-range plans rather than a projected drop in launch demand.)

Both projections point to an average of 110 launches per year through most of the next decade. When one reviews the projected commercial and non-commercial launches over the next 10 years in the context of recent launch activity around the world, it appears that there will only be, on average, about 23 more launches in any given year.

[12] FAA AST, *1999 LEO Commercial Market Projections*; COMSTAC 1999 Commercial GSO Mission Model; NASA Commercial Space Transportation Study; Aviation Week, 1999 Source Book.

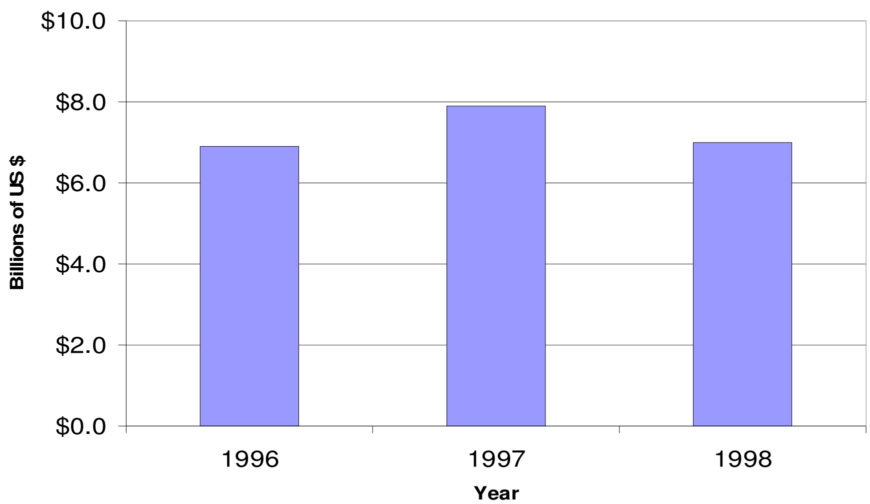
III.B.2 The Launch Services Market

Background

Worldwide revenues in the launch services market have averaged between $7 to $8 billion over the last three years. This figure includes the price of the launch vehicle, the launch services, and all related pre- and post-launch services. This figure is expected to grow to approximately $15 billion by the end of the next decade.

Figure III-5 presents the size of the launch services market revenues:[13]

Figure III-5: Launch Services Revenues, 1996-1998



Although the size of this market is predicted to double by the end of the next decade — from $7.5 billion to $15.0 billion — as a percentage of the overall worldwide commercial space marketplace, revenues decline from approximately 15 percent of $51.2 billion to roughly 7.5 percent of the predicted $200 billion.

Competitive Dynamics of the Launch Services Market

The primary commercial tenants at Cape Canaveral Spaceport (CCS) are Boeing, Lockheed Martin, Orbital Sciences, and Florida Spaceport Authority (SFA). CCS supports the broadest range of launch vehicles of any spaceport, and its proximity to the equator positions CCS favorably to launch to the Geosynchronous (GEO) orbit.

Table III-1 identifies the leading launch service providers and launch sites in the world. The sites listed accounted for over 95 percent of the launches in 1997. The data was compiled from a variety of public sources.

Boeing and Lockheed Martin, CCS's predominant commercial tenants have a long history in providing launch services for the military and NASA. Both have recently invested at the Cape to upgrade facilities in anticipation of the next generation

[13] Futron Corporation, written analysis of 10/28/99.

launch vehicle, the evolved expendable launch vehicle (EELV) which is being developed in response to military requirements.

These companies have led the effort to provide launch services to the commercial sector from CCS. However, they have also formed partnerships to provide services from Russia and from Sea Launch, which provide alternatives to launches from CCS.

For medium and heavy lift GEO launches, CCS's principal competition for in the next decade will come from Arianespace, located at Kourou, French Guyana. Also, competition will come from Sea Launch, which is able to launch equatorially, but has a limited capacity with an unproven record. Baikonur in Russia and launch sites in China will compete for launches on price, but due to geographic location, offer lower performance.

Table III-1: Current Active Commercial Global Launch Sites

Country	Site	Launch Service Providers	Orbits	Lift Capability	Active Since	Successful Launches since 1997	Comments
USA	Cape Canaveral, FL	Boeing Lockheed Martin Orbital Sciences Corp.	Equat., LEO, MEO, and GEO	Heavy, medium, light	1950	556	Supports wide range of launch vehicles, including Space Shuttle.
USA	Vandenberg AFB, CA	Boeing Lockheed Martin Orbital Sciences Corp.	Polar LEO, Polar MEO	Heavy, medium, light	1959	520	California Spaceport is under construction, with payload processing facilities and new launch pads.
USA	Wallops Island, VA	Orbital Sciences Corp.	LEO	Light	1960	20	Possesses 6 launch pads, which were used for light lift orbital launches in 1960s and1970s.
France	Kourou, French Guyana	Arianespace	Equat., and polar LEO, MEO and GEO	Heavy, medium, light	1970	94	Able to launch both north and east, allowing a full range of orbits.
Russia	Baikonur (Tyuratam)	NPO Energia, Central Specialized (Starsem), Khrunichev (ILS), Khrunichev (Eurokot), KB Polylot (Assured Space Access), Makeyev, NPO Yuzhkosmos, STC	Equat., and polar LEO, MEO and GEO	Heavy, medium, light	1957	1007	The primary Russian launch facility, especially for commercial flights. Latitude hampers launch performance for GEO launches.
Russia	Plesetsk	NPO Energia, Central Specialized (Starsem), Khrunichev, Makeyev	LEO, MEO	Heavy, medium, light	1966	1444	Primarily a military launch facility with some civil/ scientific launches also.
China	Taiyuan	China Great Wall	LEO	Light	1988	2	
China	Xichang	China Great Wall	LEO, MEO, GEO	Medium, light	1984	22	
China	Shuang	China Great Wall	LEO, MEO, GEO	Medium, light	1970	22	
India	Sriharikota	VSSC	Polar LEO	Light	1979	7	Primarily focused on the domestic market.
International	Sea Launch	Sea Launch (Boeing, RSC Energia, KB Yuzhnoye/PO Yuzhmash (Ukraine), Anglo-Norwegian Kvaerner Group (Norway))	GEO, MEO, LEO	Heavy, medium	1999	2	Limited capacity, approximately 6 launches per year. Launch platform and vehicle ship based in California.
Japan	Tanegashima	Rocket Systems Corp.	LEO, GEO	Medium, light	1975	28	
Japan	Kagoshima	Nissan	LEO, MEO, GEO	Light	1966	22	Limited capacity.
Israel	Yavne	Shavit	LEO	Light	1988	3	Rockets must launch due west, limiting orbits and performance.

The following tables list spaceports under development or consideration. Table III-2 presents the U.S. sites that are most likely to be developed and would compete against Florida for launch activity. A total of 18 states have notified the FAA that they are exploring development of a spaceport.

Table III-2: Most Likely Future Domestic Spaceports

State	Activity	Potential Tenants	Comments
Nevada	Converting a former DOE test site to commercial use.	Kistler	Planned as primary site for Kistler K-1 RLV.
Edwards AFB, CA		Lockheed Martin	Initially planned to support X-33 suborbital flights.
Kodiak, Alaska	Construction of Kodiak Launch Complex began January 1998; light spacelift for polar orbits.	Orbital Sciences Corp.	Suborbital launches started in 1998.
White Sands, NM	Southwest Regional Spaceport will be constructed in conjunction with RLV development.	Lockheed Martin, Kelly (potential)	Refurbished missile test pads planned for RLV test flights.
Utah	Pioneer Rocketplane recently moved to Utah from California.	Pioneer	

Table III-3 presents the most serious international prospects for spaceport development.

Table III-3: Potential Future International Launch Sites

Country	Location	Activity	Potential Launch Tenants	Advantages
Carribean Islands	Not yet negotiated	Beal Aerospace hopes to develop a spaceport for its BA-2 launch vehicle.	Beal Aerospace would be sole tenant.	Accommodates polar and equitorial orbits, latitude and inclination advantages.
Australia	Woomera Rocket Range. Two proposed launch sites at Cape York and Darwin.	Australia hopes to build a $1B Asian Pacific Space Center that would launch Russian rockets starting in 2000.	Kistler Aerospace's first test flight of K-1 reusable spacecraft might launch from Woomera.	Latitude and inclination advantages.

(cont'd)

Table III-3 (cont'd)

Brazil	Alcantara	Brazil is building its own space program. Annual expenditures $160M.	A U.S.-Russian venture headed by Lockheed Martin might launch Russian Proton rockets from Alcantara.	Potential advantages due to newly built range control and tracking. Also, latitude and inclination flexibility.
Canada	Manitoba (Churchill Research Range	A Canadian company is spending $300 M to build Spaceport Canada on Hudson Bay. Commercial launch site devoted to serving polar orbits.	Churchill supports many American made boosters.	Would compete with Vandenberg and Kodiak.
Indonesia	Proposed launch site Biak or Waigeo Islands	Indonesia is trying to build launch complex for communications satellite launches.	U.S. and European companies currently launch communication satellites for this country.	Primarily aimed at Indonesian market.
Russia	Svobodny	Former ICBM base.	Possible candidate for Khrunichev Rokot for medium lift to LEO missions.	Low cost, similar latitude as Baikonur.

Despite these threats of competition from other sites, Florida holds a competitive advantage over potential spaceport locations because it does not need to build pads, payload processing, and other infrastructure already located on the Eastern Range. Florida also can conduct most launches without the need to fly over populated areas, an important safety consideration for other areas. Florida contains an integrated space transportation system and institutional expertise to go along with a pool of trained workers.

Future of Florida's Commercial Launches

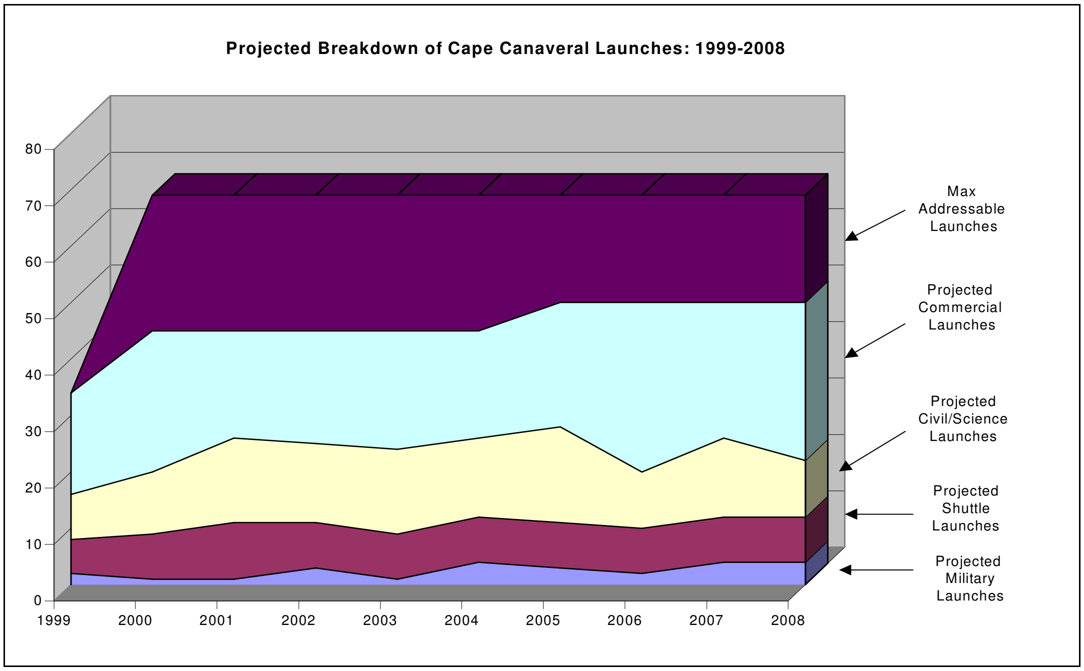
As discussed earlier in this section, the demand for launches is expected to average 110 per year, through the next decade. Based on analysis done for this study, Florida's ***addressable*** share of this global market is approximately 70 launches per year.[14] This number represents an upper bound for the launches that ***could*** come to the Cape. The balance of the forecasted global launches cannot launch from the Cape due to orbital limitations (requiring polar launches) or because they are launches supporting civil or military missions for other nations.

---

[14] Results presented by Futron Corp, 10/14/99, in support of Volpe Center research.

Figure III-6 presents the breakdown of projected commercial, military, civil, and Shuttle launches.[15]

Figure III-6: Launch Breakdown by Mission



Florida's ***realistic*** share of the global launch market is more likely to approach 50 launches a year. While some of this growth will be due to an increase in government missions, the primary driver of growth will be commercial launches. It should be noted that the launch numbers above ***do not*** include sub-orbital, test, and development launches, which may provide more opportunities to increase Florida's market share of launches, a market that SFA has recently begun to pursue.

Challenges

There are challenges and obstacles that hinder the ability of launch services providers to attract customers to Florida and provide competitive services.

- The first challenge is that launch operations and scheduling at the Cape are traditionally based on policies supporting government and military requirements rather than meeting private sector business needs. In 1998, the public sector tenants at the Cape commissioned a survey from J.D. Power and Associates to understand the needs of Florida's launch site customers.[16] The feedback revealed that the Cape's business procedures and costs may very well drive customers elsewhere. Recognition of this risk has caused the gov-

[15] FAA AST, 1999 LEO Commercial Market projections; COMSTAC 1999 Commercial GSO Mission Model; NASA Commercial Space Transportation Study; SFA, *Next Step to the Stars.*

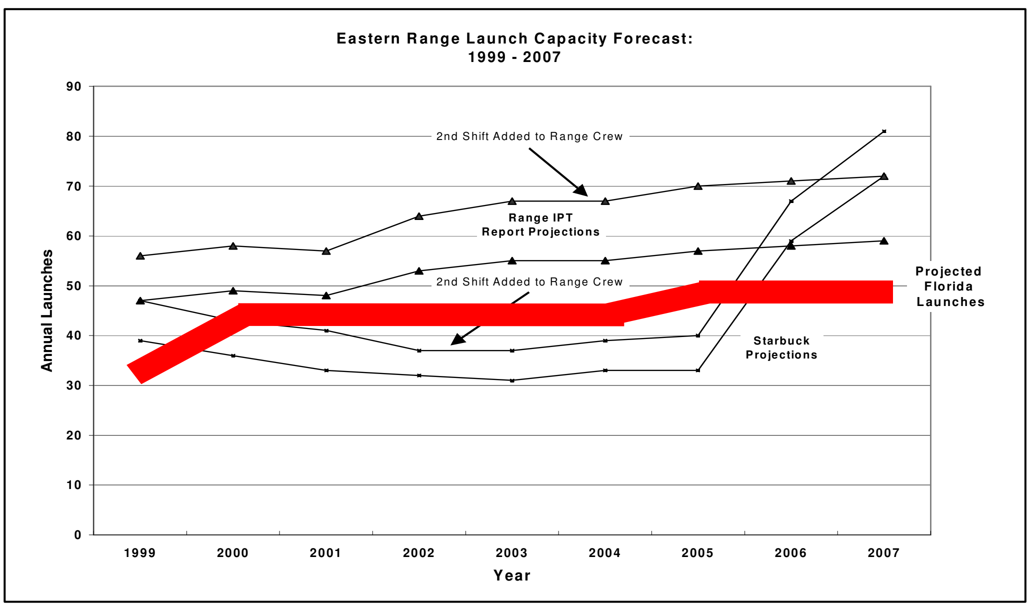
[16] *Customer Satisfaction Feedback and Action Planning,* May 7, 1999, J.D. Power and Assoc.

ernment agencies and launch service providers at the Cape to begin restructuring operations.

- A second challenge is the antiquated facilities and technologies that support launches from the Cape, including both pre- and post-launch support facilities and the Eastern Range. This problem has a significant impact on the level of capacity for launch, as well as the flexibility with which customers can schedule their launches. Steps are being taken to modernize the Eastern Range so that capacity does not become an issue, as the demand for Florida launches rises. Known as the Range Standardization and Automation (RSA) program, it is being implemented over the next 6 years. However, it appears that the range configuration may become a bottleneck between 2002 and 2006. Additional range crew shifts would ease such a bottleneck by increasing range capacity roughly 20 percent. But, the modernization program faces yet another challenge once it is completed. The technology being installed will be based on 1980s computers and systems. The Eastern Range will not be a state-of-the-art facility, despite launching state-of-the-art vehicles.

Figure III-7 illustrates how launch capacity might be affected with the additions of a second crew. [17]

Figure III-7: Eastern Range Capacity



[17] *Range Integrated Product Team Executive Report*, November 16, 1998*; Another look at Eastern Range Operations and Scheduling (AKA, Myths),* presentation by Brig. General F.R. Starbuck, 45th SW.

Once RSA is in place, capacity should increase to 15 to 40 percent above forecast launch demand. This will accommodate a greater number of launches in the post 2008 time frame. Increased range capacity will most likely increase scheduling flexibility as well.

- The third challenge at the Cape is that there is a new era of space technologies, including larger satellites, different types of payloads such as Space Station construction materials, and new types of launch vehicles. As new and different types of payloads need to go to outer space, and new launch vehicles are introduced into the market, spaceports need to be aware of and plan for new requirements in its infrastructure, workforce, and operations.

Market Opportunities

The size of the launch services support market is directly correlated to demand for launches. The most significant increase in demand for launch, and therefore launch services, will most likely occur with the growth in the satellite-enabled services market. At the moment, this growth is uncertain. While the summer of 1999 saw the bankruptcy of two large satellite services companies, other companies such as DIRECTV continue to order new satellites based on consistent market growth.[18] The majority of growth in this market, however, is predicted to emerge between 5 and 10 years from now.

This intervening time gives Florida an opportunity to understand and address the business operations at the Cape, and to position itself to be the most competitive and attractive launch site to customers needing equatorial launches. The J.D. Power study revealed new requirements for flexibility and reliability of scheduling, lower costs, and a bundling of operations and services. Some more innovative changes to consider are:

- Favorable terms and conditions (T&C) are increasingly an important element of competing for launches, particularly in the areas of financing and insurance. Arianespace at Kourou has a separate subsidiary that enables satellite operators to finance launch costs. This service is perceived by many launch providers as a significant competitive advantage.[19] The Spaceport Florida Authority has recently requested funds from the state to develop innovative financing mechanisms and a broader range of launch support business services to help Florida become more competitive. In response, the state has allocated funding to begin the Commercial Space Financing Corporation. Price of launch is also a significant determinant in choosing launch sites. However, with recent failures at low cost launch sites in Russia and China, customers are recognizing that the quality of launch, including success rate and favorable terms and conditions, must be factored into decision making.

[18] On December 8, 1999, DIRECTV announced an order of a new high-power spot beam satellite from Hughes Space and Communications Company. Floridy Today Space Online, www.floridatoday.com/space/explore/stories.

[19] Results presented by Futron Corp, 10/22/99, in support of Volpe Center research.

- The state and SFA should actively recruit new launch service providers. Fostering competition helps to cut costs and improve customer services and satisfaction. Additionally, new entrants may lead a drive to develop and adapt new business procedures.

Commercial companies also find modern and efficient facilities desirable, validating the state's actions to date in providing the financing for construction and modifications on the Cape on behalf of commercial customers. In light of launch demand projections, however, it is important to keep in mind that the Cape Canaveral Spaceport already has one of the broadest ranges of launch infrastructure and supporting services, and provides the most options for launch service providers and customers.

One option for expanding demand to benefit both the launch services sector and the state, is to capture demand from other competitor sites. Again, the state can facilitate this by working with the tenants at the Cape to foster a more user-friendly business climate, while nationally promoting the advantages that Florida's launch site has over existing and potential spaceports.

III.B.3 The Launch Vehicle Market

Background

The launch vehicle market is comprised of three important segments:

- The existing expendable launch vehicle (ELV) market.
- The near-term launch vehicle market that includes the next generation of ELVs known as extended expendable launch vehicles (EELVs).
- The future next generation launch vehicles known as reusable launch vehicles (RLVs).

Overall, the market for launch vehicles was worth $2.6 billion in 1997.[20]

Expendable Launch Vehicles (ELV) Market

Current ELV launch vehicles range in price from $6 to $20 million for launches dependent upon low earth orbit (LEO) and $40 to $100 million for launches into GEO orbit.[21] Many of the most frequently employed ELVs are derivations of 1950’s and 1960’s rocket technology. As a result, while reliability has increased, cost per pound of payload has not decreased appreciably.

There are four U.S. companies manufacturing small and large expendable launch vehicles. There are also companies manufacturing suborbital rockets for testing and experimentation, such as Coleman Research Corporation in Orlando,

[20] *The Race for Space: A General Survey of the Commercial Space Market,* David H. Vadas, The Aerospace Research Center, p. 12.
[21] Ibid.

FL. Table III-4 lists the ELV companies with their vehicles and lift/orbit capabilities.[22]

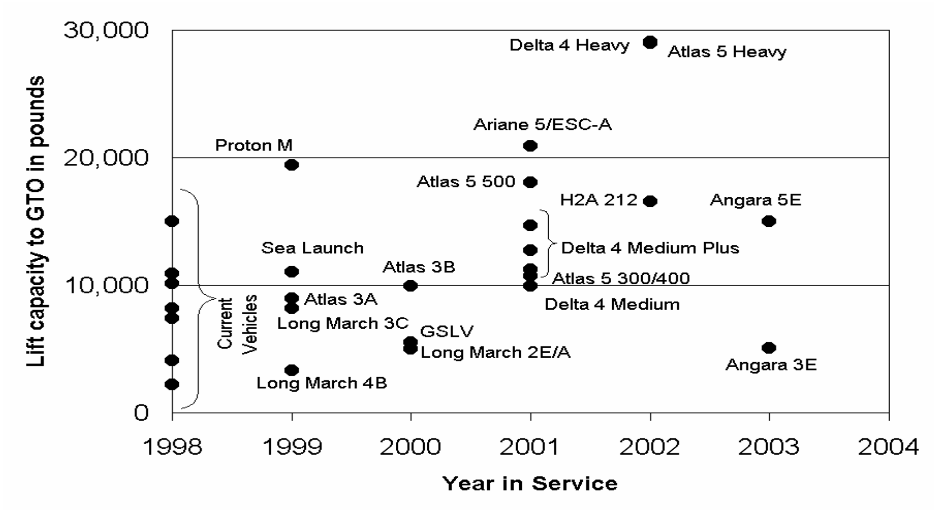
Table III-4: U.S. Launch Vehicle Manufacturers

	Manufacturer	Vehicle	Lift/Orbit
Small Expendable Launch Vehicles	Orbital Sciences	▫ Pegasus ▫ Taurus	▫ 1,000 lb./LEO ▫ 3,000 lb./LEO
	Lockheed Martin	▫ Athena 1 ▫ Athena 2	▫ 1,800 lb./LEO ▫ 4,400 lb./LEO
Large Expendable Launch Vehicles	Boeing	▫ Delta 2 ▫ Delta 3	▫ 4,100 lb./GEO ▫ 8,400 lb/GEO
	Lockheed Martin	▫ Titan 4 ▫ Atlas 2 ▫ Atlas 3	▫ 10,000 lb./GEO ▫ 6,500-8,000 lb./GEO
	ILS (Lockheed Martin)	▫ Atlas and Proton	▫ 12,000 lb./GEO

Also, at least 12 new expendable launch vehicles are projected to begin service over the next fives years, offering a range of lift capabilities. Among the new entrants are numerous Russian launch vehicles with Soviet military heritage, which are able to offer lower prices than their western competitors. Domestically, Beal Aerospace is developing a new ELV to compete with the heavy lift launch vehicles. The company expects that their system will offer customers access to GEO orbit at a significantly lower cost than current and planned programs. Figure III-8 on the next page illustrates the various launch vehicles available by their lift capacity.

[22] Information developed from a variety of public sources.

Figure III-8: Future Medium, Intermediate, and Heavy Launch Vehicles to Enter Service, 2000 to 2004[23]



Evolved Expendable Launch Vehicles Market

The U.S. Air Force recently awarded a joint contract to Boeing and Lockheed Martin to develop and manufacture an evolved expendable launch vehicle. These vehicles will share common systems and sections, to improve reliability and flexibility and reduce launch costs. The EELVs will be used for both commercial and military payloads. It is expected that these vehicles will provide a cost-savings of 25 to 50 percent in launch costs over the next 20 years.[24]

The EELV will ultimately benefit the domestic commercial launch services market by providing direct competition to Kourou's heavy-lift vehicles, the Ariane 4 and the more recent Ariane 5. These vehicles are capable of launching multiple payloads simultaneously, which brings significant cost-savings to the customer. However, because the contract was only recently awarded, Ariane 5 will have at least a 4 to 5 year lead on the U.S. vehicles.[25] In addition, Japan is developing the H2A and Russia is developing the next generation Proton rocket, the Proton M/Angara, to address these new market requirements.[26]

Reusable Launch Vehicles Market

Today, the Space Shuttle remains the world's only reusable launch vehicle. Since its first launch in 1981, it has played an important role in providing access to space and has a useful life expectancy of another 20 years. However, because of its complexity and reliance on older technologies, the cost per pound per payload exceeds its original goal. As a result of the space shuttle's high cost of operations, maintenance, and refurbishment, there are seven companies de-

[23] Futron Corporation, analysis, October 28, 1999.
[24] Aviation Week &Space Technology, January 11, 1999, p. 132.
[25] Ibid.
[26] AviationWeek & Space Technology, December 13, 1999, p. 61.

veloping next generation reusable launch vehicles.[27] The goal for these vehicles is to have higher reliability, faster turnaround times in launch processing, and a significant reduction in cost to orbit, the target being $1000 per pound.

Table III-5 on the next page lists the RLV companies and the current status of their developmental programs.

[27] Futron Corporation, analysis, October 28, 1999.

Table III-5: Reusable Launch Vehicle Developers[28]

Launch Vehicle	Status	Anticipated First Flight	Capitalization Required	Funding Raised (3rd Q. 1999)
Lockheed Martin's VentureStar	X-33 technology development vehicle (VentureStar prototype) first flight delayed until later 2000/2001	2004	VentureStar estimated at $7.2 billion for two vehicles	Private sector financing efforts waiting until X-33 proves viable. Due to major technical risks, borrowing costs may be high.[29]
			X-33 costs have been rising due to technical problems and delays. Current costs estimated at $1.3 billion.	Costs split between federal government and Lockheed Martin. Current split estimated at $1.29 billion from NASA and $125.4 million from Lockheed Martin.[30]
Kistler Company's K-1	Major component testing underway, test launch facilities at Woomera Range, Australia under construction. Signed up as tenant at planned Nevada Spaceport	2000/2001	$750 million for first 5 vehicles	$600 million
Rotary Rocket Corporation's Roton	Low-speed hover/landing mockup tested in late 1999. Engine and other flight components under development.	2000	$150 million for first flight	$30 million
Kelly's Astroliner	Tested concept of towed take-off using QF-106 and C-141 aircraft. System under design.	2002	$400 million for first vehicle	$10 million

[28] Futron Corporation, analysis October 28, 1999.
[29] *Space Transportation: Progress of the X-33 Reusable Launch Vehicle Program,* Statement of Allen Li, Associate Director, National Security and International Affairs Division, GAO/T-NSIAD, 99-243, p. 6
[30] Ibid, p. 4

Table III-5: Reusable Launch Vehicle Developers (cont'd)

Launch Vehicle	Status	Anticipated First Flight	Capitalization Required	Funding Raised (3rd Q. 1999)
Pioneer's Rocketplane	System design iteration stage as of late-1998. $40,000 grant from California to study potential RLV site.	2001	$275 million	$3 million
Space Access's SA-1	Model testing of 1st stage airframe and propulsion, little other information.	2001	Unknown	Unknown
Beal Aerospace's BA-2	3rd stage motor, steering components tested. Major component fabrication begun. 1st and 2nd stage motor tests planned in near term.	Late 2000 - 2001	100% privately funded	100% privately funded

These vehicles face daunting technical challenges, which has resulted in many of them falling behind in their development and testing schedules. Along with the technical challenges has come increased costs, and uncertain market demand for the services to be offered by the new vehicles.

The uncertain market and technical challenges has made raising capital difficult, resulting in many of these ventures facing recent financial problems. As a result of these challenges, experts predict that reusable vehicles will not be in commercial service for at least 10 to 20 years.

Attracting commercial RLV operators is not likely to result in a significant near-term increase in launch activity or financial or economic return to a state. But it does make sense for Florida to show its commitment to accommodating these vehicles in the future, through incremental investments in infrastructure and support systems.

Competitive Trends

With the number of next generation ELV and the new EELVs scheduled to become available within the next decade, experts predict an oversupply of launch vehicles. Ultimately, this will lead to a market restructuring with business failures, mergers, and acquisitions expected.[31]

The survival of these firms depends on a few critical market factors. First, launch vehicle customers have had more reason to become anxious about the issue of reliability. A recent string of launch failures has led to grounded programs, which has had a domino effect on planned launches, delaying the start-up of new communications systems, and thereby causing loss of revenues while waiting for replacement satellites.

Second, the company needs to have a sound financial foundation or ability to offer customers a viable system with a considerable price advantage. At this point, Boeing and Lockheed Martin are both able to do this with their EELV contracts for $1 billion. This EELV program will also provide at least $2 billion in guaranteed government business for the Atlas and Delta programs through 2006, supporting these companies.[32]

As with satellite manufacturing companies, launch vehicle manufacturers are well-entrenched geographically, with the majority of firms located in the western part of the United States:

- Boeing has its principal manufacturing facilities in California and Alabama, and subcontracts with Alliant Tech Systems in Utah.

[31] AviationWeek & Space Technology, December 13, 1999, p. 52
[32] AviationWeek &Space Technology, January 11, 1999, p. 62.

- Lockheed Martin has primary manufacturing facilities in Colorado and California, and subcontracts with Cordant Tech-Thiokol in Utah and Alliant Tech Systems, Boeing, and United Technologies Corporation in California and Florida.
- Orbital Sciences is based in Virginia and mostly manufactures their own ELVs. Orbital uses Alliant Tech for its engines and for one vehicle's manufacturing, they subcontract with Cordant Tech-Thiokol.

Table III-6 on the following page lists the major ELV companies and their production sites.[33]

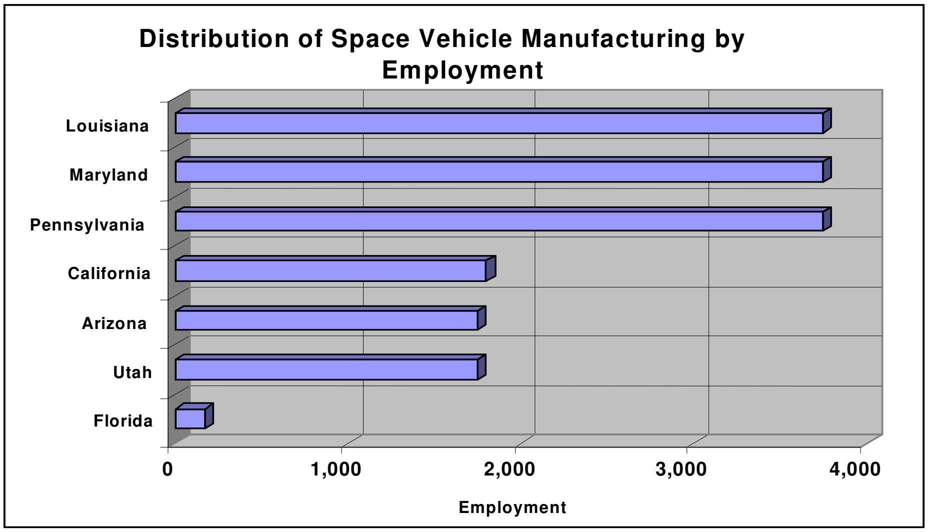
[33] This information was compiled from a variety of public sources.

Table III-6: ELV Manufacturers and Production Sites

Company	Plant	City/State	Launch Vehicles	Stage Contractor	Motors/ Engines	Other
Alliant Techsystems	Utah Propulsion Center	Magna, UT			X	
Alliant Techsystems	Alliant Aerospace	Clearfield, UT			X	
Alliant Techsystems	Alliant Aerospace	Salt Lake City, UT		X	X	
Boeing	Rocketdyne Division	Canoga Park, CA			X	
Boeing	Space Systems Division	Seal Beach, CA	X			
GenCorp	Aerojet - Sacramento	Sacramento, CA			X	
Lockheed Martin	Skunk Works	Palmdale, CA			X	X-33 engine with Rocketdyne
Lockheed Martin	Astronautics	Denver, CO	X	X		
Lockheed Martin	Manned Space Systems	New Orleans, LA				Shuttle External Tank
Orbital Sciences Corp	Launch Systems - AZ	Chandler, AZ	X	X	X	
Orbital Sciences Corp	Launch Systems - VA	Dulles, VA	X			X-34 manufacturer
Thiokol	Thiokol Propulsion, Elk-ton	Elkton, MD			X	
Thiokol	Thiokol Propulsion	Brigham City, UT		X	X	
Thiokol	Cordant Technologies	Salt Lake City, UT		X	X	
Thiokol	Clearfield Operations	Cleafield, UT			X	
United Technologies	Pratt & Whitney, Chemi-cal Systems Division	San Jose, CA		X	X	
United Technologies	Pratt & Whitney, Liquid Rockets	West Palm Beach, FL			X	
Coleman Research Corporation	Orlando, FL	Orlando, FL	X	X		Partnerships with Italy and Israel for sub-orbital aunch vehicles

Florida does not have a presence in the manufacturing of launch vehicles as Figure III-9 demonstrates.

Figure III-9: Florida Space Vehicle Manufacturing



A more recent opportunity to bring this type of manufacturing to the state occurred in 1997. After considering a number of sites, including one in Florida, Boeing chose Alabama for its EELV manufacturing plant.

Market Opportunities

As the information above demonstrates, opportunities to develop launch vehicle manufacturing in the state of Florida are limited. Current ELV manufacturing is consolidated in a few companies and located in only a few states, mostly in the western U.S. There appears to be sufficient capacity to meet expected demand over the next decade. When combined with the EELV market, the number of new vehicles due to enter the market over the next few years suggests an oversupply of vehicles will occur in relation to demand. In addition, the EELV companies are the same manufacturers as the ELVs.

The RLV companies present a great amount of risk and uncertainty at this time. The best opportunity for Florida to pursue in this market is to attract a new launch service provider and put together a package that brings manufacturing to the state. Beal Aerospace in Texas is looking for a launch test site is actively considering Florida.

A potential opportunity is in the manufacturing of sub-component parts and systems for the launch vehicles. Florida's base of high-tech industry and its expertise in spaceport technologies makes the manufacturing of components and systems a good fit and an attractive industry sector to target.

III.B.4 The Satellite Manufacturing Market

Background

The total commercial market for the design and manufacturing of satellites resulted in $13.5 billion in revenue in 1997. [34] By 2007, forecasts predict that this industry will generate $50 billion in revenue.[35]

In 1997 there were 783 satellites on orbit broken-down as follows:

Table III-7: Satellite Uses[36]

- 480 satellites for telecommunications, including voice (telephony), broadcasting, and data
- 87 for intelligence and classified activities including remote sensing, imaging, and communications
- 84 for scientific research
- 75 for navigation
- 51 for meteorology and civil/commercial remote sensing applications
- 6 for other.

By the end of the next decade, it is estimated that over 1200 communications satellites, valued at almost $60 billion will be delivered to orbit.[37]

Satellite manufacturers are divided into two categories:

- **Geosynchronous** (GEO) satellite manufacturers produce large satellites with more capacity and power. GEO satellites weigh 6,000 to 10,000 pounds, cost over $100 million and last for about 15 years.[38]
- **Low earth orbit** (LEO) satellite manufacturers produce small satellites as part of constellations. LEO satellites weigh between 800 to 1500 pounds, cost between $3 to $10 million, and last for about 8 years.[39]

Three U.S. GEO manufacturers – Hughes, Loral, and Lockheed Martin – have 68 percent of the worldwide satellite business. These firms have, within the last five years, invested from $1.5 to $2 billion in new manufacturing facilities, centralizing and upgrading them to increase the output and reduce the cost of satellite manufacturing.[40]

The following two tables list the major global satellite manufacturing companies.

---

[34] 1997 Estimate: *Satellite Industry Statistics Survey, 1997* (conducted for Satellite Industry Association by Futron Corporation); 2007 estimate: Futron Corporation.
[35] Ibid.
[36] Ibid.
[37] *The Race for Space: A General Survey of the Commercial Space Market,* David H. Vadas, The Aerospace Research Center, p. 10.
[38] Ibid.
[39] Ibid, p.11.
[40] Ibid, p.11.

Table III-8: GEO Satellite Manufacturers[41]

Satellite Manufacturer	% Market Share of GEO production	% of GEO satellites on order	Location
Hughes	36%	26.5%	California
Lockheed Martin	19%	9%	California
Space Systems/Loral	13%	26.5%	California
Matra Marconi	9%	9%	Europe
Aerospatiale (acquired by Alcatel)	8%	16%	Europe
Alcatel	0%	5%	Europe
Other (includes DASA and Alenia Spazio, both merging with Matra)	15%	8%	Europe

LEO manufacturers have been adopting new methods of production using assembly lines and common platforms that serve multiple satellites. They are also relying more on off-the-shelf components. As a result of more efficient production processes and investments in facilities, LEO manufacturers have been able to increase their output and reduce costs, setting records for producing new satellites in 3 to 5 days.[42]

Table III-9: LEO Satellite Manufacturers[43]

Satellite Manufacturer	Location
Space Systems/Loral	California
Motorola	Arizona
Lockheed Martin	California
Boeing	California and Washington State
Matra Marconi	Europe
Orbital Sciences Corp.	Virginia
Spectrum Astro	Arizona

Competitive Trends

Because the telecommunications market offers the potential for significant growth, a number of companies have been positioning themselves to move into the satellite manufacturing market. Companies that were recently awarded major commercial contracts include Harris Corporation (located in Melbourne FL), Orbital Sciences, and Boeing.[44] Other manufacturers maintain a capability to ex-

[41] *State of the Space Industry 1999*, p. 26.

[42] *The Race for Space: A General Survey of the Commercial Space Market,* David H. Vadas, The Aerospace Research Center, p. 10.

[43] Compilation from public sources of information.

[44] *State of the Space Industry 1999*, p.24. Harris was selected as the prime contractor for the first GE*Star Satellite System, which will use satellite platforms from and integrate the spacecraft at

pand into this market, including DASA, Alenia Spazio, TRW, Ball Aerospace, and Spectrum Astro. NEC has also expressed an interest in becoming a prime contractor.[45]

Based on anticipated growth in commercial telecommunications services revenues, satellite manufacturers are expanding their business focus into such areas as financing satellite networks, retail marketing for subscribers, obtaining market access agreements to facilitate the transmission of signals for local distribution, and making sure that ground stations are built and operating properly.[46] Companies are doing this by forming partnerships with service firms. One recent example of this kind of integrated expansion is Hughes Electronics Corporation merger with DIRECTV to form Hughes Space & Communications. This new venture recently bought U.S. Satellite Broadcasting and Primestar, Inc. to expand and bolster its direct-to-home business. The direct-to-home television market is predicted to expand significantly and DIRECTV recently ordered a new high-power spot beam satellite from Hughes Electronics.[47] Hughes also helped fund a demonstration launch from Sea Launch, which has a firm order for 10 Sea Launch missions with an option for five more.[48]

Market Opportunities

Attracting new satellite manufacturing capacity to the state appears to be very difficult. As is the case with launch vehicle manufacturing, production capacity is concentrated on the west coast.

Many historical factors anchor existing facilities at their current locations, and this review indicates that growth in these markets is not sufficiently strong enough to necessitate further expansion in the near future. Beyond the need to be competitive in business climate and workforce training, there are additional considerations that create barriers to firms and states hoping to enter this business. The factors working against Florida's ability to attract new space manufacturing companies to the state include:

- A lack of demand for new plants due to the over capacity at existing facilities.
- Significant sunk costs and recent investments in plant, equipment, and real estate at existing facilities.
- Ties to critical suppliers and supporting businesses in existing areas.

A State of the Space Industry for 1999 report assessment notes that the "competition for new contracts is intense [and] the number of satellites being awarded in the next few years to new market entries is anticipated to remain limited." [49]

Aerospatiale, a French company. (Harris News Release, June 15, 1998, http://www.harris.com/harris/whats_new/ge-satellite.html.)

[45] Ibid, p. 27-28.

[46] *The Race for Space: A General Survey of the Commercial Space Market*, p. 11.

[47] *State of the Space Industry, 1999,* p.59.

[48] Aviation Week & Space Technology, December 13, 1999, p. 50.

[49] *State of the Space Industry*, *1999*, p. 28.

There is plenty of capacity at existing facilities to meet demand and this suggests that investments in new plant locations are unlikely.

Prospects for new satellite manufacturing capacity are also reduced as a result of the recent financial problems that some of the new telecommunications service providers are encountering. The financial difficulties driven by uncertain consumer markets and high service costs will moderate speculative increases in satellite manufacturing capacity. As a result, there does not appear to be much opportunity for Florida to attract satellite manufacturers to the state. However, as with the launch vehicle market, opportunities may exist to manufacture subcomponent parts and systems for satellites. Although most supplier companies have a history with the major satellite manufacturers, opportunities for new firms to enter the market arise as technology evolves.

II.B.5 The Ground Equipment Systems Market

Background

This market consists of a wide and diverse variety of companies who manufacture products or provide services for uploading and downloading of data and information from satellites. Products include:

- Ground stations and antennas
- Electronic receiving and transmission equipment
- Information technology
- Computer software and hardware
- High-capacity data storage.

This market overall was valued at $11 billion worldwide in 1997. It is projected to grow to $30 billion within the next 10 years.[50] Industry forecasts predict that healthy growth in this market will continue as ground systems and consumer devices are needed to distribute and access data and information from satellites. Current revenues and projections make this market attractive for investors.

Competitive Trends

There are many small and mid-sized companies in this market, but this sector has seen a great deal of consolidation recently as firms merge to become full service providers for satellite customers. Mergers and acquisitions in this sector are being driven by the need to provide a full range of features that combined, offer a complete communications system to the customer.

Consumer equipment will be a large industry growth driver, with particularly significant growth in the Very Small Aperture Terminal (VSAT) market and consumer electronics market. Low cost ground terminals that allow direct data and telephony links to satellites for consumer use, is also a major market driver.

[50] Futron Corporation in *Via Satellite*, May 1999, p. 50.

Some of the major U.S. companies in this market include:

- Hughes Network Systems in Maryland
- L-3 Communications in New York and California
- LNR/Trexcom in New York
- Tripoint Global Communications
- Spacenet, Inc. in Virginia
- Radyne in California.

As a result of Florida's strengths in telecommunications equipment manufacturing and its long history in supporting launch activities and downloading launch data, the state has a base of companies involved in ground equipment systems for earth stations and data transmissions. These are listed in Table III-10:

Table III-10: Florida Companies Involved in Satellite Data Transmission

Company	**Location**
Frontline Communications Corporation	Clearwater, FL.
Gulf Communications International	Palm Bay, FL
Infotel International, Inc.	Melbourne, FL
International Communications Products, Inc.	West Melbourne, FL
Vector Communications Network Corporation	Miami, FL

Florida also has a base of companies providing satellite uplink services, as listed in Table III-11.

Table III-11: Florida Companies Involved in Communications Services

Company	Location
Satellink Communications	Clearwater, FL.
Digital Communication Link	Ft. Lauderdale, FL.
Vidcom Corporation	Ft. Lauderdale, FL.
Vista Satellite Communications	Ft. Lauderdale, FL.
Starlink	Ft. Lauderdale, FL.
BAF Satellite and Technology Corporation	Melbourne, FL.
Calhoun Satellite Communications, Inc.	Miami, FL.
ICG Satellite Services	Miami, FL
Conus Communications Florida	Tallahassee, FL

Market Opportunities

Of all of the space market segments, this is the most diverse and diffuse. Florida already has companies established in various segments of this market place. In addition, the Florida economy has a well-established base of telecommunications services that synergistically aligns well with this market. Exploring opportunities in this market should be the most productive of the launch-related markets for Florida.

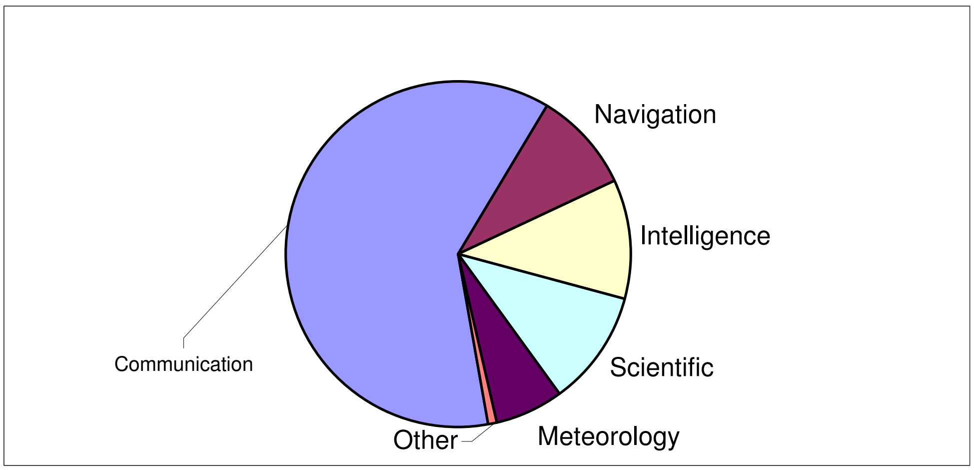
III.C The End-User Services Market

III.C.1 Background

The end-user services market is comprised of products and services that are enabled by satellites in orbit such as telephone, television, data communication, radio, remote sensing and meteorology, navigation, military intelligence, and civil government applications.

Figure III-10 depicts the breakdown of the end-use services market:

Figure III-10: End-User Services Market Breakdown



Telecommunications is a leading driver and revenue generator of this market and the space industry in general. Revenues for this market segment are forecasted to increase; it is the fastest growing among all of the space-related markets.

- The global commercial satellite services market generated $19 billion in revenue in 1997.
- $95 billion in revenue is projected by 2007.

The end-user services market includes three important sub-segments for Florida to focus on:

- Telecommunications services, including voice communications, broadcasting, and data communications (including broadband) (Section III.C.2).
- Remote sensing and imaging services (Section III.C.3) including:
  - Weather, disaster management, and environmental monitoring; and
  - Utilities, agricultural and infrastructure planning.
- Navigation and location services, using the GPS system established by government satellites. (Section III.C.4).

The remaining segments shown in Figure III-10 are intelligence, scientific, and meteorology. These segments are not included in this review because they are do not generate commercial revenue, but instead are determined by government missions and appear to be fairly stable in the coming years.

III.C.2 The Telecommunications Market

Background

The telecommunications market generates revenues by leasing capacity on satellites and by selling wireless satellite services to consumers on the ground. It generates revenue in three major market areas:

Fixed satellite services (FSS): The fixed satellite services market is the most mature. It has increasing overall capacity and stable lease rates. It supports telephony and video distribution. It also transmits a limited amount of internet data. Currently FSS generates 70 percent of revenues from video and television, and less than 30 percent from data. The anticipated growth in internet usage is expected to reverse this. The *1999 State of the Space Industry* report states:

> "With global satellite internet revenue earnings doubling every five months, revenues have increased from nearly nothing two years ago to an estimated $1billion in 1999, rising to $4.7 billion in 2000." [51]

Some forecasts suggest that it could exceed $20 billion annually in a decade.

This market is in transition. Many of the original satellites and networks were established by national governments, but are now being privatized, such as Intelsat and Comsat, which is being sold to Lockheed Martin. This market is dominated by a few large private and public sector agencies and companies. These players have access to large amounts of capital to invest and are developing new services. Many of these large players are moving into broadband multi-media, which will increase speed and transmission rates for larger amounts of data. Table III-12 lists the partnerships that are establishing new systems to compete with established FSS providers and to offer broadband services to capitalize on the new markets for high speed, high quality access to data and information.

[51] *1999 State of the Space Industry*, p. 47.

Table III-12: Fixed Satellite Service Providers

Network Partners	Orbit	Type	Name of Network	Comments
Microsoft and McCaw Cellular	LEO	Broadband Multimedia	Teledesic	$9B initial investment
Motorola	LEO w/ GEO	Broadband Multimedia	Celestri	$12.9B initial investment
Loral Space & Comm, and Alcatel Alsthorn	LEO and GEO	Broadband Multimedia	Cyberstar/Skybridge	$7.5B initial investment
Lockheed Martin	GEO	Broadband Multimedia	Astrolink	$4B initial investment
Hughes Electronics	GEO	Broadband Multimedia	Spaceway	$3B initial investment

The five new broadband multi-media networks represent over $35 billion in initial investment and will be supported by over 400 LEO satellites and approximately 20 GEO satellites. The broadband markets are only just beginning to emerge, but show great potential for growth. This part of the market is not expected to generate revenues until early in the next decade.

Mobile Satellite Services (MSS): The mobile satellite services market supports the portable communications market. In the long-term, this market is expected to attract millions of customers. An important consumer feature is that mobile satellites can integrate with cellular networks and expand services, allowing cellular phones to operate in areas where traditional cellular services are not available. However, in the near term, Iridium and Globalstar have shown that demand for these systems is still uncertain and consumers have been wary about initial service prices.

The privatization of Inmarsat, the intergovernmental organization that provides global maritime distress and safety signals, will provide high-speed data connections to laptop computers. Owned by several of the world's national telecommunications organizations, this international agency has access to funds much greater than their competitors. As can be seen in Table III-13, this market is one where telecommunications companies have partnered with satellite manufacturers.

Table III-13: Mobile Satellite Companies

Network Partners	Orbit	Type	Name of Network	Comments
Hughes, AT&T, Singagpore Tele-comm, and Mtel Corp.	GEO	GEO stationary wire-less communications	American Mobile Satel-lite Corp.	
Space Sys-tems/Loral, Qualcomm	LEO	Mobile wireless communication net-work	Globalstar	$2.5B initial investment
Lockheed Martin	GEO	GEO stationary wire-less communications	Asian Cellular Satellite Sys-tem	$900M initial investment
Motorola	LEO	Mobile wireless communication net-work	Iridium	$5B initial investment
Orbital Sciences Corp., Teleglobe, Inc.	LEO	Mobile wireless communication net-work	Orbcomm	$330M initial investment
Constellations Communications, Inc.	LEO	Mobile wireless communication net-work	ECCO	$1.2B initial investment
ICO Global Com-munications (In-marsat spin-off)	MEO	Mobile wireless communication net-work	ICO Global Communica-tions	$4.6 initial investment
Mobile Communi-cations Holdings, Inc.	MEO	Mobile wireless communication net-work	Elllipso	$1B initial investment

These global telecommunications systems represent initial investments totaling over $15 billion and will be supported by approximately 200 LEO satellites.

<u>Direct-to-Home Services</u>: Direct-to-home television market has been one of the fastest selling consumer electronics products in history. There are over 10 million subscribers in the U.S., and over 35 million globally. These numbers are expected to double to 20 million U.S. subscribers alone by 2005. The direct-to-home television sector continues to expand its customer base in the U.S. and Europe, while new systems focusing on Asia-Pacific, Japan, Latin America, and the Middle East are being developed.

The two major players are DirecTV and Echostar who are in competition with cable providers. Echostar has about 3.1 million subscribers versus DirecTV's 7.8

million at the end of 1999.[52] In the U.S. alone, these services add an average of 8,235 new customers a day.[53]

Market Opportunities

Despite the fact that this is the fastest growing segment of the space market, recent delays, failures, and economic downturns in other parts of the world have had an impact on this market which is likely to spread out the development of the market over a few more years.[54] Aviation Week & Space Technology lowered its prediction of over 1200 new satellites placed in orbit by the year 2007 to just 1,017 by 2008, a reduction of nearly 200 satellites.[55] As a result, the industry would see a corresponding reduction in launches. Thus, some investors have deemed this market to be higher risk than once thought, and the flow of capital in this section is slowing.

However, the telecommunications market is vast and will consist of products and services that do not even exist today. Some of these new products and services could be the fastest growing segments of the market 5 -10 years from now. In anticipation of future opportunities and partnerships, especially driven by the direct broadcast satellite market, satellite companies as a whole performed well in 1999 in the stock market and analysts are optimistic about performance in the future.[56]

Most of the partnerships developing the networks are well established and consist of major international telecommunications, satellite, and software companies without any direct affiliation with Florida. Florida needs to explore these opportunities with its existing telecommunications companies. The products and services to be developed in this area are considered one of the high growth, high profit markets of the next century.

III.C.3 Remote Sensing and Imaging Market

Background

The remote sensing and imaging industry consists of two parts.

- The first part includes satellite operators who actually acquire the remotely sensed data and return it to ground stations. Satellite operators include both private companies and government agencies that sell data. Besides having satellites on orbit, satellite operators must have ground facilities for controlling the satellites as well as for receiving the data stream from the satellite. Major companies in this sector include Orbital Science's OrbImage subsidiary, Spot

[52] Aviation Week & Space Technology, Market Focus, December 21, 1999.
[53] Aviation Week & Space Technology, Headline News, April 12, 1999. The average was from a six month period, October 1998 through March 1999.
[54] Aviation Week & Space Technology, January 11, 1999, p. 143.
[55] Aviation Week & Space Technology, January 11, 1999, p. 143.
[56] Aviation Week & Space Technology, Market Focus, December 13, 1999.

Image of France and Lockheed Martin's Space Imaging and Earth Search Sciences.

- The second part of this market consists of companies that process the raw data into usable information and then interpret it for a specific market or use. As higher quality raw data has become available from satellite operators, more companies become involved in this market. These companies must possess the technological ability to process and interpret data purchased from the satellite operators and possibly combine or enhance it with other sources of data. One of the most visible ventures in this market is the Terra Server project, which is the result of a partnership between Aerial Images Inc., Microsoft, Kodak, and others to provide very high quality earth imagery via the world wide web.

Estimates for the potential remote sensing and imaging market vary widely, with estimates ranging between $500 million a year to $2 billion a year through 2004, and some estimates placing the potential as high as $3 to $5 billion by 2005.[57] The federal government alone plans on purchasing an average of $200 million a year in commercial space imagery[58].

These market estimates are for imagery and data alone. There are a number of potential niche markets that could make use of this type of data. High definition sensors combined with sophisticated data communication and image processing now allow satellite-based remote sensing and imaging to be used for many applications that previously required ground-based or aircraft based surveying. Current and potential commercial markets include real estate, construction and utility surveying, mineral exploration, commercial fishing and crop management. Current and potential civil markets include weather forecasting, geologic and archeological surveying, flood and other disaster management, and environmental monitoring.

Competitive Dynamics

This market is in transition. It began as a service offered by the government, with customers being solely the military and intelligence community. The recent trend toward privatization and pressure from Congress to cut costs has created an opportunity for private sector firms to begin offering these services, with Lockheed Martin and Boeing being two of the predominant players.

One of the more recent shifts in this market is the contract awarded by the National Reconnaissance Office to Boeing, replacing the incumbent contractor, Lockheed Martin, who has worked with the NRO since 1958. Boeing offered lower prices and a more innovative design to win the award to build the next

[57] Mecham, Michael, *Finally, Debut Nears for 1-meter Satellites*, AviationWeeks Space Business: http://www.aviationweek.com/spacebiz/apr05/sb_image.htm

[58] Anselmo, Joseph, "NRO May Shift Routine Work to Commercial Operators," Aviation Week's Space Business: http://www.aviationweek.com/spacebiz/july19/nro.htm

generation imagery spacecraft. Boeing teamed with Hughes, Raytheon, Eastman Kodak and Harris Corporation.[59]

To meet the NRO's requirements, companies must have expertise in electro-optics. Boeing gained this expertise through the acquisition of Rockwell International and McDonnell Douglas. This expertise will become more important as the remote sensing and imaging market grows.

Market Opportunities

This market is still in its early stages. Aviation Week & Space Technology forecasts 40-50 commercial, earth-imaging satellites will be launched during 1999-2008 to support systems such as:[60]

- Space Imaging EOSAT's Ikonos
- Orbital Sciences' OrbView
- EarthWatch's QuickBird
- SPOT Image's Spot
- Canada's Radarsat.

Image or data processing and interpretation may find synergies with digital imaging technologies/industries currently supporting media and entertainment industries in Florida.

A likely growth area for companies that possess a command of the various disciplines, such as geology, agriculture, environmental or civil engineering, and use remotely sensed data and images will be in the area of consulting services.

Universities may foster growth in specialized start-up companies that focus on parlaying remotely-sensed data and images into useful and marketable analysis. Possible markets within Florida may be found in agricultural management, environmental monitoring and surveying in support of Florida's continuing high population growth and environmentally sensitive wetland areas.

III.C.4 The Navigation and Location Services Market

Background

Satellite navigation systems allow a user to determine their location through precise distance measurements from satellites within a network overhead. Known as global positioning systems (GPS), two operational systems exist today – one in the U.S. and one in Russia. Both were developed primarily for military purposes, but have found use in the commercial market with automotive and marine industries offering services to locate drivers in an emergency, or for travelers navigating through unknown areas.

[59] Aviation Week's Space Business, September 13, 1999, p. 26.
[60] Aviation Week & Space Technology, January 11, 1999, p. 144.

The GPS market is expected to grow dramatically over the next 6 years. A 1999 report by the Japanese GPS council estimated that globally, by 2005, there would be 3.5 million GPS-based automobile navigation systems, over 1.6 million handheld GPS units, and several tens of thousands of marine GPS navigation systems.[61]

The State of the Space Industry 1999 report notes that future uses are even more broad, noting applications in asset management, air traffic control, fleet management and tracking, land and water surveying, mapping and GIS data acquisition, and corporate and commercial aviation.[62] A European Union forecast puts the market for GPS services at $50 billion by 2005.[63]

Market Opportunities

The first opportunity for business development in this segment is for satellite manufacturers. The latest generation of U.S. NAVSTAR satellites will need to be replaced at the average rate of about 2 to 3 per year over the next decade.[64]

The second opportunity is for companies to sell services for civilian navigation and location services. As the State of the Space Industry 1999 report notes, the industry's potential can be evidenced by the "$50 million joint venture between Magellan Corp. and Hertz to supply 50,000 navigation systems for their rental fleet."[65]

[61] Japanese GPS Council, 1999.
[62] *State of the Space Industry, 1999*, p. 53.
[63] Ibid.
[64] *Aerospace Source Book,* Aviation Week & Space Technology, January 12, 1998, p. 146.
[65] *State of the Space Industry, 1999*, p. 53.

III.D Future Markets

III.D.1 Background

To be commercially viable when one looks beyond the near-term commercial opportunities in space, new technologies, products and services will require a base of operations in space. Although the International Space Station offers the first viable space environment from which to conduct business, it is not clear when or how other environments, such as manufacturing facilities or hotels will evolve.

However, the reality of this base of operations is not beyond either the dreams or investment decisions of today's space leaders. If the litmus test for investments is the certainty of demand, some business leaders are already betting that the future direction of their companies' includes space. For instance, one the world's largest hotel chains has been publicly discussing its plans to conceptualize a space hotel, while two tourism agencies are willing to accept future reservations for flights into space.

The future markets include five sub-segments for Florida to consider:

- The market for Spaceport Technologies (Section III.D.2).
- The market based on International Space Station construction and operations (Section III.D.3).
- The market for space-based manufacturing (Section III.D.4).
- The market for space tourism (Section III.D.5).
- The market for long-term space research and development (Section III.D.6).

The cursory assessment done for this report suggests that state investment in these areas should be used to position existing companies to capture business as it emerges, most notably to capture construction and operations business associated with the ISS. There is some room for near-term investment, also, to position Florida's tourism businesses to conceptualize the future space tourism industry. However, the majority of investment in this market segment should focus on growing new companies in line with these markets when they emerge.

III.D.2 The Spaceport Technologies Market

Background

Spaceport technologies include the wide-array of products and services that contribute to the launch vehicle and payload achieving launch and when applicable, being successfully retrieved and processed. Among the areas included under this market segment are:

- Range technologies, which includes safety and tracking systems, telemetry systems, and command and control systems.

- Payload processing which includes both preparatory and retrieval services and includes any future payload applications for space-based manufacturing
- Launch pad technologies which includes mating payloads to vehicles and migration to “modular” technologies that allow for the accommodation of a variety of launch vehicles with faster turn around times.
- Vehicle assembly and fueling facilities, including RLV retrieval and refurbishment capabilities, hanger facilities to store and perform routine maintenance on vehicles, and runways and associated technologies for RLV and other vehicles requiring them.

Market Opportunities

Florida is well positioned to excel in this market segment due to the level of existing and planned investments at the Cape. There is both an institutional history and future commitment to the Cape as a location for NASA, military, and civil operations that make it an ideal place for these technologies to be researched, developed, and implemented. Also, Florida’s skilled workforce, space institutions, as well as NASA and university researchers have experience in this area.

The most important opportunity in this area is NASA/KSC’s transition to a center for spaceport technology research and development. This will increase the opportunities for Florida and its universities to obtain grants and develop expertise in spaceport technologies. In addition, Congress has committed $20 billion to build the ISS, and there are business opportunities associated with its development and construction. This work in spaceport technologies aligns with the type of engineering needed to develop (and support) an international space station.

Progress in this area also supports the goal of improving operations and lowering costs. Other ways in which Florida can use its advantages to build this market are:

- Florida’s large inventory of launch pads and supporting infrastructure make it the ideal test bed for researching, developing, testing, and implementing new launch technology.
- Collectively, KSC, NASA, the 45th Space Wing, private industry in Florida, and universities have significant institutional expertise in this area that would need to be duplicated elsewhere. Florida could help business capture this expertise for consulting on new spaceport development around the world.

However, for this market to truly emerge as commercially viable, transportation to space will need to become routine. Demand will then drive the establishment of new spaceports around the world that will need these technologies. The recent success of Command and Control Technologies of Cocoa, FL, in developing systems for new spaceports in the U.S. is a prime example of how established Florida companies are well positioned to capture business in the future market.

III.D.3 The International Space Station-Based Market

Background

This market segment is defined by business opportunities generated through the construction and operations of the International Space Station (ISS). Companies involved in designing and building components for the space station should be assessed in more detail as possible candidates for attraction to the state of Florida.

The second sub-segment of this market is more speculative. It is involves envisioning the research and commercialization opportunities that will become available by having the space station. Because the space station will house experiments leading to the discovery of new products, opportunities could exist for Florida to attract businesses interested in establishing small companies to pursue commercialization potential of new products. The two most promising sub-segments have been identified as pharmaceutical and agricultural research. A third area is R&D into space based manufacturing processes that are based on the micro-gravity, or vacuum, conditions of orbit.

However, it is expensive to conduct research in space and the price per pound of launch must come down substantially for pharmaceutical and agricultural companies to conduct research in space. Internal requirements for R&D investment generating market success still does not look favorable with the current high price of launch and space operations.

Market Opportunities

Florida businesses and universities are clearly positioned to capture opportunities since space station launches will most likely originate from the Cape. In this respect, having state-of-the-art processing facilities to support missions and experiments aboard the ISS — the Space Experiment and Research Processing Laboratory (SERPL) — is key and could lay the groundwork for future space-based manufacturing.

III.D.4 The Space-Based Manufacturing Market

Background

Research is under way to take advantage of the micro-gravity conditions in orbit for various manufacturing processes. Current research is focused on three areas:

- Materials Research and Development (R&D)
- Biotechnology
- Agribusiness

Materials R&D has focused on the fact that micro-gravity conditions allow materials to be manufactured without gravity-caused defects or asymmetries, as processes growing crystals or multiphase structures are often strongly influenced by gravity. One example of a material being researched for manufacture in orbit includes aerogels, which are very lightweight "foam" structures with extreme thermal insulating properties. There have also been investigations into taking advantage of the near-vacuum conditions of space as a giant zero gravity vacuum chamber for production of thin-film coatings. Possible applications include production of semiconductor infrared lasers, high efficiency solar cells, oxide thin films for computer memory applications, and ultra-hard thin film coatings for wear resistance in micro-devices.[66]

In the area of biotechnology research, commercial researchers have used the microgravity environment aboard the orbiting shuttle to produce "large, near perfect protein crystals, which far surpassed the quality of insulin crystals grown on the ground."[67] As with crystal growth, microgravity can allow cells to grow in ways different from the way they would under the constant pull of gravity. Microgravity may offer opportunities for growing cells and tissues for a variety of applications.

In 1998, the pharmaceutical and electronic industries invested more than $35 billion to expand their knowledge or develop new and improved products with microgravity. As noted in the *1999 State of the Space Industry* report:

> Although significant medical and electronic test results have been generated by microgravity experiments, research by private firms to date has been limited. This has been more from a lack of understanding by researchers on how to use the environment in their research than in any technical, financial, or operational deficiencies…A number of commercial firms are actively involved in developing equipment for automated experiment processing or in arranging flight opportunities to achieve microgravity. [68]

Research in agribusiness has focused on the altered growth of plants in microgravity. Research is focusing on tapping the microgravity-altered growth to either use plants to produce useful compounds, such as anti-cancer compounds, or to develop completely new varieties in space. It is felt that these potentially can be bred and produced more easily in microgravity than on earth.

Market Opportunities

At this point it is unclear what the cost targets for launch services to support these potential businesses should be, or what the volume of demand for production of these products would be. It is clear, however, that costs will need to decrease substantially for the market for space-based services to be more fully realized.

Most likely, space-based manufacturing will be first prototyped on the ISS over the next decade, either through NASA research efforts or as commercial pro-

[66] NASA Commercial Space Centers page; http://commercial.nasa.gov/csc.html.
[67] NASA Space Product Development page: http://commercial.nasa.gov/research.html.
[68] *1999 State of the Space Industry*, p. 54.

grams using rented space aboard the ISS. Florida has an advantage in certain areas since it has developed and processed experiments for the shuttle.

III.D.5 The Space Tourism Market

Background

Florida is one of the world's most popular tourist destinations. Over 45 million people per year come to visit the cities, the theme parks, the beaches, the space coast, or just to relax in the warm sunshine. Florida thus has the necessary infrastructure and services in place to grow the space tourism market.

Currently the space tourism market can be defined as tourism that educates the public about space, with some activities that allow tourists to experience/simulate space. For instance, Florida has a Space Camp that introduces young people to space science, study rocket propulsion, experience astronaut training simulators from different eras of the space program, and participate in simulated space shuttle missions using realistic shuttle and mission control mock-ups. Space Camp participants have the opportunity to perform experiments in physics, chemistry, and space science. Over 30,000 children have attended Space Camp Florida.

It is these types of space-like experiences that offer the opportunity for Florida to grow space tourism. The next step is to simulate space-like environments to prepare tourists for actual space travel. This form of adventure travel has been growing dramatically in recent years. Using space, Florida has the opportunity to capitalize on this form of tourism.

In the long-run, some of the more interesting and potentially promising markets in the long run include space tourism and suborbital intercontinental space flight.

Market Opportunities

Studies on space tourism by Bristol Spaceplanes[69] and Coniglio[70] have used a range of trip pricing between $10,0000 and $24,000 (in 1994 dollars) for tourist trips to orbit. Coniglio's study is based on a market of 750,000 annual passenger-trips, whereby he foresees orbit being achievable for $24,000 a passenger. Bristol Spaceplanes estimates that their two stage horizontal takeoff and landing spaceplane could get a person to orbit for $10,000.

A figure of $100 per pound of payload to orbit as a level that enables new markets in space business, generally agrees with other industry sources. For example, Aviation Week's 1999 Industry summary stated that currently it "usually costs $2000 to $8000 per pound. To launch payload to orbit, costs will have to come closer to $100 per pound before there is a true expansion in the number of new

[69] *About BSL,*Bristol Spaceplanes website; http://www.bristolspaceplanes.com/aboutbsl.shtml.
[70] Coniglio, Samuel, *Practical Tourism in Space*, 1996; http://www.magicnet.net/~sam123/spacetou.html.

launch customers."[71] And the "100-fold reduction in launch costs" is often identified as one of the goals that must be achieved in order for space transportation tourism to become a viable transportation mode.

Besides meeting cost targets, space launch must achieve levels of safety, reliability and frequency of service that would be expected of a passenger and cargo transportation system.

As the *1999 State of the Space Industry* report notes:

> Recent market surveys suggest that the space travel and tourism market could generate annual revenues in the vicinity of $10 billion per year. With eco-tourism and adventure travel currently over $5 billion as a market, several private companies have begun to offer tour packages consisting of extreme-altitude and parabolic aircraft flights to experience microgravity along with space education classes. These organizations hope to provide actual trips into space within the next several years. For the foreseeable future, though, the tourism market is severely limited by launch costs and lack of in-orbit facilities and activities. Furthermore, these companies hope to offer their services by the year 2002 but it will probably take at least several years more for a safe human-rated reusable vehicle to be designed, tested, and approved by the appropriate regulating agencies. [72]

III.D.6 The Market for Long-Term R&D

Background

To successfully diversify its economy, Florida needs to support investments in long-term R&D that synergistically align the space economy with the state's corporate and university capabilities. Table III-14 contains a list of successful partnerships among NASA and Florida's universities and small companies. These partnerships have turned ideas and experiments into commercial products and services that are solving problems in today's society.

[71] "Launch Vehicles: Steady Growth," Marco Antonio Caceres, Aviation Week & Space Technology, January 11, 1999, p.131.
[72] *1999 State of the Space Industry*, p. 54.

Table III-14: Examples of R&D and Commercialization in Florida

Industry Area	Company / Organization	Activities
Medical Research	RATCOM, Inc. (Miami, FL)	NASA teamed with the American Cancer Society (ACS) beginning in 1989 to develop a compact flow cytometer for research of microgravity and the immune system. One outcome of this cooperative effort was the development of an advanced flow cytometer useful in DNA analysis of solid human tumors. RATCOM, Inc., of Miami, Florida, began offering the first commercial instrument stemming from this NASA/ACS partnership in 1997. Advanced flow cytometry has the potential to become a significant tool in fighting cancer.
Medical Research	SyMed, Inc. (Gainesville, FL)	NASA research concerning astronaut medical diagnose led to new health care computer hardware and software. An electronic medical library and record keeping system providing interactive medical information and diagnostic support was developed in conjunction with the University of Florida. This system provides microcomputer access to medical and patient information. In 1995, SyMed, Inc. was founded to facilitate the commercial adoption of these computer-based, medical interactive care systems.
Lightning Protection Equipment	NASA Southern Technology Application Center (STAC), University of Florida	The NASA STAC provided the opportunity for a private inventor to study NASA research in lightning protection, facilitating the development and refinement of a lightning retardant cable used to protect home satellite dishes. Offered commercially through Consumer Lightning Products/GS Cable, Inc., inroads are being made in both the consumer market, for example, consumer kits for protecting small satellite dishes from lightning strikes, and the commercial market, in airport lightning systems.
Construction	Surtreat Southeast, Inc. (Cape Canaveral, FL)	Surtreat Southeast, Inc., approached the Kennedy Space Center with a chemical option to fight structural corrosion of steel-reinforced concrete structures. With previous research in electrical treatments for structural corrosion, NASA provided testing specifications and procedures for the GPHP product provided by Surtreat Southeast, and analyzed the effectiveness of the GPHP product. This product, when applied to steel-reinforced concrete structures, helps to inhibit corrosion.
Space Launch	Command and Control Technologies Corporation (CCT) (Titusville, FL)	Command and Control Technologies Corporation developed a spaceport control system providing comprehensive spaceport and range safety functions for the Kodiak Island Launch Complex in Alaska. This system was designed as a commercial off the shelf product with software technology licensed from NASA.
Lasers and Laser Components	VLOC, Inc. (New Port Richey, FL)	VLOC manufactures virtually all of the optical components required for solid-state lasers. Exploration by VLOC into certain laser materials was kickstarted by NASA Small Business Innovation Research (SBIR) awards. The NASA funded work ultimately resulted in the commercial availability of a reliable source of high-quality, damage resistant laser material.

Market Opportunities

In response to NASA's need to support long-term space development, the National Research Council (NRC) was commissioned to identify *high-risk, high-payoff* technologies that could improve the capabilities and reduce costs to NASA, other government and commercial space programs.

As a result of this research, six key technologies were identified that met the criteria of requiring low-level funding and had the potential to produce major improvements. It is being recommended that NASA support each of these technologies. It is important to stress that these technologies are considered high-risk, high-payoff technologies that, if proven to be viable, could lead to greatly reduced costs or increased capabilities of future space activities. Table III-15 contains the six technologies and the market needs that they are addressing.

Table III-15: National Research Council Recommendations to NASA[73]

Wideband, High Data-Rate Communications over Planetary Distances	Wideband, high data-rate communications over planetary distances would allow for live transmissions of high-resolution images from intermediaries such as robotic rovers. The development of these communications is currently underway by several U.S. Department of Defense agencies. NASA should support the development of these communications through funding technologies such as high-precision spatial acquisition and tracking systems.
Precisely Controlled Space Structures	The development of structures to be utilized in space's weightless environment present many control challenges that are essential to meet in order to advance the space program. NASA is best suited to conduct research in areas such as controlling deformable reflectors that will directly aid this effort.
Microelectromechanical Systems (MEMS) for Space	A strong push is currently underway in MEMs research, however little of this work is targeted specifically for space applications. Funding areas specifically targeted to space applications such as NASA unique sensors could supplement MEMS research initiatives that are already underway and lead to greater advances.
Space Nuclear Power Systems	It is anticipated that advanced nuclear power systems will eventually be required to support a number of future space exploration endeavors such as lunar and planetary bases and extended human exploration missions. NASA could enhance this future development effort by providing research and technology funding to ensure that the systems eventually developed is more efficient, safer, and cost-effective.
Low-Cost, Radiation-Resistant Memories and Electronics	Radiation in the space environment can lead to a number of problems such as damaging sensitive electronics and degrading microelectronic devices. At this time, low-cost, high capacity, low mass radiation-resistant memories and electronics are not available. NASA could lay the groundwork for vast improvement in this area by providing funding focused on exploratory research in low mass shielding and the use of radiation resistant
Extraction and Utilization of Extraterrestrial Resources	The ability to extract and utilize space resources can benefit the future space activities on many fronts, including greatly improving the performance and reducing the costs of planetary exploration. NASA's support in R&T areas such a planetary material handling are particularly important since no other organization is currently conducting research in this area.

[73] National Research Council, *Space Technology for the New Century.*

In addition to the six key technologies cited above, the study lists other opportunities for space R&D, space products or services with commercial potential. Key stakeholders in Florida should consider similar sources to better align its corporate and university capabilities with future directions in space commerce.

SECTION IV: A COURSE OF ACTION

Despite the risks, uncertainties, and challenges present in the commercial space market, the state of Florida is well-positioned to shape its future in space transportation and the emerging space market segments. A solid foundation exists in the state upon which to build, and important legislative steps have recently been taken that will help Florida's space community address the major challenges.

This report clearly revealed the need for:

- A coordinated effort to address impediments to commercial launches at the Cape.
- Better integration of Florida's universities and small business community into emerging scientific and new technology research and development opportunities.

The establishment of the Spaceport Management Council and the Florida Space Research Institute (FSRI) are key developments that should improve the state's performance in these areas and its overall space economy.

The state can shape its future in space commerce by focusing its efforts on attaining two goals:

- Remain a leader in space transportation by supporting the evolution of Kennedy Space Center and Cape Canaveral Air Station into a world-class spaceport – the Cape Canaveral Spaceport.
- Diversify Florida's space economy by helping its companies strategically pursue opportunities in the non-launch space markets and by strengthening the state's science and research and technology development capabilities.

IV.A Leadership in Space Transportation

Cape Canaveral Spaceport is currently the hub of the nation's space transportation system. To retain that leadership and to be internationally competitive, CCS must evolve into a world-class spaceport. This means developing a state-of-the-art, multi-use facility that is responsive to the needs of all commercial customers. In achieving this goal, the state of Florida faces two major challenges:

- Existing buildings, support facilities, and basic utilities infrastructure, are antiquated and many use electronic systems developed in the 1960s. A plan to modernize the facilities and operating systems must be developed and incorporate the needs of the military, scientific, and commercial sector users.
- While more frequent than in the past, launches are still treated as special events. Cost-effective, routine access to space will require the application of new business concepts and procedures more commonly found in mature transportation sectors such as airports and commercial freight shipping.

To support the evolution toward a world-class spaceport the state should:

1. Improve communications, the flow of information, and implement a strategic planning process.
2. Incrementally invest in facilities to support the next generation launch vehicles and operations.
3. Address institutional and business impediments to commercial operations at CCS.
4. Partner with key stakeholders, such as industry, NASA, and the Federal Aviation Administration (FAA), to design and test next generation technologies and operating procedures for spaceports.

IV.A.1 Improve Communications and Strategic Planning

The demand for launches and support services and the development and application of new technologies are the key external factors that will determine Florida's future in space transportation. However, a single event like the bankruptcy of a satellite communications company can reduce the need for 50 to 100 satellites and their corresponding launches. Or, a failure in a test flight can set back the introduction of a new launch vehicle and transportation system several years and hundreds of millions of dollars.

Greater awareness of these and other market and technology developments should be major considerations in the state's decision-making for future investments. Realistic market and technology assessments need to drive the state's continued involvement in the launch business.

In addition, clearer and more timely information about Spaceport Florida Authority's activities and plans need to be communicated to state officials and legislators in order to maintain support for its programs.

Therefore Florida should:

- **Establish a process whereby SFA will improve its communications with Tallahassee.** SFA is critical to the state's efforts in developing a viable commercial launch industry within Florida. At the same time, SFA must also protect the interests of the state and its taxpayers in dealing with the existing tenants and operators of the facilities at the Cape who, in turn, respond to broader corporate and national requirements. Thus, SFA needs the authority and flexibility to resolve problems and make investments supporting the development of the state's spaceport. However, in order to understand and maintain support for its programs, SFA and the state should establish a formal reporting process where SFA communicates its plans and activities in the context of the state's goals in a more timely and thorough manner.
- **Develop an institutional capability within the state to conduct ongoing market and technology assessments, and make this information available to the public**. Many people and organizations involved in space in Florida expressed the need to have objective and balanced data and information on developments in space markets and policies. This information forms the

basis for new funding programs and investments, and could help Florida's space business community evaluate opportunities in new markets. The University of Michigan established one such model — the Office for the Study of Automotive Transportation (OSAT) to provide research and analysis, information resources, and communication forums that respond to the continually changing needs of the international automotive and motor vehicle transportation industries. A Center for the Study of Space as part of the Florida Space Research Institute (FSRI) could be established along similar lines.

- **Develop an ongoing strategic planning process for the space sector in order to keep its space strategies current and its underlying programs and investments focused**. This process, largely dependent upon the data and information from the state's "space research center," can drive the state's new programs and steer existing activities.
- **Develop a 5-year space transportation plan similar to those used to support transportation funding for airports and seaports**. The Spaceport Management Council was recently created to begin work on a plan that will identify and prioritize requirements to upgrade launch pads, roads and support facilities at the Cape that will evolve it into a fully-integrated, multi-use space transportation system.

IV.A.2 Incrementally Invest in the Cape Canaveral Spaceport

Competition to provide launch services to the commercial sector is intense. Currently four launch sites — Kourou, Baikonur, Xichang, and Sea Launch — are capable of competing with the Cape's existing tenants. Planning for new spaceports is underway in over a dozen states throughout the nation. However, it is not in Florida's interest to "over react" to these real or perceived competitive threats. Florida has strategic advantages over many, if not all, of these sites.

However, many of the support facilities and equipment at CCS are old and antiquated. To be a viable alternative to more modern spaceports, Florida and its tenants must upgrade critical facilities in a prudent manner. The state should take stock of its strengths and weaknesses and formulate an investment strategy that will build upon its existing assets and position to capitalize on new opportunities.

Therefore Florida should:

- **Invest in selected multi-user infrastructure to support the next generation RLVs and ELVs**. Florida is currently the only fully integrated, multi-use launch facility in the world. By strategically investing in selected launch support facilities it will signal its competitors that it is committed to developing public and private sector partnerships that support the needs of the next generation launch vehicles and pre-and post-launch processing requirements. The expansion of the RLV hangar currently underway sends a clear signal to all potential launch vehicle manufacturers that the state will support their requirements in a timely fashion when required.

- **Support the development of the SERPL building**. Support for SERPL demonstrates the state's commitment to space in two ways. It is a critical link to broadening the state's role in scientific research. This investment also sends a clear signal that the state will support the needs of companies planning to conduct experiments on the International Space Station and those looking to provide transportation services for the ISS. Given the size of the commitment from the state, the Governor should not be hesitant to require additional commitments from NASA. These might include establishing a new "science niche" for Florida universities, additional RLV research to help better position CCS as the future home of next generation RLVs, or require that ISS launch support requirements originate from the Cape.
- **Invest in the roadway and utilities at the KSC Space Station Commerce Park**. This investment is consistent with traditional economic development practices, supports the anchor tenant (the SERPL building), and makes readily available the land and supporting infrastructure that new tenants may need.

IV.A.3 Address Institutional Impediments to Commercial Launches

Launch vehicles, physical infrastructure, and support services are necessary to support launches. However, as is the case with existing and new transportation systems, meeting the needs and concerns of the end users and addressing institutional working arrangements are the primary determinants of success or failure. The evolution of launch activity away from singular events supporting scientific or security missions toward a multi-user space transportation system that meets the needs of commercial customers, will require a significant amount of effort from the leadership of the state. Unless the business operations concerns of existing and new launch service providers are addressed, adding needed certainty and reliability in CCS operations, commercial payloads will seek other sites.

Therefore Florida should:

- **Aggressively recruit new launch service providers.** New launch service providers will not be dependent on long standing government contracts and working relationships. Nor will they be responding to a broader set of corporate goals and business concerns distant from the state of Florida. New launch service providers will be able to clearly communicate their requirements for launching at CCS and what the impediments are to operating at CCS. SFA should continue to recruit Beal Aerospace, and open discussions with others in an effort to increase the commercial sector tenants at the Cape and open up the opportunity to bring launch vehicle manufacturing and assembly to the state. SFA should lead the recruitment activities, but coordinate with Enterprise Florida and local development corporations across the state on siting and business climate and incentive decisions.
- **Use SFA to represent the needs and concerns of customers at the Cape.** The Spaceport Management Council has already identified the need to ad-

dress customer requirements. Given the diverse and diffuse needs of existing and new tenants and how they may like to redesign business operations, SFA needs to be a strong advocate for true “one-stop” shopping and customer satisfaction.

- **Provide SFA with clear guidelines and authority to offer economic development and financing packages to attract new launch service providers to the Cape and retain current ones**. Also, SFA needs the support of a financing corporation to attract telecommunications and satellite companies that are shopping for launch service providers and sites. Since many of the new telecommunications services will require satellite constellations, companies will be looking to buy “launch packages” with “one-stop shopping” for financing, insurance, support services, and launch dates. Currently, Kourou offers just such a package. If SFA or other tenants at the Cape can not offer these packages, CCS tenants will be at a competitive disadvantage.
- **Have the Governor’s office take the lead in addressing national policies and institutionalized federal operating procedures that impede greater commercial use of the launch facilities**. Despite the best efforts of SFA and other CCS tenants, national policies on excess capacity, range modernization, and import/export controls still represent comparative disadvantages in making the business decision to launch from CCS. The Governor needs to be more vocal in the state’s positions, since the majority of key stakeholders are responding to corporate or national policy concerns that do not consider the state’s stake in their decisions. The Governor should also consider aligning with other space states to develop a broader base of support for changes in national space policies.
- **Look into the assessment of a national “end-user” fee or tax on satellite derived products and services to raise funds for infrastructure upgrade and maintenance**. These fees are similar to those found on telephone or cable bills. It would appear that a nominal user fee on satellite-based products and services could help defray the costs to the Air Force and NASA of maintaining the launch infrastructure at a time when the commercial sector and consumers are benefiting from new products and services supported by space systems.

IV.A.4 Partner with Stakeholders in Developing New Vehicle and Spaceport Concepts

Unlike the past when the federal government was willing to invest the funds necessary to design and develop launch vehicles, payloads, and the launch and supporting infrastructure, success in the future will be determined by developing strategic alliances and partnerships that leverage funds and expertise. Along with a policy of incremental investment, the state should strengthen existing, and establish new, partnerships. These partnerships should be developed to keep Florida’s space community at the leading edge of new vehicle and spaceport technology developments and operating procedures.

Therefore Florida should:

- **Strengthen its existing partnerships with KSC, the Air Force, and industry in the development of next generation spaceport concepts.** While other states are preparing plans to design and develop a spaceport, Florida should strive to develop and test new technologies at its existing spaceport. As part of this effort, a spaceport master plan should be developed that will serve as a roadmap for future investments, and demonstrate to new launch service providers Florida's long-term commitment to developing a world-class spaceport. Florida should ensure the participation of the many companies in the state that are involved in launch and support operations, so they can maintain a competitive edge and be well-positioned to be a national source of supply for these technologies, products, and services in the future.
- **Partner with FAA as it begins to assume a greater role in the future for licensing new launch vehicles and spaceports, and developing operating procedures.** As federal agencies develop new programs and areas of responsibility, they are required to conduct studies for internal management to gain approval for funding. SFA could partner with FAA and help produce mission needs statements, concepts of operations, and rough order of magnitude costing studies. SFA could also partner with FAA and industry to independently evaluate the potential of GPS for tracking launches.

IV.B Diversify the State's Commercial Space Economy

Florida's space economy is currently concentrated in the launch services market. However, the state has strengths in other sectors, such as the design, manufacture and operations of ground equipment, radio and television communications equipment, optics, and simulation software. Building on these strengths should provide opportunities for Florida to move into new markets that are enabled by satellite systems and services. To create greater opportunity and improve the robustness of its economy, the state should build on its history in space and diversity into selected non-launch segments of the space market. The state should also strategically pursue emerging market opportunities that were highlighted in Section III.

To ensure the long-term robustness of its economy, the state needs to improve its record in investing in science, research and technology development, and education and training programs. These areas are critical if a state wants to build an economic foundation that generates innovation and commercialization of new products and services.

To achieve diversification, Florida faces two major challenges:

- The existing launch-related markets show *limited* opportunities for attracting new business to Florida. As discussed earlier, the established companies are well-entrenched geographically. Because of the high risks and uncertainties associated with projected launch demand, many of these firms will be hesitant to invest in new capacity at this point in time. Florida will need to conduct in-depth market assessments to understand the changing dynamics of the non-launch space sectors and to be able to identify when the market might experience the kind of steady growth that requires firms to invest in new capacity. These market assessments would also help Florida identify opportunities for its small and medium-sized firms, as well as opportunities where the state may want to work with existing companies to establish new lines of business.

- Florida has concentrated its priorities on building infrastructure in response to its rapid population growth, its agricultural and tourism requirements, and its concentration of elderly population. The state's investment in workforce development, basic and enabling research, education, and science reflect these priorities. Until recently, space and space science have not received much attention or funding. The state needs a new focus that supports the needs of an "innovation driven" economy and begins to build the intellectual capital needed to support a more dynamic and growing economy.

To support the evolution to a more diverse space economy, the state should:

1. Conduct an in-depth strategic assessment of the non-launch space market segments.
2. Align the state's space sector with other key economic and technology sectors to pursue new business development opportunities.
3. Partner more strategically with NASA to develop commercialization opportunities.
4. Support the Florida Space Research Institute and the Florida Space Institute in order to build intellectual capital.

IV.B.1 Conduct Strategic Market Assessments

Given the limited time and resources available for this review, the market assessment in Section II provides a summary of recent developments and opportunities in key commercial space market segments. It also provides a generalized structure for Florida officials to follow in conducting more detailed assessments.

Based on projected revenue streams, the greatest opportunities for diversification exist in the end-user services markets. Demand for end-user services, predominantly telecommunications, data and information exchange, and broadcast services, is growing and is predicted to grow at a rapid rate in the future. Many of the companies in these sectors are continuing to invest in new services, supported largely by venture capital generated from internal and external sources. However, as seen in the bankruptcies of the Summer of 1999, the underlying consumer demand for these services is extremely volatile. The key issue is that prices have not yet fallen within the reach of the intended market.

A more detailed assessment of future opportunities and risks in these markets is required to support a state-wide strategy for attracting, expanding, and growing new commercial space businesses. Florida already has a favorable business climate and a full range of economic development incentives at its disposal. But it lacks a comprehensive strategic assessment of its opportunities as well as a plan to pursue them.

Therefore Florida should:

- **Conduct more detailed market assessments for each of the non-launch space markets.** Where opportunities are identified, Enterprise Florida should develop business strategies that align the assessments with existing corporate and industrial capabilities within the state. The strategies should identify where opportunities exist to recruit companies to the state, and identify where opportunities exist for existing companies to expand their operations and lines of business within the state.
- **Develop marketing information tailored to the commercial space community and develop web-based tools that communicate the advantages of locating businesses in Florida and instruct new businesses on how to explore location opportunities in Florida.**
- **Ensure that the state's economic development tools and services support the development and expansion of small, start-up companies.** The state's economic incentives are geared toward larger, more capital intensive firms. These incentives should be modified to promote the growth of smaller businesses within the state, especially focusing on the needs of high-tech and science-oriented start-up companies that may emerge from the ISS and SERPL research.

IV.B.2 Align Florida's Key Economic and Technology Sectors with the Space Economy

In addition to looking at business development opportunities in the broader commercial space areas, Florida should pursue opportunities to diversify its space economy by taking advantage of some of its existing sectors, and build upon their strengths. Florida should look for synergistic alignments between emerging markets and existing economic sectors, such as communications services and equipment, tourism, optics, silicon technology, or simulation software. Enterprise Florida has developed successful partnerships that have benefited companies and university research centers, while creating opportunities for economic development. Pursuing similar partnerships that align Florida's technology sector strengths with emerging space industry research requirements, is needed.

Florida's strength in tourism may provide two opportunities for greater involvement in a market that will be emerging in the next decade, and one that will not probably be realized until we are well into the next century.

Therefore Florida should:

- **Partner with selected satellite communications service providers and the tourism industry to use Florida as a test market for wireless products and services that are dependent on satellite access**. The large number of tourists that visit Florida from around the world creates a natural test-bed for satellite-provided telecommunications and internet access. Orlando was a natural site for the first extensive test of in-vehicle navigation systems, due to the large number of visitors and the related demand for rental cars. The lessons learned from that test shaped federal intelligent transportation systems (ITS) policy, and helped industry design better navigation systems. In the "wired" economy of today, access to email and the internet to stay in touch with families and the workplace is a fast growing phenomenon.

- **Lay the groundwork to ensure that Florida will be the gateway of choice for space tourism**. Today, space tourism in Florida is driven by the desire to view launches, visit the Kennedy Space Center and its museums, and to send children to space camps. While the though of tourists traveling to outer space is still a distant dream, Florida should consider the needs of this market as it develops land use plans at the Cape, and works with the tourism industry on new theme parks and other ventures.

IV.B.3 Strategically Partner with NASA

NASA and the Kennedy Space Center have been important players in supporting the development of Florida's space economy. In 1998, NASA/KSC added an additional $900 million dollars to Florida's economy. This revenue was generated through NASA funding for operations and launch services, as well as for tourism. Starting this year, NASA headquarters has designated KSC as a center for research and development for spaceport technologies. This new responsibility provides the state opportunities to attract grants to the state, develop a state university expertise in space technologies, and explore emerging opportunities for the commercialization of new technologies.

Florida has a well-established niche in meeting the engineering needs of the space industry. However, it has not established a strong foothold in space science. The SERPL building will provide the state the opportunity to better integrate its universities and high school science classes into real experiments. This also helps to showcase Florida to scientists and businesses around the world.

Florida's universities and educational institutions have programs that leverage NASA/KSC's expertise in space for education. There are programs to develop teachers, programs to encourage K-12 students to conduct space science experiments, and programs to integrate space problems into math and science curricula. However, more focus and investment is needed to develop the statewide science expertise as a foundation for a more dynamic economy.

Therefore Florida should:

- **Establish a more science-oriented research agenda with NASA that involves its university system and interested companies.**
- **Support the construction of the SERPL and the Academic Support Center, and establish provisions that NASA will provide more help to the state to achieve its goals of attracting new generation launch vehicles, diversifying the space market, and developing new science niches.**

- **Establish a recurring match for federal funding under the NASA Florida Space Grant Consortium.** This will support the development of new research capabilities within Florida's universities. Recipients could justify the use of funding by documenting the commercial potential of the funded research.

IV.B.4 Support the Florida Space Research Institute and the Florida Space Institute

The fundamental role of innovation, research, and technology development as a primary driver of economic growth continues to gain widespread acceptance. Recently, Federal Reserve Chairman Alan Greenspan noted that the country's "remarkable run of economic growth" is directly attributable to "roots in ongoing advances in technology," advances that are the product of innovation and business clustering.[74]

States and local economies around the nation have proven that a rich scientific base of research conducted at academic institutions drives innovative industries and products. One state, Massachusetts, compiles indicators of the innovative process and benchmarks them against competitor states on a yearly basis. For Massachusetts, this index has demonstrated that the innovation process is "fundamentally sound"[75] and provides an underlying strength to the state's economy.[76] Another state, North Carolina, has demonstrated similar dynamic growth in the Raleigh-Durham areas with investments in research and technology development supported by its university at Research Triangle Park.

The programs needed by a state to create this type of dynamic growth are:

- Graduate research and education.
- Development of university centers with science expertise.
- Funding for research and technology development.
- Funding for partnerships with industry to support new start-ups and commercialization.
- Workforce development programs.

To some degree, Florida has elements of all of these components. However, the state needs a more coordinated focus on space and space science. FSRI and FSI provide a means for better focusing and coordinating these efforts:

- FSRI is a recent creation of the Florida State Legislature, designated to be an industry-driven center for research and education. Through FSRI, the state forms a strategic partnership with industry in an effort to create: opportunities for universities to work with industry and further development their expertise; opportunities for industry and universities to partner to compete more vigorously for research grants; and, opportunities for university research to be

[74] Synopsized from: The Massachusetts Collaborative Technology report transmittal letter, 11/12/99.
[75] Ibid.
[76] Ibid.

commercialized through industry, thereby spurring the innovation process to support dynamic economic growth.

- FSI is a partnership of five Florida academic institutions that work closely to provide undergraduate, graduate, and continuing education, in partnership with the agencies and companies at Cape Canaveral. Through FSI, the state has a mechanism to address workforce development needs. FSI conducts education programs to support the Kennedy Space Center as a NASA Center of Excellence for launch and payload processing systems. Through FSI, the state has established a stronger science foundation with FSI's work in research and development. FSI has a number of research projects related to satellites and payloads. FSI also provides the state with a mechanism for long-distance learning in space — through a partnership with Boeing and KSC, FSI is being provided with a fiber optic link to their Orlando campus. This link has many advantages. First, it supports FSI's program to deliver graduate level engineering courses to industry at the Cape, as well as to cooperating university centers in order to increase academic support for existing space industry operations. Second, this link allows universities around the nation to participate in FSI's programs and research.

It is these kinds of partnerships and resources that feed into dynamic, innovative growth of economies.

In summary, the space world is changing, with public policies and market forces at work that present both risks and opportunities for the state of Florida and its space businesses. The state appears to be well positioned to respond to the challenges. And, the time is right for Florida to develop and aggressively pursue strategies to diversify into non-launch related industries, and to lay the foundation for a stronger space science research and development community. It is intended that this report help Florida chart a new space business strategy.

Appendix A: Interview Highlights

State government:

- There was a strong desire to maintain Florida's reputation and position in worldwide space enterprise. Many interviewees expressed uncertainty in their knowledge of the status of the marketplace, what the market drivers are, what the market segments are and what the diversification opportunities are; the status of next generation technology development and how and when it would have an impact; and the status of space R&D within the state, the expertise of universities in support of space, and why better linkages to university R&D had not developed within the state.
- There was a corresponding strong concern about the role of SFA. Some interviewees felt that it was necessary to have an agency with broad authority to react to opportunities; for others, it provided a confusing situation as to what business SFA was in, or supposed to be in, and how that reflected on the state.
- There was a consistently strong interest in providing incremental investment to build Florida's niche in the worldwide space enterprise, but an equally strong desire to have it more formally tied to intelligent assessment of the market for products and services and NASA's new pursuits.
- A number of government officials recognized the transitions occurring at this point in history, and therefore expressed a strong desire to create a sense of urgency for Florida to take action, along with an understanding that space is not just a one county issue, but that it is statewide. As space continues to evolve toward commercial enterprise within Florida, it has an opportunity to have an even greater statewide impact/benefit. The current e-commerce environment allows business to settle anywhere, but having access to the business environment close at hand and being located where industry is vertically integrated creates a more powerful business dynamic.

Industry:

- The major players are mostly focused on sustaining the ability to do business at the Cape given the shifting nature of contracts and the federal government's privatization efforts. The current structure of the contracts makes it difficult to figure out how to "make money" in the launch business, and the looming issue of "sudden" and "full cost accounting" is frightening.
- The role of U.S. Air Force policies created an unattractive business climate for attracting commercial launch customers. National policies on access to the range create great uncertainty and work against Florida's current tenants.
- Many businesses, both small and large, noted the lack of information on space business and market opportunities within the state. Many businesses called for one

source of information. They found the many agencies involved in space confusing and they weren't sure what the state was trying to achieve with all of its various incentive programs.

- Small businesses continually noted the barriers to entry into Florida's space economy. They find that the state's incentives are geared toward big businesses who can create many jobs at one time, or can invest a large amount in new equipment to take advantage of the sales tax. Small businesses find that there is a lack of programs and incentives geared toward them.
- Many businesses also told of the lack of coordination among the local economic development agencies and Enterprise Florida. They had difficulty finding support or answers to their questions, not being clear on who to contact for information.
- Almost all businesses told of the lack of access to venture capital funds, grants and assistance for R&D. R&D funding is the heart of innovation and it generates dynamic economic growth. There is very little available to the space businesses in Florida, in part because it is difficult to show returns of 300 to 400 percent in the manner of information technology businesses. However, the Florida small businesses do feel that there is enough of a solid market to sustain growth evenly for the next 10 years or until technology reduces the cost per pound of launch, which holds the possibility of increased demand for launch and spaceport construction.

Federal Government:

- Agencies told us that there is little consensus in Washington, D.C. on many policies that need to be crafted. Operating spaceports like airports is not a near-term reality. Licensing and permitting processes are not at all established and there is much debate on how to establish them.

Academic Institutions:

- The academic community told of a lack of commitment in Florida to improving space education, despite the *realization of* higher skilled workers with better math and science skills. They provided information on how small amounts of funding would have a significant impact on Florida's image and base of expertise in space science:
  - First, it would show Florida's commitment to space in a very public way. On a yearly basis, 52 space grants are awarded to each state plus Washington, D.C. and Puerto Rico. Most states commit matching grants. Florida, despite wanting to be the "place for space," does not make this commitment.
  - Second, dedication to funding Type I Centers and increasing funding for graduate education and research would facilitate building a more solid R&D and science community. These types of commitments allocate funding to dedicating faculty time to R&D, supporting graduate education research, providing funds to structure programs with NASA and industry to leverage their expertise into edu-

cation, and promoting space education in K-12. These programs, once implemented, would then produce a workforce more clearly matched to space industry needs.

- Academic interviewees told of how the state could help in developing partnerships and niches by developing and funding programs. Examples are the FSI and FSRI.

Non-Profit Agencies:

- Told of how the state needs more commitment and a more strategic approach.

Appendix B: Interviewees and Contributors

Agency	Name
Governor's Office, State of Florida	**Governor John Ellis Bush** **Lt. Governor Frank Brogan**
45th Space Wing, U.S. Air Force	**Patrick Blucker**, Chief, Plans and Programs **General Randy Starbuck**,
Aerospace Insights, Inc.	**Shirley Bottomley**, President **Godfrey Bottomley**, Senior Vice President
AJT & Associates, Inc.	**Dale Ketcham**, Business Development
Beal Aerospace	**Hugh Cook**, Director of Launch Operations **Dave Spoede**, Vice President and General Counsel
Bionetics Corporation	**Jerry Moyer**, Project Manager, Life Sciences Support Contract
Boeing Company	**Timothy P. Ferris**, Director - Operations, Space Coast Operations **J.B. Kump**, Director, Communications & External Relations **Ronald L. Larivee**, Manager, Expendable Launch Systems Business Development **Bruce E. Melnick**, Vice President, Space Coast Operations **R.J. Murphy**, Director, CCAS & VAFB Launch Operations Expendable Launch Systems **Michael Sklar, Ph.D.**, Specialist R&D Engineer **Brad V. Lenz,** Executive Development Program
Brevard Community College	**Thomas E. Gamble**, **Ph.D**., District President
Command and Control Technologies Corp.	**Kevin Brown,** Vice President, Business Development **William J. Collins**, Government Affairs & International Business Manager **Peter Simon,** President

United States Congress	**Brian Chase**, District Director for Congressman Dave Weldon **Pamela Gillespie**, Executive Administrator for Congressman Dave Weldon
Dynacs Engineering Co., Inc.	**Vicki J. Johnston**, Analyst, Technology Programs & Commercialization Office
Economic Development Commission of Florida's Space Coast	**Lynda Weatherman**, President and CEO
Enterprise Florida	**Michael T. Fitzgerald**, President and CEO, International Trade & Economic Development Board **Steve Mayberry,** Senior Vice President, Business Retention and Recruitment **Roger Miller,** Director, North American Recruitment **Greg Moore,** Director of Space Programs
Executive Office of the Governor, State of Florida	**Warren May,** Office of Planning and Budget **Wynelle Wilson**, Office of Planning and Budget
Federal Aviation Administration	**J. Randall Repcheck**, Aerospace Engineer, Licensing and Safety Division
Florida Department of Transportation	**Travis Dungan,** Manager, Fast Trak, Economic Development and Space Transportation
Florida A&M University	**Katherine Milla**, Remote Sensing Lab
Florida Atlantic University	**Dr. Rick Mroz**, Medical Laboratory Sciences Program
Florida Aviation and Aerospace Alliance	**James Bodine**, Chairman
Florida Business Associates	**Linda Davis**
Florida Inspector General	**Fred Lawrence,** Chief Inspector General's Office
Florida High Tech Corridor Council, Inc.	**Randy Berridge**, President

Florida House of Representatives

Representative Randy Ball, District #29

Representative Rudolph Bradley, District #55

Barry Brooks, Executive Director, House Economic Development Council

Representative Tom Feeney, District #33

Timothy Franta, Legislative Assistant to Rep. Howard Futch

Representative James Fuller, District #16

Representative Howard Futch, District #30

Representative Harry Goode, District # 31

Eliza Hawkins, Transportation and Economic Development Appropriations Committee

Representative Bill Posey, District #32

Paul Whitfield, House Business Development and International Trade

Florida Senate

Senator Charlie Bronson, District #18

Bill Cotterall, Legislative Aide to Patsy Senator Kurth

Senator Jim Hargrett, District #21

Allen Josephs, Committee on Commerce and Economic Opportunities

Senator George Kirkpatrick, District #5

Greg Krasovsky, Assistant to the President, Senator Toni Jennings

Senator Daryl Jones, District #40

Jackye Maxey, Deputy Staff Director, Committee on Budget

Eric Maclure, Staff Director, Committee on Commerce and Economic Opportunities

Senator Jim Sebesta, District #20

Tonya J. Shays, Legislative Assistant to Senator George Kirkpatrick

David Winialski, Chief Legislative Assistant to Senator Jim Sebesta

Florida Space Grant Consortium

Penny Haskins, Associate Director

Florida Space Institute

Dr. Ronald L. Philips, Director

Robert F. Crabbs, Assistant Director

Futron	**Carrissa Christensen** **Greg Lucas**
Government Financial Advisors	**Thomas B. Holley**, Independent Financial Advisor to Local Governments
J. Rolfe Davis Insurance	**James D. Pruett**, Commercial Agent
Johnson Controls, Inc.	**John L. Byron**
Lobbyist	**Guy Spearman**
Lockheed Martin	**Forrest McCartney**
NASA/KSC	**Dr. Gale Allen**, Associate Director, Technology Programs and Commercialization Office **Roy Bridges**, Director, Kennedy Space Center **Greg Buckingham** **John Halsema,** Legislative Liaison **Jan Heuser,** Program Manager, Space Experiment Research and Processing Laboratory **John Hudiburg,** Advanced Development Office **James L. Jennings**, Deputy Director for Business Operations **Lori N. Jones**, Space Experiment Research and Processing Laboratory **David R. Makufka,** Commercial Technology Manager **Warren Wiley**, Deputy Director of Engineering Development, Program Manager, Future Vehicles
NASA/Langley, Education	**Ed Prior**, Deputy Director, Office of Education
Office of Tourism, Trade & Economic Development	**Debra Corkhill,** Coordinator for Defense, Space & Technology **Pamella Dana**, Deputy Director **J. Antonio Villamil**, Director
Reliable System Services Corp.	**Tony Perez-Falcon,** President

Spaceport Florida Authority	**Edward Ellegood**, Director, Policy & Program Development **James D. Leary, Esq.**, Chief Operating Officer **Edward O'Connor**, Executive Director **Dave Teek,** State Government Affairs **Albert Thomas**, Deputy Director **E. Keith Witt, Jr.,** Systems Planning Manager
SMART Enterprises	**Christine Rodgers,** President
Southern Technology Applications Center, University of Florida	**J. Ronald Thornton**, Director
Space Business Roundtable	**John Byron, Johnson Controls** **Bud Gardner, Tilden Lobnitz Cooper**
Spacehab Payload Processing Facility	**Dale Steffey**, Vice President, Operations
State University System of Florida	**Dr. Adam Herbert**, Chancellor **Thomas C. Healy**, Vice Chancellor for Governmental Affairs
Tilden Lobnitz Cooper	**Winston W. Gardner, Jr.,** Principal, Regional Office Director
Technological Research Development Authority (TRDA)	**Bob Allen**, Deputy Director **Frank Kinney**, Executive Director
United Space Alliance	**Leslie Dughi,** Governmental Consultant **Christopher M. Holland,** Counsel, USA Legal Office
University of Central Florida	**Tim Kotnour, Ph.D.**, Assistant Professor
White House, Office of Science, Technology, and Policy	**Vic Villhard**
Consultant	**Janice Bellucci Dunn**

Appendix C: Remarks to Florida Legislature

Remarks to the Florida State Senate and House of Representatives
December 7-9, 19999
John O'Donnell and Suzanne Sloan
U.S. Department of Transportation
John A. Volpe National Transportation Systems Center

Text:

Good Afternoon Representative/Senator.

Four months ago we started a review of Florida's current space-related activities, and began to explore where new opportunities in space commercialization existed for the state.

Last week, the Volpe Center submitted a draft report to the Governor's Office and the Office of Tourism, Trade and Economic Development.

The report provides a discussion of why space is important to Florida, and why now is a good time for the state to develop a space strategy. It provides an assessment of the global space market and recommends a course of action to assist the state in achieving what we believe should be its two guiding goals. The first goal is to retain its leadership position in space transportation. The second is to diversify Florida's space economy.

Our remarks today are intended to highlight the findings and recommendations contained in our report.

To begin with, I don't think it will come as a surprise to anyone that space is important to Florida.

- Space is not just a Space Coast issue. Although many firms are clustered around Cape Canaveral and throughout Brevard County, approximately 50% of space businesses are located elsewhere in the state.
- The high-wages and skilled workforce make this industry vital to Florida.
- It is also important to highlight Florida's prestigious reputation in space. When the average citizen thinks about the nation's achievements in space, he or she automatically envisions the awesome power and beauty of a launch from Cape Canaveral. This positive image is an intangible, but important benefit to the state, especially in tourism.

As a result of its long history in space, Florida has many advantages and strengths.

- The state is the hub of the nation's space transportation system and it is the only facility in the world that currently supports both expendable and reusable launch vehicles.
- Because of this unique infrastructure and its geographic location, Florida holds a great competitive advantage over other spaceports. While many locations are planning to build spaceports, Florida has all the necessary elements in place to evolve its facilities into the leading spaceport of the next century.
- The number of commercial launches from the Cape is among the highest in the world and leads the domestic commercial launch industry. Over the last five years, Florida has successfully launched 90 payloads, 39 of which were for commercial customers. By comparison, California has launched only 39 payloads, of which just 18 were for commercial customers. In 1998, approximately 1/3 of the commercial launches worldwide originated in Florida.

Despite this good news, it is important for Florida to take action now. Florida's position in space transportation is being challenged by competition around the world, at a time when space transportation forms the most solid basis of Florida's space commerce.

In addition, there are decisions being made in the public and private sectors, that may have a significant impact on Florida's position in space transportation, and **<u>will affect</u>** its ability to diversify its space economy.

- Let me give you some examples. In the public sector, federal policy decisions are being made that reflect reduced budgets, changing priorities, and the trend toward downsizing. Which means that, just at a time when the commercial sector is expected to become the largest customer for launch services, the national commitment to launch infrastructure and launch activities is becoming more uncertain.
- In the private sector, investment decisions are being made in response to cost pressures to consolidate and rationalize lines of business. At the same time, emerging satellite communications markets are believed to show great promise. **<u>But</u>** these markets are highly uncertain, as the near-term viability of many of these services and satellite systems is unproven. While on the one hand, this uncertainty may impact the future demand for launch activity, on the other hand, these emerging markets **<u>may</u>** provide new business opportunities for Florida to pursue.
- If Florida accepts the status quo and assumes that no other location will emerge as a viable alternative launch site, **<u>it does risk losing</u>** its commercial launch business. It's clear that without evolving the infrastructure and business support services to meet future customer requirements, commercial launch customers **<u>will</u>** seek other sites.

However, as is the case when the private sector invests, Florida **<u>must avoid the risk</u>** of moving too quickly and making investment decisions without the necessary market information. The near-term costs associated with over investing may very well be **<u>as great</u>** as the long-term costs of under investing.

Let me explain this a bit. When we reviewed last year's requests for funding for projects from the tenants at the Cape, we saw investments that added up to almost $100 million without any clear description of how the investment would bring more business to the state over a specified period of time. Some of the more modest infrastructure investments did make sense for meeting current customer needs. Our assessments, however, suggested that a number of these investments could be deferred without jeopardizing the state's ability to grow its space business.

Because of the limited time we have today, I will provide only a quick overview of our analysis of the space market, and highlight some of the opportunities that were identified.

The space market can be segmented in many different ways. To assess what opportunities are promising for Florida, we divided the global space market into three segments.

The first market segment is comprised of companies and activities related to launch.

Florida is the nation's leader in launch services and thus is well-positioned to capture a greater share of the commercial launch market over the next ten years. We also believe it is well-positioned to recruit and support the next generation launch vehicle and launch service provider companies.

However, enthusiasm for supporting a greater number of commercial launches must be tempered by the fact that we do not expect a two- or three-fold increase in launches. We see demand increasing by no more than 15-25 launches per year, worldwide, over the next ten years. This is not a dramatic change and it depends on the demand for still uncertain satellite launches. Increasing the number of launches also depends significantly on changes being made in the business operations at the Cape. Modernizing the range without these business changes will not be enough.

Continuing with opportunities in the launch related market, it is important to note that Florida also has a well-established industrial base in the ground equipment and support systems market. Industry forecasts predict healthy growth in this market for both communications equipment and support services, and for the services to upload, download, and transfer data and information from satellites.

Ironically, Florida will also benefit if the demand for new domestic spaceports materializes, since the state has a well-established base of companies that support pre- and post-launch processing, and launch control and support activities.

The second market segment in which there are opportunities for the state of Florida, is the market for satellite-enabled services. This includes mobile phones and handheld devices, portable computers, direct-to-home TV, remote sensing and imaging, and navigation and location services.

Currently the market for satellite-enabled services is the largest and fastest growing space-related market, as measured by revenue. Experts predict that substantial growth in this market will occur five to ten years from now, giving Florida a chance to begin to lay the foundation for capturing this potential growth when it happens.

The remote sensing and imaging market offers Florida a current opportunity. This market is now in transition. It is moving from a federal government service to being commercialized with private sector firms. There are potential niches that align with Florida's interests in land use planning, agriculture, and environmental monitoring.

In addition, our report recognizes a unique opportunity for Florida in the satellite-enabled services market. We believe that Florida is a natural site to test emerging wireless communications products and services. Tourists from around the world visit Florida, and like many of us, they have become accustomed to staying connected to their families and offices via the internet and wireless phones. Using an international customer base to test wireless broadband internet and other services, would appear to be a natural fit for the state.

The third space market segment consists of opportunities that are clearly 20 to 25 years away. Examples include the space-based manufacturing market, the space tourism market, and the market for long-term R&D, including new products developed on the International Space Station. By examining market needs in these areas today, Florida can begin to diversify its economy for the long-run, while exploring critical R&D opportunities that may benefit businesses now.

For example, the National Research Council recently identified six high risk, high pay-off technologies that could improve the capabilities and reduce costs to NASA, other government, and commercial space programs. The NRC noted that while some of these technologies were important, no organizations were currently conducting research in the area.

So while our review uncovered a mix of opportunities and uncertainties, we believe that the state is well-positioned to shape its future in space at this time. Our report recommends that the state move forward with a focus on attaining two goals:

- The first goal should be to remain a leader in space transportation, by supporting the evolution of Kennedy Space Center and the Cape Canaveral Air Station into a world-class spaceport — the Cape Canaveral Spaceport, and
- The second goal should be to diversify Florida's space economy, by helping its companies strategically pursue opportunities in the non-launch space markets, and by strengthening the state's science and research and technology development capabilities.

We feel that the state needs to focus its efforts to attain these goals in four areas:

- Instituting a state-wide strategic planning process for space;
- Making selected investments in infrastructure;

- Addressing institutional impediments; and
- Developing stronger partnerships.

First, our report recommends that the state needs to implement a space-related strategic planning process. Realistic market and technology assessments need to drive the state's continued involvement in the launch business.

But to diversify its economy, comprehensive assessments of opportunities in the non-launch markets, and strategies to pursue these opportunities are needed. We consistently heard, how important it is, that this information be made available to the economic development and business communities.

Where opportunities are identified, Enterprise Florida should pursue business development strategies with Spaceport Florida, and align these opportunities with existing corporate and industrial capabilities within the state, including the state's strengths in non-space areas, such as tourism.

The state also needs to develop marketing information tailored to the space community and web-based tools that communicate the advantages for businesses to locate in Florida.

Second, we concluded that the state should support selected investments in the Cape Canaveral Spaceport. To be a viable alternative to more modern spaceports, Florida and its tenants must continuously upgrade critical launch and support facilities, but in a prudent manner. These decisions should be supported by information on market demand, and the status of how new technologies are evolving and when they will be ready for use.

An important part of this process requires clearer and more timely information from Spaceport Florida Authority about their activities and plans to state officials and legislators in order to maintain support for its programs.

The state should also invest in selected infrastructure to support the requirements for reusable and expendable launch vehicles. The current expansion of the RLV hangar and the recent upgrades to decommissioned launch pads, sends a clear signal, to all potential launch vehicle manufacturers, that the state will support their infrastructure requirements.

However, we do agree with the state's decisions not to fund many of the past year's requests for new infrastructure or facilities. These requests lacked the strong business case needed to prove that they were required to meet clear customer needs at this time.

Our report also recommends that the state should invest in the roadway and utilities at the Kennedy Space Center Industrial Park, and should support the development of the Space Experiment Research and Processing Laboratory (SERPL) building. Support for the park and for SERPL demonstrates the state's commitment to space in three ways.

- The investment sends a clear signal that the state will support the needs of companies planning to conduct experiments on the International Space Station (ISS), and will help the state showcase Florida to scientists and businesses from around the world.

- Having the SERPL facilities broadens the state's role in scientific research.
- And, the SERPL building will also provide the initial anchor infrastructure in the planned industrial park on the Cape that **could** stimulate development similar to that realized at the Research Triangle Park in North Carolina.

However, before committing state resources, the state should obtain clearer commitments from NASA about the use of the facility by the space stations' international partners, for future R&D partnerships for the state's universities and companies, or other terms and conditions favorable to the state.

Third, the state must address institutional impediments to commercial launches at the cape. While the current Air Force commitment to upgrade the range is important, this will only address issues related to technology obsolescence. Unless the business and operational concerns of existing and new launch service customers and providers are addressed, commercial customers will seek other sites.

- Therefore, the state needs to use Spaceport Florida to represent the needs and concerns of customers at the Cape. Spaceport Florida needs to be a strong advocate for true "one-stop" shopping and customer satisfaction, including offering innovative financing packages.
- Our report also recommends that the Governor's office take the lead in addressing policies and operating procedures that impede greater commercial use of the launch facilities at the Cape, and other federal policies that could support the nation's space program.

Diversifying the state's space economy holds the greatest promise for long-term, sustainable economic growth.

To create greater opportunity and improve the robustness of its economy, the state should build upon its history in space and develop partnerships among NASA, the state's universities, and industry. A new focus that supports the needs of entrepreneurs and 'innovation driven' companies, will start to build a more solid foundation needed for a dynamic and growing economy.

And so, fourth, stronger partnerships should be developed with key stakeholders in the space industry.

The partnership with NASA is one of the most important. The state has a great advantage in the Kennedy Space Center, and it should endeavor to strategically partner in emerging research areas. Starting this year, NASA headquarters has designated Kennedy Space Center as a center for research and development for spaceport technologies.

This is an important change for the state of Florida. Other NASA centers have had research designations for years, and the pattern of economic development surrounding these centers suggests that their research has lead to successful innovation and commercialization of technologies, to a degree that has not happened in Florida. This shift in the Kennedy Space Center's mission offers potential for attracting new scientists and engineers, which should help stimulate new businesses and economic growth for Florida.

The state also needs to continue to partner with organizations that are developing new vehicle and spaceport concepts. A unique partnership to consider is working with the FAA in the development and testing of procedures for licensing new launch vehicles and spaceports, and for developing spaceport operating procedures.

And finally, as a means to institutionalizing a greater role for the state's universities in space and improving the quality of its workforce, the state should support the Florida Space Research Institute and the Florida Space Institute.

The fundamental role of highly skilled, and entrepreneurial workforce leading to innovation, research and technology development as the primary driver of economic growth, continues to gain widespread acceptance. Support for FSI and the establishment of FSRI, appear to put the state on the right track toward a more coordinated focus to develop space and space science skills.

It is also important for the state to match the yearly NASA space grant. Publicly, it points to the state's commitment to space science education, and it offers a means of leveraging research opportunities within the state.

In summary, the space world is changing with public policies and market forces at work that present both risks and opportunities for the state of Florida and its space businesses. The state appears to be well positioned to respond to the challenges. And, the time is right for Florida to develop and aggressively pursue strategies to diversify into non-launch related industries, and to lay the foundation for a stronger space science research and development community. We hope our review helps Florida chart a new course.

Thank you for giving us the opportunity to report on our findings today, and we look forward to hearing your comments.