Brevard Workforce

Aerospace Workforce Outlook Report

Phase III

January 2010

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Executive Summary

The Phase III Aerospace Workforce Outlook (AWO) Report presents findings and conclusions related to efforts to analyze and define the nature of specific Florida-based work and workforce skills for select Shuttle and related-system program activity. Florida's space industry workforce is a unique asset critical to the future of the next generation space program, as is the supply chain that supports it. The aerospace workforce is the best recruiting tool and economic development incentive Brevard County has for attracting new space and expanding industry employers to the area.

They are also NASA's most critical resource, and will be most crucial toward the success of the nation's future space program. Keeping both the supply chain and workforce strong during the transition period is essential. However; the effects of the transition will not be the same for everyone, and the nature of both the workforce and industry supply chain will undergo some change. That change will reflect a shift from primarily supporting an operating "reusable" spacecraft to introducing and managing a family of new technologies and "primarily expendable" spacecraft into the Nation's future exploration program. This will require a significant re-alignment and re-vitalization of both, the STS workforce and the contractor supply chain population.

Approach The data gathering used to update the Phase III AWO Report consisted of the following:

- The AWO research team met internally and with KSC, BW and Brevard County officials to identify and assess issues that might be associated with updating the Aerospace Workforce Outlook (AWO) report, current plans for the workforce transition, and to identify any new requirements to assist the Shuttle workforce.

- The team also met with select NASA, Air Force, and Shuttle prime contractor and sub-tier officials to identify and secure both updated workforce numbers, skills, and supply chain information. This dialogue identified companies to be contacted and provided a key element of the database, a multi-tiered listing of Supply Chain companies.

- A summary of survey data for primary and secondary source contacts was developed for use in contacting employers. Approximately 25 companies were contacted as primary sources for participation in the survey. A much wider base of 113 companies were also surveyed for secondary source information.

- The study used NASA supplied information which was limited to the identities of vendors of services to NASA at KSC, CCAFS and limited

NASA functions off-site. To obtain data necessary to prepare this study, researchers identified and interviewed vendors who received federal funds from NASA as of 1st quarter, 2009. Select vendors were queried on the number of employees whose sole employment was due to the existence of the Space Shuttle program. Based upon the results of the interviews, researchers classified employees in two categories:

- Employees who charge their time directly to NASA's Space Processing Operations Contract (SPOC), and
- Employees who charge their time to NASA as KSC institutional support and whose employment is reliant upon the existence of the Space Shuttle program.

- Considerable effort was expended in contacting and gathering data with designated shuttle-related aerospace industry organizations as well as with key commercial and other service suppliers in the local area. A combination of phone, in-person interview and electronic communication was used to support data gathering. This data gathering did result in the update of the profile of the current Shuttle-related companies (shown as Appendix A) involving use of their space-knowledgeable workforce.

- Some assessment of the industry's historical attrition and retirement experience was also identified. Not all companies provided this information. Where appropriate, the status of internal company transition planning, re-training, and assistance planning was also discussed. Also, wherever possible, data was gathered on the extent of secondary economic impact from anticipated Shuttle-related job losses and lost spending for local commercial and other support services.

- Key to the eventual analysis of the extent of the current Shuttle workforce that will be impacted by Shuttle retirement, is the assessment of requirements for those same Shuttle workers in the next generation programs likely to be selected by the White House from recommendations emanating from the *"Study of the Future Direction of the Nations Exploration Program"* by the Augustine Task Force. Results from initial analysis of Augustine Task Force recommendations are included in Appendix B***. [It must be noted, however, that the White House is still deliberating over the Augustine Task Force recommendations and the direction of the future exploration program, and the President's eventual decision may well affect the level of the impacted workforce estimates in this study.]***

Limitations

The data gathering and analysis efforts were complicated by multiple factors which directly impacted the ability to definitively characterize the shuttle workforce at a level required to clearly assess existing skill and work functions against the skills requirements and planned work functions of new program

opportunities.

First among these issues was the reticence of some employers to release data on their workforce that might in any way be used to highlight individuals or groups that could be impacted by the impending shuttle retirement. Their reticence is based on concern that the early highlighting of any workgroup or work function vulnerability to future instability might accelerate worker initiatives to seek work stability in other industry areas. These workers are clearly required to meet current critical space program and safe Shuttle fly-out needs.

Second, many of the current Shuttle contractors are actively pursuing new space program opportunities under competitive bid. Therefore, employers have provided information to the research team on a limited use basis, to support joint analysis and development of future skills mapping initiatives. Specific data associated with employer workforce numbers and skills/capabilities is protected and not releasable.

A third difficulty lay in the fact that contractors may not use the same criteria for classification of a worker to a position description, or in the reverse, may use differing qualifications for similar position description titles.

Fourth, and perhaps most limiting, the description of future skills needs and capabilities requirements in Constellation or any other future space program opportunity, is best done by defining the functional or work area of application, and then assessing the nature of the skills required to perform that work, and then to determine the level of competence. There is not a consistent form or methodology applied from program to program or from company to company that permits an "apples to apples" mapping of current, commonly used worker classifications to future need. ***And, most important for this study, the definition of the future program and related assignment of work to the Florida-based workforce has not yet been made by the White House and NASA.***

Recommendations

The estimates made herein, reflect a worst case scenario with little or no future work assigned to KSC beyond what is already scheduled for EGLS, ISS Cargo and Crew Processing activity, the Engineering Services Contract and other facilities operation and maintenance activities. The recommendations are centered on workforce, economic development and education for the future pipeline of workers.

The recommendation for workforce activities is to provide $3.2 million from state funds to meet the demands of the large number of workers yet to be connected to services, assessed, trained, or in any way assisted with transitioning to a new career or becoming competitively skilled for the next generation programs.

Economic development activities such as supporting a Research and Development Tax Credit or a Commercial Launch Zone are vital to increasing the number of jobs available for the workforce over the next twenty-four months. And to this end, the full funding of Space Florida is critical to pursuing the strategic direction laid out recently in the Space Florida Business Plan. Successful business attraction will create jobs, where aerospace workers are highly competitive and required. That is exactly why Space Florida must be appropriately funded.

Education for future aerospace workers means that today Florida must support Science, Technology, Engineering and Math (STEM) activities such as the Governor's School for Space, Science and Technology. More activities need to be identified and supported by industry and elected officials that will renew interest in STEM pursuits by those who are only 10 to 12 years old right now.

Space Transportation System (STS) Shuttle Team Today

Overview

The Space Transportation System (STS) uses the Space Shuttle as its access-to-orbit vehicle.

An overview of AWO study results indicates the Shuttle today employs a prime, sub-tier and related base support workforce level of approximately 2,000 civil servants and 9,160 Shuttle-related employees in the state of Florida, with approximately 6,140 of those employees, with the United Space Alliance (USA). The total estimated shuttle-related payroll for this workforce is estimated at approximately $660,000,000, with USA accounting for approximately $414,450,000 of that total.

Prime Contract (SPOC)

In the early years of the Space Shuttle Program, the operations and support workforce was spread across five principal NASA Centers, with most other Centers playing a support role in the program, and across 12 major support contracts, each with a significant sub-tier. In August 1995, NASA announced a plan to consolidate the 12 principal Shuttle program contracts under a single prime contractor. More than 40 companies responded to the Request for Proposals.

The United Space Alliance was formed out of an assembly of shuttle-related operations from Rockwell International and the Lockheed Martin Space Operations Company in Houston, Texas. This combined, new company was formed for the purpose of pursuing the NASA consolidation of Shuttle contracts. At the conclusion of NASA's proposal evaluation period, the new venture, the United Space Alliance (USA) was selected as the single prime contractor for future Shuttle operations support.

The initial Space Flight Operations Contract (SFOC) between USA and NASA was signed in September 1996 at the Johnson Space Center and both Lockheed Martin's Shuttle workforce and Rockwell's employees at the NASA Shuttle Logistics Depot joined together in USA. Boeing later purchased the aerospace and defense components of Rockwell Corporation, including its share in USA, with USA ownership principally remaining steady through today.

The initial focus of the SFOC Contract was primarily Orbiter focused; however, NASA later added more than $900 million in additional work to the contract for performing Solid Rocket Booster (SRB) assembly and refurbishment (previously performed by USBI at Kennedy Space Center (KSC) in Florida), Shuttle flight software design, production and verification from Lockheed Martin in Houston, and flight crew equipment processing from Boeing Aerospace Operations, also in Houston.

NASA did exercise a number of contract options for SFOC, keeping USA as prime contractor for the Space Shuttle program through 2004, and then again through 2006. NASA has executed a new contract, the Space Program Operations Contract (SPOC), with USA, which keeps USA as NASA's prime contractor for Space Shuttle operations through the planned retirement of the Shuttle fleet in 2011.

Under SPOC, USA has approximately 10,080 employees located primarily in Texas, Alabama and Florida. In Florida, the principal site for Shuttle spaceflight operations, USA has a workforce of approximately 6,140 employees.

Major Sub-Contractors

NASA utilizes the services of contractors like USA to perform SPOC and contractors like EG&G, Inc. to maintain and sustain the KSC institution. USA utilizes the services of subcontractors in the performance of the SPOC. Boeing and Pratt Whitney-Rocketdyne are USA's major subcontractors. USA's sub-contractors (including Boeing for Orbiter engineering and Pratt & Whitney - Rocketdyne for Space Shuttle Main Engine processing) account for approximately 755 Shuttle-related employees. These prime and sub-tier contractors provide the ground pre-launch processing, launch and post-mission recovery activities for all the Shuttle elements.

The cargo and payload processing activity, primarily under the CAPPS contract (Boeing and their sub-tier contractors) require a staff of 649 employees. The institutional and base support contractors, as well as the information management and communications support that directly support the Shuttle Program account for another 1,559 employees.

Other than the prime contractor and major sub-contractor manpower numbers, all other data were combined to protect any individual contractor who may be involved in pursuing a new acquisition. The civil service workforce is currently not projected to be immediately impacted by Shuttle fly-out and is not included in the cumulative manpower data in this report. However, the timing and content of future Exploration work assignments, as they are decided by the White House may affect even the size of the civil service workforce, if future work and budgets are pushed out far into the future.

A composite of all major aerospace contractors who support the Shuttle Program is shown in Appendix A. This composite was derived from interviews, unrestricted human resources data, input from NASA and input from NASA contractors.

Supply Chain

The scope of this study did not permit a detailed quantitative assessment of the

Shuttle supply chain. However, the STS program relies upon vendors state-wide for goods and services. Research into the data associated with the Supply chain at a summary level was conducted.

Data analysis provided a number of findings and conclusions regarding classification of the Shuttle-related workforce, and the nature of requirements for managing workforce transition to new opportunities.

USA has maintained an active supply chain of sub-tier support contractors and suppliers ranging from 1,400 to 1,550 at any point in time, out of a total qualified vendor list totaling between 3,000 and 4,000 companies.

The following contractors represent the current top-level of the Shuttle Workforce supply chain, and constitute the majority of the skilled Shuttle workforce. Only primary support companies with over 50 employees are included in this list. The actual database is being maintained across a much larger population of aerospace suppliers, including many with less than 50 employees, including lower-tier Shuttle materials supply companies, business support and retail suppliers.

- Abacus Corporation
- Advanced Electrical Installations – Ground Operations
- Aerodyne – Ground Operations
- Allied Barton Security – KSC
- Allied Barton Security – Solid Rocket Booster
- Boeing
- Brevard Achievement Center
- EG&G
- Geologics - Ground Operations, Logistics and Program Management
- GHG – Logistics
- Government Contract Resources, Inc. (GCR)
- Indyne Corporation
- Innovative Health Applications (IHA)
- L&M Technologies, Inc. – Facilities
- Launch Coast Services – Ground Operations
- Medical and Environmental Support Center
- Met-Con – Ground Operations
- Oneida Construction – Ground Operations
- Precision Fabrication and Cleaning – Solid Rocket Booster
- Rede – Critique
- Rocketdyne – Ground Operations
- S. C. Jones, Inc.
- SDB Engineers & Constructors – Solid Rocket Booster
- SGS Corporation
- Sorenson Moving and Storage – Ground Operations and Facilities
- Spherion – Facilities and Support to Various Functions
- Troutman Technical Services – Ground Operations
- UNISYS – Information Management
- United Space Alliance, LLC
- Visium Resources, Inc.
- Wiltech – Ground Operations
- Wonder Mechanical – Ground Operations

Other Support

A number of other contractors also support the Shuttle during the time of launch activity, and are typically not included in program estimates of the Shuttle workforce, largely because their contract sources of funding are from institutional base support sources, rather than from program sources. These elements of the workforce are normally made active on an on-call basis, whenever there is a Shuttle launch in-process, as base support to the activities at the Cape. The major companies which fall into this category are also identified in Appendix A.

STS Transition Scenario

The US Human Space Program transition from Shuttle to Constellation is rooted in the Vision for Space Exploration (VSE) as announced by President Bush in January 2004. The basis of the VSE stated:

1) The Space Shuttle would fly through September 2010 and complete assembly of the International Space Station (ISS).
2) A replacement human space flight system (crew exploration spacecraft and launch vehicle) would be developed for missions to the moon by 2018 and on to Mars. Initially, the new system would service the ISS with crew and cargo.

The VSE acknowledged at the onset that there would be a hiatus in the US human space flight program (called “the gap”), but it would be survivable and manageable with a duration of approximately two years. In the interim, service to the ISS would be provided by utilizing the hardware and services of our international partners as well as the emerging domestic commercial launch industry.

Also apparent was the fact that even without the gap, the new spacecraft and launch vehicles would require far fewer workers processing the hardware for launch at KSC. The Shuttle, as a reusable system requires extensive turn-around processing prior to its next mission. As such, Shuttle is manpower intensive in its launch and mission preparation activity.

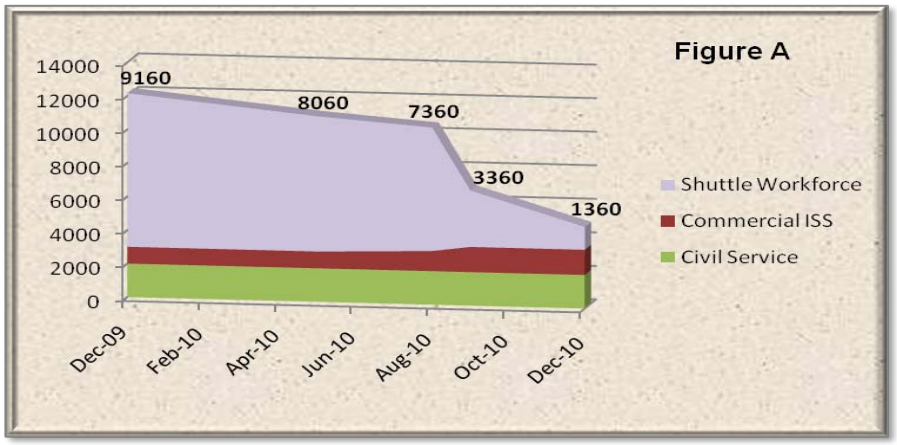
The envisioned expendable systems on Constellation would require at least 50 percent fewer workers for launch processing. This made early estimates for workforce reduction at Shuttle fly-out approximately 3,500 employees. Since this is a delta number (Shuttle versus Constellation), any slip in the Constellation schedule while maintaining the Shuttle fly-out schedule would increase the workforce downsizing.

The ensuing NASA budget reductions coupled with hardware development issues have done just that. The first human flight on the new Constellation launch system has progressively slipped to March 2015 which extends the gap to over four years, and many agency insiders believe that the actual program schedule for ARES and Orion launch activity may well slip beyond that, further

exacerbating the "gap" issues for the workforce.

NASA's internal estimate for workforce reduction was at least 4,500 direct employees by early FY11. The Augustine Task Force study indicates that out-year budget estimates are not likely to support a "closing of the Gap" and, therefore, have a larger workforce impact (in the absence of any new, near-term decision by NASA Headquarters and/or the White House to place new work assignments in Florida to remediate the impending gap impact).

Continued slippage in Constellation element development means equivalent slipping in the first launch schedule and ground processing that precedes it. Hence, the KSC workforce, after Shuttle fly-out, is significantly reduced to support the necessary work of international and commercial suppliers to ISS. Along with the deferral of associated work on lunar systems (ground and flight) these slips result in a new workforce reduction figure of 7,000 at the time of the Shuttle retirement as depicted in Figure A.



Phase-down of Workforce

Based on current planning, the Shuttle is scheduled to complete its fly-out of all remaining five missions by the end of 2010. However, as a result of the Augustine Task Force review, and due to political and mission safety concerns, the ability to complete the Shuttle manifest has been allowed to slip into 2011. There are still concerns that this slip is not funded and therefore not truly available as an alternative. While the beginning of the planning phase of retirement activities has already begun, this slip may place a heavier portion of the workforce reductions in 2011.

The phase-down of the Shuttle workforce reduction has already begun, with the layoff of 538 workers in October 2009 including 70 security workers at the Cape Canaveral Air Force Station. This represented the start of what is expected to be a total of an approximate 7,000 aerospace worker reductions after the Shuttle is completely retired. Adhering to the current program of record, the workforce

reduction is expected to be dramatically more visible in 2010, with a decrease of approximately 2,100 workers before October 2010 followed by the remaining decrease of 4,000 occurring between Oct 2010 and March 2011 (As noted by Figure A above). **This is an approximate phase down schedule, which will be highly influenced by the decisions to be made by NASA and the White House on future direction of the Nation's space Program and the Exploration work content designated for KSC.**

It is still expected that approximately 2,000+ of the current workforce, and possibly considerably more, will be retained and assigned to new work packages in the next generation program once decisions and work assignments are made. The estimates made herein, reflect a worst case scenario with little or no future work assigned to KSC beyond what is already scheduled for EGLS, ISS Cargo and Crew Processing activity, the Engineering Services Contract and other facilities O&M. In addition, there is an expected 400 workers who can be retained through new work assignment for the NASA Shuttle Logistics Depot, and a Sustaining Engineering effort of approximately 700 people who will support next generation activities.

Disposition of Physical Assets

Transition and Retirement (T&R) of Space Shuttle Program flight and ground assets will be conducted in accordance with recently completed NASA and KSC Transition Management Plans. These plans delineate the requirements for deactivating and disposing of the entire Program's flight hardware, ground support and services equipment and associated facilities. The T&R task will be performed by an extension of the Shuttle Program Operations Contract (SPOC) and by the Constellation ground processor on the new EGLS contract. This is the follow-on to United Space Alliance's SPOC and the winning contractor will be the recipient of some of the shuttle transitioned workforce. The EGLS contract is currently in the KSC acquisition cycle and will include an option for performing the transition and retirement task. This new contract will be awarded in April 2010 with physical work beginning in October 2010 which coincides with the originally projected timing of Shuttle fly-out.

The actual number of workers required will be defined by each contractor bidding on the T&R Requirement, and is competition sensitive, but in general, they will be required to perform the tasks described below.

> Prior to the completion of the Shuttle manifest in 2011, the Shuttle Program will begin transition or retirement of several major capabilities, beyond its workforce. These transition capabilities include its facilities, and other real property. Implementation projects will also include non-facility actions, such as performing personal property disposition and transfer.
>
> The transition implementation projects are expected to be preceded by an assessment to determine timelines, methods, sequencing, end states, and

requirements for facility 'safing' and/or turnover, and are expected to be led by NASA personnel and executed by the primary contractor operating the facility or system. Implementation projects are currently scheduled to be started in 2010 or the beginning of 2011, as soon as the last Shuttle flight has been completed.

Tangible property in the Shuttle Program falls into one of two categories: Real Property or Personal Property. According to KSC definition, Shuttle "Real Property" consists of land, buildings, structures, and utility systems identified in the KSC facility database. This definition includes nearly all of the Shuttle's related real property at KSC consisting of numbered buildings and the permanently installed equipment needed to operate the spacecraft.

KSC will be responsible for the disposition of several hundred individual facilities in the Center's facility database. Many of these facilities support multiple functions, and may contain combinations of office space, labs, shops, test facilities, or other unique functions. In some cases, discrete capabilities within a facility may need to be handled independently in regard to transition. For example, the Launch Control Center will be incrementally transitioned, with Firing Rooms released to Constellation for their use as they are no longer needed to support the Shuttle manifest. Each of these facilities, and to some extent the capabilities they contain within, will be assessed for last use/need by Shuttle, and any future need for the facility/capability by others.

The property disposition effort will require close collaboration among all government and contractor participants. While the government will organize and manage the property disposition process, most of the burden of actually executing the process will fall on the contractors who support Shuttle. The time required for disposition of all Shuttle-related real property is expected to cover a minimum of a two to three year period, during which time the workforce associated with the disposition activities will continue to be gradually reduced.

Both Shuttle and Constellation program personnel will be involved in identification of future uses of Shuttle property, and the disposition team will likely be composed of multiple contractor personnel. As such, this disposition team will be responsible for the Shuttle transition including oversight and execution of the property transition process, and will administer the property disposition database and provide disposition reports as needed.

Personal Property is essentially all other physical property assigned to Shuttle, such as equipment, computer and telecom systems, tools, meters, hoists, etc. In general, personal property will be processed for disposition in the order that facilities are to be released. That is, the priority for disposing of personal property correlates with the timetable for real property disposition.

Disposition of all of personal property at KSC is expected to take several years to complete as well. In the Shuttle Processing element, approximately 23,000 launch and landing equipment line items must be processed. The property

disposition responsibility will likely grow to a total of some 130,000 line items when all non-flight ground material is included, and to over 300,000 total Shuttle line items at KSC. Transition and property disposal activities are expected to be quite intense, and will have a priority because of the need to conserve program budgets following Shuttle's last flight. Many property items, real and personal are quite costly to maintain, so timely removal of them from Shuttle responsibility will be as important to the Agency as it is for completion of the Shuttle manifest.

Three main steps will make up the personal property transition process. First, the Program will generate and capture information on property items that are needed to make a transfer decision and identify special handling requirements. Second, property may be assessed for "end state" reconfiguration requirements to satisfy safety, storage, or utilization needs. Finally, the property will enter the disposition process, removing it from Shuttle responsibility and making it available for excess or transfer.

The primary objective is to transfer the Shuttle Processing element's personal property items to another NASA or other agency user.

Assets Planned for Future Use

T&R of Shuttle is a major undertaking in that the Shuttle, as a reusable launch vehicle, requires extensive facilities and ground equipment for the production, repair, refurbishment, testing and turn-around processing of flight hardware and integrated systems. Some of the facilities and equipment will be allocated to the Constellation Program but much will be declared excess to the new program's needs.

The list of assets, at a top level only, include Orbiters, SRBs, External Tanks, buildings, firing rooms, crawlers, MLPs, OPFs, SSMEs, and thousands of items and part numbers that have to be bagged, tagged and dispositioned. Whether this work is performed by SPOC or EGLS, the skills required are the same and staff would most likely come from the current workforce.

Characterization of the Workforce in Transition

Workforce

As noted earlier in this report, the Space Shuttle workforce was formulated to support a highly complex launch system that requires a large number of "hands-on talent" for its preparation, maintenance and flight safety assurance. The reusability feature is the primary driver. After each mission, each Orbiter is de-serviced, thoroughly inspected, refurbished, re-configured for the next mission and completely re-tested and verified. This is a time-consuming and manpower-intensive activity. It is noted that the replacement launcher and spacecraft (Ares I, V and Orion) are mostly expendable and will require an estimated 50% fewer workers to perform the launch processing and recovery operations.

The Shuttle workforce is composed of engineers (mechanical, electrical, systems, industrial, software, et al), skilled flight hardware technicians (mechanical, electrical, and other), program support specialists (quality, safety, data, and information systems), ground services and equipment specialists and a myriad of scientific, administrative and managerial disciplines.

Approximately 88 percent of the aerospace workforce lives in Brevard County. Most of them (58 percent) live in the Central Brevard area consisting of Cocoa, Merritt Island, Rockledge, Cape Canaveral, Cocoa Beach, Port St. John, Sharpes, and Canaveral Groves. This is contrary to the popular belief that most aerospace workers live in the Northern area of Brevard (Titusville, Mims and Scottsmoor). However, regardless of where they live they engage in activities across the entire East Central Florida Region, including entertainment and dining in the Orlando area, which makes the ripple effect of the Shuttle retirement an area of concern for the entire Region.

Within these disciplines, there exists a work ethic and culture that may be unique to human space flight. Each employee involved in Shuttle work is engrained with a strong sense that they are personally responsible for the highest level of quality and safety in performing every task. The safety of the astronauts is tantamount. The incredible success of the nation's human space flight program is testimony to the quality-focus and work approaches of this workforce.

Commercial industry places a high value on work ethic and a quality culture in its workforce. Most Shuttle-related teams reflect the vital cultural components of their Shuttle-oriented training and work approach. For example, each employee involved in Shuttle work is engrained with a strong safety and quality ethic. Without a strong safety and quality-focus and work ethic in spaceflight operations, those engaged in future spaceflight missions could be placed in greater danger. This regard has high value in aerospace and other private sector industry areas.

Much of the Shuttle workforce is also engrained in the requirement for precision in work-process and measurement-monitoring functions. Without a disciplined attention to precision and accuracy in operations and flight preparation, future spaceflight operations consistency and reliability would be negatively impacted.

The Shuttle workforce is thoroughly acclimated to an environment of accurate monitoring and record-keeping. Keeping track of the voluminous data monitoring and documentation requirements is a particular skill. The Shuttle workforce learns and practices this discipline from their first day on-the-job, and has an internalized work practice that every action requires a proper recording trail and documentation. Many industries spend considerable training time and budget to develop this capability.

Another attribute of the Shuttle workforce is one that many other industries require - functioning under the Star Certification of OSHA's Safety - Voluntary

Protection Program. This program is a cooperative effort at every level of employment and the OSHA community. The Star Certification exceeds mere compliance with OSHA and is difficult to earn. It is valuable to a company because Star certified sites experience:

- Fewer injuries because the safety program is owned by the employees at all levels
- Improved employee motivation to work safely at home as well as on the job
- World class recognition
- Improved morale – a realization of caring for the workforce's health and well-being
- High quality and higher productivity at lower cost
- Reduced worker's compensation claims

The Star certification is another example of how valuable Brevard's aerospace workforce is to businesses that value safety since they come equipped with this work ethic and that reduces the company's need to invest in training to instill the value of safety.

The STS workforce is also accustomed to working in an environmentally sensitive, national wildlife refuge. In testament to environmentally sound industry practices, USA and others have earned ISO 14001 certification. The aim of this certification is to reduce the environmental footprint of a business and to decrease the pollution and waste a business produces. Environmental compliance is another arena in which other industries make significant investment and having a workforce with the experience of achieving ISO 14001 certification is valuable to next generation programs.

The AS9100 quality management system is the aerospace industry's quality standard developed by the International Aerospace Quality Group for quality assurance in design, new product introduction, manufacturing and servicing. The intent of the AS9100 is to deliver significant improvements in quality, while reducing cost throughout the supply chain in the aerospace industry. The AS9100 standard is a set of requirements for quality management systems that includes all of the elements of ISO 9001:2000; however, it is expanded to address international aerospace requirements that are now approved by major aerospace companies around the world. This certification is another valuable characteristic of many of the aerospace workers that businesses can take advantage of in their operations.

The replacement system (Constellation) will require most of the same culture in the engineering and technical disciplines but at a reduced workforce level. Shuttle ground processing activity was preparing three Orbiters on double shifts whereas the Constellation launch system will be processed on a single shift basis and to a reduced manifest of initially two launches per year.

The design philosophy employed in the development of the Constellation

hardware will drive the kind of skills and workforce required in the future. The culture of safety and quality in the STS workforce is one that industries nation-wide expend significant expense to achieve. The STS workforce is engrained with this culture and this valued non-physical asset is translatable to other industries. The need for safety and quality does not go away, and it has strong value in drawing industry to Brevard who desire such a culture.

Design Evolution

In the early period of US launch vehicle history, vehicle design was driven by the need for reliable and accurate vehicle platforms for the nation's inter-continental ballistic missile program. Launch vehicle design reflected hardware elements that would have a high probability of working ***once*** when called for, always ready to work properly at quick notice, be fast, and highly accurate in performance to meet mission needs.

These vehicles would be used once and were expendable, whether used for test purposes or for mission need. Design focus was driven by such disciplines as radiation hardened parts, components with long shelf life, minimal "touch" or maintenance requirements, high overall reliability and a robust quality assurance program. Design teams reflected this reliability and quality assurance mentality.

As the nation's space program moved to the concept of a ***reusable vehicle,*** a reusable transport system, there was a significant change in design focus, which became stronger with time; a safety mentality. Design has focused on ease of maintenance, but extensive maintenance, use of redundant systems and parts, multiple monitoring and test/measurement systems on-board, ground team capability to "touch" the vehicle and disassemble and assemble it for launch readiness many times.

Reliability and QA has been in the design stage, but inspection, rigorous testing, and safety will always prevail. This was magnified both in manpower and safety procedures, complexity of operations process practices and manpower required to ensure that adequate monitoring and checking of rigid handling and operations procedures were followed each time and in the same way for each flight.

To meet this need, the Shuttle operations and processing team grew and its practices became very manpower intensive. As we look to the future in Constellation, we look back to the use of a highly reliable, accurate, man-rated launch system, with significantly reduced "touch-time" with advanced technology parts and systems which reflect the design technology of today, thereby reducing the manpower intensity.

Design Evolution Impact

The basic transition scenario presented in the July 2008 Aerospace Workforce Outlook Report remains unchanged. The experience base required for Shuttle remains directly applicable to that required for processing, launching and recovering Constellation elements. The major system elements and architecture

are either identical (solid rocket booster) or similar (propulsion systems, avionics, crew support systems) and the developed processes for launch preparations will easily translate.

A noteworthy exception is the processes and skills required to maintain the Orbiter thermal protection system (tile and blankets). The replacement vehicle will not require such a system to the same extent. The basic structure of the launch control system and some of the ground support equipment will be common to both programs, but do require major upgrade modification. As a result, the workforce is readily transferred but will require some skills update training for the newer systems to be used.

This training includes focusing on the use of advanced materials and parts; extensive built-in nanotech sensors and monitoring capability; extensive use of microprocessors; advanced avionics; use of composites; and hybrid manufacturing of vehicle structure processes. Design and operations teams in Constellation, no matter what "Alternative" the White House chooses will reflect these disciplines in their makeup, and will also reflect a robust reliability, QA and safety mentality.

The early staffing for Constellation processing will be assigned to turnover of ground systems and facilities as well as the design, development and activation of new ground support equipment and facilities. Included are the verification, validation, operation and maintenance of these items in preparation for delivery of the first flight hardware. This work will be the initial tasks on the Exploration Ground Launch Services (EGLS) contract and it is obvious that the winning EGLS contractor would capture key individuals and requisite skills from the incumbent SPOC workforce. Again, some skills training and re-training would be required.

While this workforce study was being developed, the Human Space Flight Program was being re-assessed by a Panel of space experts appointed by the President. In June 2009, this Panel (known as the Augustine Committee) was chartered to review NASA's current human space flight plans and present a range of options for a post-Shuttle program that "speeds the availability of new systems capable of ferrying crew and cargo to the ISS, support missions to the Moon and points beyond, stimulate commercial space flight capability, and fit NASA's budget profile for exploration". The latter requirement is a real challenge in that the total budget is significantly less than projected when the VSE was initially announced.

The Panel findings were presented to the White House in October 2009 and are still being deliberated by The White House. Several options for Human Space Flight are being considered. However, the option assumed throughout this report is Continuation of the Current Program of Record (Continuation Option). That is, safely and successfully fly the remaining five Shuttle missions, complete assembly of the ISS and continue development of Constellation elements (mainly

Orion and Ares I and V) while aiming for first human launch in 2015. (A chart of the Augustine Committee Options and their impact is included in Appendix B.)

With the assumption of current inadequate funding levels, the Continuation Option would be impacted by causing the Program of Record schedule to slip further to the right, causing the availability of some planned next generation work to also slip farther out in time. (This is especially true of Lunar Lander and related Ares V Exploration hardware for ferrying and supporting astronauts to other destinations.) This would cause a deeper and wider "gap" resulting in the increase stated in this report regarding the extent of the workforce impact.

Next Generation Skills Needs

As has been stated, the next generation program will not require as large a labor-intense process for human safety inspection of operations and process management, physical inspection, maintenance and assembly/disassembly of systems as there is today with the Shuttle. It is expected that reliability, quality assurance and maintainability will be reflected "in the design" of the vehicle to ensure reliability of working when called for, and safety of its crew and payload. Design for reliability, quality assurance and easier "touch time" operations and processing will become the focus of the design team as it fields a new human-rated flight vehicle.

Therefore, a greater use of systems engineering and integration skills with a robust reliability and quality assurance and safety culture will be required. The highly regarded "safety culture" of the Shuttle workforce will still be required. Advanced technological skills will also be required in more extensive and sophisticated avionics, sensor and monitoring systems, built-in test systems, advanced composites and materials, etc.

While there are many areas of workforce application that may not be required at the same levels in the next generation of space program activity at KSC, the advanced technological skills and experience are highly transferable to commercial space and other industries. Many of the engineering and technical skills available in the current shuttle workforce are directly applicable to endeavors both inside and outside of aerospace.

The major areas where workforce skills are currently thought to be in excess for next generation programs and which can be transferred to other industries are detailed in Appendix C. From the Phase II AWO Report, it is known that the original anticipated 3,500 unemployed workers in these areas breakdown along the indicated percentages for engineering, technicians, management and administrative support. This same percentage cannot be extrapolated to the new anticipated 7,000 workers without a job due to uncertainty in what emphasis the next generation programs and other business programs will need with regards to specific skills. The majority of the workforce in the identified skills areas, for the original anticipated 3,500 affected workers, is in the hands-on technician

inspection occupations and their direct support occupations.

The skills difference as the nation retires the Shuttle and moves to a newer class of launch and spaceflight system will be most visible in the use of much advanced technology in materials, avionics, environmental systems, extensive use of micro-processors, and a culture of "less and easier" handling and processing for flight readiness.

Next Generation Program – Skills Upgrades

Most of the next generation program workforce is expected to come from the current Shuttle processing prime contractor (USA) and key subcontractors. The remaining workers are expected to come from the other indirect support contractors in the sub-tier level. However, when examining the nature of the total skills base available as compared to the next generation program needs, several skills gaps become clear.

First and foremost, as NASA plans future requirements for Constellation and for future human spaceflight initiatives in general, the challenge to develop or find adequate numbers of space-qualified program management and systems engineers in the existing workforce will be difficult in future years due to the lack of a major human spaceflight development program in recent years. In addition, constrained hiring as a result of continued aerospace industry downsizing and skepticism about whether NASA's Constellation program will have sustained political and financial support exacerbates the difficulty of finding adequate numbers of space-related systems engineers.

Further, universities are not generating sufficient numbers of space-qualified systems engineers, space system software engineers, systems integration engineers, and spacecraft design engineers with a strong reliability and quality assurance focus to their education and experience base. Additionally, with 25 percent of all aerospace workers being 54 years of age or older today there will be a need to increase, within the emerging workforce, specific engineering and software design and development disciplines to address the needed skills for the next generation program. Those workers who wish to remain in aerospace activities must also upgrade their skills in order to remain viable for all anticipated aspects of next generation work. The disciplines that the current and emerging workforce needs to focus on with training include:

- Spacecraft systems design and engineering skills, especially in advanced avionics,
- Launch vehicle structural design for maintainability and operability,
- Launch vehicle reliability and quality assurance design skills,
- Advanced computer software design and software integration skills,
- Advanced microprocessor design and engineering for space systems,
- Advanced environmental control and monitoring system design skills,
- Human and machine cognition design/interface skills,

- Space program management and cost/schedule/technical performance skills
- Advanced ground support systems design and engineering
- Space mission planning and mission modeling and simulation skills
- Robotics and man/machine modeling and simulation,
- Remote inter-operability of Lunar surface equipment,
- Lunar life support science/environmental systems design,
- Advanced flight control systems design,
- Advanced materials and composites technology and handling skills
- Materials bonding technology and skills
- Embedded sensor systems/self test and measurement systems
- Advanced battery/power systems design/interface skills
- Advanced propulsion design and handling systems skills

There is also a great need to connect educational entities directly with industry to ensure that these disciplines are being taught in a manner conducive to supplying the right skills in a very fast and efficient manner. Many of the current aerospace workers are unable to attend classroom training and many employers will not allow time for such training. This creates a push for education to adjust their delivery system to one that is more online, offered at varied times and even exploring options to provide training at the employer's worksite. More education and industry partnerships will need to be developed over the coming twenty-four months to ensure the workforce has the skills required to transition to next generation programs.

While these skills gaps and impacted areas are highlighted at a fairly high level, they are indicative of on overall need in the next generation space program for overall systems thinking and experience across functions, across system interfaces, multi disciplinary design skills, software engineering and interface controls, skills in the use and design of systems with a high microprocessor content, structural design skills utilizing composites and advanced materials, and in general, "operator thinking" in-the-design. Appendix D displays a more detailed summary of future skills needs for next generation programs. Brevard Workforce has developed www.coolspacecareers.com as a focal point for sharing information about new skills needed for both next generation programs and for career transition. This site includes links to educational entities as a way of promoting life long learning and a link to the emerging pipeline of talent.

Workforce Impact Assessment

Total Impacted Workforce Estimate

Based on results of information gathered in Phase III, it is still highly likely that the engineering talent in this workforce will more easily transition to new work assignments in next generation programs than non-engineering, technician and administrative support staff, ***assuming that next generation work tasks are in-place when needed***. Additionally, many of the technician level and other direct

support operations and processing staff currently engaged in critical processing functions may be required in Constellation activities. However, these workers will likely require additional training for application to these new jobs. These workers, with training, are also ideally suited to positions in non-Space high-tech and related manufacturing, such as cyber-security, clean energy, telecom, and advanced software applications.

Two factors represent the greatest uncertainties associated with transitioning workers to next generation work tasks; the first being the ability to define content and skill requirements of future work; and second being the timing availability of such work. Both are related, as work that is not expected to be available for several years will have work skill requirements that are difficult to determine right now. This is because the details of program content will not be defined for some time, and program content, program participants, and technologies will change.

Of the 9,160 total current Shuttle-related workers, the Phase III analysis estimates that approximately 6,400 to 7,000 will be impacted as they will not easily transition, at this time, to known new programs and therefore resources are required to provide transition assistance for these impacted workers.

Note: This increased range of 6,400 to 7,000 impacted direct aerospace workers is a snapshot based upon contractor supplied information indicating the following items: lower retirement and attrition rates than originally estimated; uncertainty of timing and loss of business packages that would have retained workers; and an overall decrease in business packages to pursue right now.

Retirements and Attrition Estimate

Historical retirement and attrition data were reviewed and adjusted for the more recent lower rates associated with the economic conditions prevalent today. Historical attrition rates for this industry had been running around eight percent per year, but have been lower in 2008 and 2009 industry-wide.

The overall NASA workforce has matured like the shuttles. By 2011, it is estimated that approximately 30 percent of the workforce at the Kennedy, Marshall and Johnson Space Centers will be eligible for retirement. An estimated one-quarter of all shuttle workers at those three centers are 54 years old or older today.

Retirement levels have dropped considerably during this recent time-period due to economic conditions, and also because of a strong workforce commitment to completing the fly-out of the Shuttle manifest. At this time, no one can predict whether potential retirees will truly retire or if they will continue to seek employment. However, according to *Congressional Research Reports for the People: Older Workers: Employment and Retirement Trends September 16, 2009*, participation in the workforce among persons aged 55 and older is

influenced by general economic conditions, eligibility for Social Security benefits, the availability of health insurance, and the prevalence and design of employer-sponsored pensions. Recent Census Bureau data show that the percentage of men and women age 62 and older who work in paid employment has risen over the past 10 years. 81percent of employed men aged 62 to 64 were working full-time, compared with 77 percent in 1995 Among working women aged 62 to 64, 69percent worked full-time in March 2006, compared with 60percent in both 1995 and 1990

If the aerospace workforce follows this same national trend then the retirement levels are likely to remain lower than the original historical and estimated rate of eight percent. Yet, this also poses a problem since unemployed workers from ages 55 to 64 have nearly tripled since the recession began, U.S. Labor Department. By comparison, the number of jobless workers of all ages has roughly doubled. This drop in employment for older workers follows a period of nearly three decades in which a greater share of individuals approaching retirement age had jobs. At the peak of the boom, employment among those ages 55 to 64 topped out at nearly 63 percent. At the time, workers were seeking to keep up with the rising cost of living, while employers were more willing to hire older workers in a tight labor market.

Research, from the Chartered Institute of Personnel and Development (CIPD), indicates more than 70 percent of workers aged 55 and above said the financial crisis had left them with no option but to shelve their retirement plans. The figure was just 40 percent in the same survey two years ago. A cruel combination of shrinking pension pots, low interest on savings and the fall in property prices is forcing them to stay at work.

Yet, older workers are being ‘pushed’ into retirement rather than choosing it right now. According to economists, Courtney Coile and Phillip B. Levine from Wellesley College, almost 50 percent of older workers will need to work longer as a result of stock market losses. Some unemployed workers nearing retirement age are dipping into their savings accounts to make ends meet. Yet, savings for most people have taken a hit in the economic downturn. Drawing on Social Security is equally fraught, since the earlier retired workers begin to withdraw their benefits, the lower their monthly payments will be -- for life. The end result, said Ms. Coile, is that "it leaves workers forced into retirement by a late-career layoff with lower income and a higher risk of poverty."

Across the nation unemployed older workers say it is even more difficult for them to find work because of what they see as age bias. Many feel that by the time the economy recovers they will be in their late 50’s, out of a job for two to three years, and probably without much of a shot to return to work.

This same trend of being ‘pushed’ into retirement may impact the current aerospace workforce, especially if they have not upgraded their skills to meet the demands of the private sector workplace. Over 2,200 workers are in the age

range of 55 – 64 and they will be the ones most at risk of needing to be employed because of stock market losses, yet at risk of being unable to be re-employed because of outdated skills levels. The mindset of being 'too old to return to school' must be broken with these workers and the educational delivery system is vital to making this paradigm shift. The concept of classroom training from 25 years ago is what most workers do not want to return to and yet the educational delivery system has not changed drastically to draw in the older workers.

Workforce Skills Applicable to Other Areas Estimate

Based on current insight into the requirements for known programs today, approximately 2,000 – 3,000 of the current workforce, and possibly considerably more, will be retained and assigned to new work packages in the next generation program. The estimates are based on the assumption that little or no future work will be assigned to KSC beyond what is already scheduled for EGLS, ISS Cargo and Crew Processing activity, the Engineering Services Contract and other facilities operation and maintenance.

The NASA Shuttle Logistics Depot (NSLD) has been developed and equipped to repair, refurbish or manufacture most of the Shuttle Orbiter components. The depot will be closed when the Shuttle stops flying as NASA has not included the depot capability in the Constellation element process planning. The assets will be declared excess with all the other items of Shuttle support infrastructure. There is a business case being developed to convert the depot into a Maintenance and Repair Center that would support Constellation elements as well as be available to commercial users and the aerospace/defense industry at large. If this proposal is successful, the NSLD could become an asset of significant value in support of multiple logistics streams and, in the process, retain approximately 400 skilled workers during the gap period and beyond.

During the gap (between Shuttle and Ares I/Orion), crew service to the ISS will be provided by foreign partners; however, cargo service will be provided by two international partners and the emerging US commercial launch industry. Two companies, SpaceX and Orbital Sciences Corporation are developing new launchers with NASA assistance through the on-going COTS (Commercial Orbital Transportation System) Program. Both entities will require cargo preparation activity that can only be performed at KSC. The Cargo Re-supply Services (CRS) contract anticipates two launches per year for the gap period (2011 through 2015). Launch processing workforce requirements for CRS and other new space launch activity are estimated to retain approximately 500 to 600 employees at the Cape. Additionally, if these new launch systems can expand their spaceflight capability to include human flight, the staffing for both could easily double. The transitioned skills from Shuttle would then have direct application. The Commercial Spaceflight federation has released a survey of data from spaceflight contractors who would likely bid on a new Commercial Crew Initiative, and estimates that a robust Commercial Crew capability of three

contractors would produce as many as 1000 to 1700 new full time positions for Florida-based activities.

Also included in the estimate for retained workers is the sustaining engineering activities that could retain from 800 to 1,000 workers in a variety of areas requiring troubleshooting and systems engineering. Collectively, these represent an estimated 2,000 to 3,000 positions that the current workforce could transition to if the timing is right and their skills have been correctly developed. Yet, by slipping the next generation program timing at least 2,000 of these positions may not be available until 2014.

A Labor Market Vacancy Survey was conducted in October 2009 by Brevard Workforce in the East Central Florida Region to determine the number of openings within related industries that aerospace workers could transition into over the next year. Over 252 vacancies are currently available in the area of systems engineering and IT systems support functions. The average hourly wage for these vacancies is $30.36 or $63,149 annually. This is a viable option for technicians, who further their education within these occupations, since currently 79 percent of the technicians are earning between $59,000 and $63,000.

In the medical field, which is a good cross-over area for direct support workers, 36 openings were identified that range from radiological technician to physician. In the strictly administrative support field 61 vacancies were noted with a salary range from $11.75 to $21.17. Over 74 percent of direct support staff are currently earning somewhere between $60,000 and $68,000 annually. The replacement salary level in the medical fields, even at the highest end ($44,000 annually), will still cause a reduction in the household financial situation that will need to be addressed.

Management vacancies included: marketing; computer science; financial; construction and sales managers. There were 57 openings reported with a salary range from $91,600 to $124,814 annually. These occupations required at least a bachelor degree with experience in the specific field.

Business and financial occupations showed 36 vacancies with an average salary of $61,000 annually. These occupations range from financial analysts to cost estimators and require specific education to enter the field. However, this is also a good transfer of aerospace skills for those in the cost estimating occupations.

This labor market information gives us an idea of the potential markets and occupations that are in demand even during a recessionary time and that have the potential to grow over the coming twenty-four months. These are the occupational areas that transitioning workers are encouraged to explore first for any potential career changes.

The NASA Center Planning and Development Office (CPDO) serves as the “front

door" for external partnerships with Kennedy Space Center, facilitating future center development strategies that maximize use of underutilized infrastructure, both for NASA missions as well as commercial and non-NASA customers. The purpose of the CPDO is to provide center-wide leadership for the development of strategic partnerships and complimentary work, funded from outside of NASA, which emphasizes NASA Kennedy Space Center's (KSC) launch, research and technology competencies and contribute to achievement of the Center's priority goals.

The main focus of CPDO for 2010 will be to proactively transition the Kennedy Space Center from the Space Shuttle Program to the nation's future civil space activities by ensuring the maximum utilization of the center's physical and intellectual resources and capabilities.

As a way to determine workforce skills applicable to other occupations, Brevard Workforce engaged in a Regional Aerospace Workforce Initiative (RAWI) to build ties with economic, business and government leaders from Brevard, Flagler, Lake, Orange, Osceola, Seminole and Volusia Counties to respond to the needs of the aerospace workforce. A Core Regional Leadership Group was established to provide oversight and implementation of the regional strategy to assist with such activities as mapping out the regional training assets, providing a more comprehensive understanding of targeted industry clusters, identifying the existing infrastructure and the support organizations that can assist in the workforce mission. The RAWI team is urging business leaders to share their current and future workforce needs, including specific skills in targeted industries, to ensure education and training programs are available that will best prepare workers for jobs in growing and emerging industries.

RAWI is focused on the seven industry clusters selected by the Florida High Tech Corridor Council as emerging growth industries. Those clusters are: Digital Media; CleanTech; BioTechnology; Aerospace/Aviation Cluster; Modeling, Simulation and Training; Nanotechnology; and Photonics (Optics/Lasers). The research in Appendix E was gathered through electronic and face-to-face surveys with business leaders from these clusters and indicates that there are definitely crossover occupations for aerospace workers to these emerging industries.

Recommendations

History has shown that closing and transitioning facilities, equipment, and people is expensive and time consuming, and among the principal lessons learned from other base and program terminations is that, historically, it has generally taken three-plus years to close down a program fully, complete transition of usable assets and property to new programs, and dispose of excess property. Therefore, it is likely that even with the current program of record and scheduled Shuttle retirement by 2011; the full transition will more likely take place over

several years, which will help retain some workers for these activities after the conclusion of the last Shuttle flight.

However, the current expectation is that thousands of workers will be laid off by the end of March 2011. This massive movement of workers requires a unified approach at the Federal, State and Local levels in three areas: workforce development; economic development and pipeline activities.

Workforce Development

Of the 9,160 total current Shuttle-related workers, the Phase III analysis estimates that approximately 6,400 to 7,000 will be impacted as they will not easily transition, at this time, to known new programs and therefore resources are required to provide transition assistance for these impacted workers.

There are multiple initiatives underway by federal, state and local entities to address this challenge. The Office of Management and Budget and the Office of Science and Technology Policy, NASA, and the Florida delegation are actively working to address the potential impact on the state of Florida from Shuttle retirement. A recent success at the Federal level was the inclusion of a $1 million civilian appropriations request for training of affected aerospace workers in the FY 09-10 Omnibus bill. This request was heavily supported by Senator Nelson and Congressional Representatives Kosmas and Posey. Their continued support will be vital through the next two years for workforce development activities to continue.

NASA has also initiated a strategic initiative to ensure that critical skills are retained as needed for new programs. This initiative includes: identification of a career path to follow-on work in Constellation and other agency programs, maintaining a collaborative and creative environment, and supporting outside career development and learning opportunities. NASA has been heavily engaged in transitioning key Space Shuttle civil service workforce to other Agency programs as is using tools such as workforce synergy, matrix assignments, detailing for cross training, and retraining. In addition, the agency has worked to identify opportunities for the placement of needed skills in other organizations, to open opportunities for the shuttle workforce.

Yet, the sheer numbers to be connected to services, assessed, trained, assisted with transitioning to a new career or becoming competitively skilled for the next generation programs requires much more than $1 million in funding. The average cost of training aerospace workers to date is $3,800 per worker. If this same average is used to train <u>just one-third</u> of the workforce (3,000 workers), excluding the ones already being trained, then $11.4 million is required for the training alone. When the staffing and overhead needs are added the cost increases to over $12 million. Obviously, such huge funding requests are unlikely in these economic times and Brevard Workforce (BW) recognizes the improbability of obtaining resources at these levels. Therefore, BW has also

established some criteria for training of workers including: giving priority to workers who are identified as critical skills needs for next generation programs; giving priority to workers who are already being provided tuition reimbursement through their employer as a way to match the funds and accelerate the completion of training; and giving priority to training that matches directly to business needs and which could give the worker a competitive advantage such as being considered as an internal candidate for open positions.

Funding is still required and the current request for $3.2 million from state funds is vital to the success of continued training and transition activities. This request is fully supported by the Aerospace Career Development Council and other organizations, such as the Brevard County Commission, are adding it as one of their legislative priorities for the 2010 Legislative Session.

Economic Development

NASA's Center Planning and Development Office (CPDO) will be developing strategies that maximize use of underutilized infrastructure, both for NASA missions as well as commercial and non-NASA customers. Therefore at the federal level, NASA might need some relaxing of regulations for launches, environmental permissions given for companies to use the existing infrastructure and overall congressional support for NASA's top line budget. Additionally, NASA KSC could benefit from a greater focus on research and development through an FAA-sponsored multi-university center of excellence for space transportation-oriented research and development, based in Florida and by appropriating funds for annual prioritized R&D equipment purchases aimed at expanding Florida's role in space exploration science and technology development.

Space Florida, the Economic Development Community, Brevard Workforce, and other state organizations are also seeking new work programs aimed at assisting the workforce in pursuit of new positions, new job opportunities, training and additional skills development required for placement in new positions or industries, and other career and transition assistance. For instance, in October 2009, thanks to Space Florida's involvement, NASA and Starfighters, Inc. announced the signing of a formal Space Act Agreement enabling Starfighters, a private aerospace company that operates high performance fighter aircraft, to fully utilize the Shuttle Landing Facility (SLF) to conduct flight operations providing commercial space flight training, support research and development, test and engineering for the benefit of the emerging commercial space industry, and to otherwise advance aerospace and space-related technology in Florida.

Space Florida and Starfighters began initial discussions in 2007 and officially partnered in 2008, when Space Florida reached an agreement for the aerospace company to house and maintain aircraft in the State-owned and operated Reusable Launch Vehicle (RLV) Hangar, located adjacent to the SLF. This partnership will also lead to an initial 20 high skilled positions with the opportunity

to expand operations over the next several years.

Space Florida has established ten industry clusters where they will focus their efforts for business development. As noted on the Space Florida website, http://tinyurl.com/spaceflbusiness there are many ways they are able to help attract businesses to Florida and these efforts are being channeled to those industries that have the ability to use the skills of the aerospace workforce. The state's best economic tool for attracting much of these future work opportunities is the strength and quality of its aerospace, shuttle-related workforce. With an aggressive range of economic development activities, Florida may be able to retain a significant share of the workers currently supporting the Shuttle program and stimulate new jobs in expanded business opportunities for the state.

Fully funding Space Florida so it can pursue the strategic direction laid out recently in the Business Plan is essential to continuing successful business attraction that will create jobs where aerospace workers are highly competitive and required. The funding for Space Florida has decreased over the last several years; however, this trend is risky when other states such as Alabama, Texas, Colorado and West Virginia are looking to increase their space initiatives in an attempt to lure businesses and the aerospace workers to their areas.

There are several other legislative initiatives that can be taken that will further promote economic development activities and they are listed in Appendix F for both the state and federal levels. The legislative initiatives have been supported by the Aerospace Career Development Council for the 2010 Legislative Session and the state items are also supported by the Brevard County Commission.

Brevard Workforce (BW), in conjunction with NASA, Space Florida and other state and local County partners is aggressively pursuing actions to preserve space industry capability. This includes cooperative efforts to pursue new roles in next generation programs, aggressive economic development activities to attract new employers and job opportunities, industries and direct training and transition assistance for the Shuttle workforce to help position them for the new opportunities.

County economic development officials were successful in attracting final assembly and integration work in the next generation Orion program from Lockheed Martin. BW is actively engaged in curriculum development and training activities to ensure that the local workforce will meet this next generation program's skills need. Additionally, there are many other new Constellation program roles and new, near-term economic development opportunities which are being pursued as part of the County's strategy to respond to the Shuttle transition and preserve its space industry workforce.

Economic development activities such as supporting a Research and Development Tax Credit or a Commercial Launch Zone are vital to increasing the number of jobs available for the workforce over the next twenty-four months.

Pipeline Activities

As was noted earlier in this report, universities are not generating sufficient numbers of space-qualified systems engineers, space system software engineers, systems integration engineers, and spacecraft design engineers with a strong reliability and quality assurance focus to their education and experience base. Combining this lack of specifically trained workers with the aging of the current workforce, it is clear to see that the talent pipeline must be addressed today to ensure Florida is ready for the aerospace activities associated with next generation programs and commercial ventures.

One of the primary mechanisms for enhancing the pipeline of talent is to support Science, Technology, Engineering and Math (STEM) activities such as the Governor's School for Space, Science and Technology. More activities need to be identified and supported by industry and elected officials that will renew interest in STEM pursuits by those who are only 10 to 12 years old right now. As noted by the Alliance for Science and Technology Research in America, http://tinyurl.com/usinnovation which is one of the resources of the STEM Education Coalition, http://www.stemedcoalition.org , '*overall scientific research and development (R&D) promotes economic development, job growth, national security, competitiveness and global leadership.*'

To be successful Florida must push the K-12 system to engage and motivate students in STEM pursuits past high school. The resources for such engagement should be a priority for the next decade if Florida wants to remain on the cutting edge of aerospace and other related industries that will demand high skills levels produced through STEM education.

Additionally, if Florida can stimulate the development of scientific and technological advances by targeted industries, increasing competitiveness and creating high-wage research jobs in Florida then it will ensure this pipeline will stay within Florida due to the availability of jobs. This can be accomplished through a Florida tax credit modeled after the federal research tax credit in Title 26 U.S. Code section 41 that is already available in 30 states.

In summary, there are many steps to be taken before the conclusion of the Shuttle mission manifold and all of them involve workforce, economic development and education working hand in hand for solutions. The recommendations outlined here are but a few of the steps that can and must be taken today before time runs out and the economic impact of the Shuttle retirement can no longer be forestalled.

APPENDIX A

Shuttle Workforce – November 2009
By Major Contract and Company

Contractors **Employees**
- Prime and Sub-Contractors
- Direct Shuttle Manpower (Note *)

SPOC (Space Program Operations Contract)
United Space Alliance (US……**6140**
- Responsible for all Shuttle Element Processing,
- Ground Operations, Launch and Recovery

SPOC (USA Sub-contractors)……755

Boeing Company (Orbiter Engineering Services)
Pratt-Whitney Rocketdyne (SSME Processing)
Wiltec (Cleaning Services & Labs)
Launch Coast Services (Logistics)
Troutman Technical Services (Technical Training)
Spherion (Contract Labor Specialties)
8 Small Companies (Miscellaneous Services)
6 Companies (Construction)

CAPPS (Cargo and Payload Processing Services)

Boeing Company ……504
- Responsible for pre-launch processing of payloads for Shuttle and International Space Station.

CAPPS (Boeing Sub-contractors)……145

Jacobs Technology (Facilities O&M)
Creative Management Technology
All Points Logistics (Logistics Services)
Indyne (IT Services)
Yang and Alenia

USTDC (Univ Affil Spaceport Technology Development)
Artic Slope Research Corp……...**120**
- Provide engineering services to KSC Various Center Customers

IMCS (Information Management & Comm Support)……335

Abacus Technology Corporation
- Provide IT and COMM services in support of Shuttle Station, Payload Carriers and Launch services.

Sub-Contractor …. Analex Inc.

ISC (Institutional Services Contract)……785

EG&G Technical Services
- Provides base operations support to KSC including Facilities maintenance, O&M, roads and grounds.

EG&G ISC Subcontractors:
Northrup Grumman (Protective Services)
Dynamac / Bionetics (Life Sciences)
Sierra Lobo (Propellant Services)
Wiltec (Cleaning Services)
Yang Enterprise

OTHERS……..270

KISS (KSC Institutional Support Services)
REDE/Critique JV

MESC (Medical & Environmental Support Contract)
Innovative Health Applications

SMASS (Safety and Mission Assurance Support Services)
Millennium Engineering, Inc

SRM LAUNCH SERVICES
ATK Corporation

LAUNCH AND MISSION SUPPORT SERVICES
Lockheed Martin Astronautics

Total **9160**

* Except for the Prime hardware processing contracts (SPOC and CAPPS), all other Sub-contractor and "Other" are combined numbers so as to protect Individual Company human resources data.

Scenario	Option 1	Option 2	Option 3	Option 4A	Option 4B	Option 5A	Option 5B	Option 5C
	Program of Record	ISS + Lunar	Program of Record + $	Moon First / Ares-5 Lite	Moon First / Shuttle Extend	Flexible Path Ares-5 Lite	Flexible Path EELV	Flexible Path Shuttle-Derived
Budget	Current Plan	Current Plan	Add $3B/yr.	Add $3B/yr.	Add $3B/yr.	Add $3B/yr.	Add $3B/yr.	Add $3B/yr.
Space Shuttle	2011	2011	2011	2011	2015	2011	2011	2011
Space Station	2015	2020	2015	2020	2020	2020	2020	2020
Ares-1	2017	No	2017	No	No	No	No	No
Ares-5 / Lite	Late 2020s	Late 2020s	Mid 2020s	Early 2020s	No	Early 2020s	No	No
Commercial Cargo	Maybe	2010/11	Maybe	2010/11	2010/11	2010/11	2010/11	2010/11
Commercial Crew *	No	2016	No	2016	2016	2016	2016	2016
Shuttle-Derived Heavy-Lift **	No	No	No	No	Pre 2020s	No	No	Pre 2020s
Commercial Heavy-Lift	No	No	No	No	No	No	2015/16	No
Human Flight Gap *	6-7 years	5-6 years	6-7 years	5-6 years	1-2 years	5-6 years	5-6 years	5-6 years
Heavy-Lift Gap	~16 years	~16 years	~13 years	~11 years	~0-5 years	~11 years	~4-5 years	~3-9 years
Moon Landing	2030s	2030s ?	Mid 2020s	Mid 2020s	Mid 2020s	Late 2020s ?	Late 2020s ?	Mid 2020s ?
Mars Exploration	Future Goal	Future Goal	Future Goal	Future Goal	Future Goal	Future Goal	Future Goal	Future Goal
Other Exploration	No	No	No	No	No	Early 2020s	Pre 2020s	Pre 2020s
Technology Dev. Program	No	Yes	No	Yes	Yes	Yes	Yes	Yes

* 2016 estimate for *Commercial Crew* capability does not match some industry claims that a ***2013/14*** capability is possible.
** Estimates for *Shuttle-Derived Heavy-Lift* capability vary but an availability by ***2014*** was briefed to the panel by NASA and DIRECT

Appendix C
Probable Excess Workforce Skills
Due to Next Generation Program Skill Needs

*E= Engineers T = Technicians M = Management A = Admin Support

Project Management (E – 22%, T – 32%, M – 31%, A – 15%) Includes:
- Project managers
- Sub-system and Area project managers (for complex systems/functions)
- Planning and scheduling specialists
- Graphic arts and presentation specialists
- Supply / logistics specialists

IT Software and Computer Systems support
(E – 21%, T –16%, M – 7%, A – 57%) Includes:
- IT Software management professionals
- Processing documentation authoring and maintenance specialists
- Digital launch processing system specialists

Fluids operations and management (E – 8%, T –62%, M – 6%, A – 22%) Includes:
- Toxic propellant handling technicians
- Cryogenic fluids handling technicians
- Spacecraft NH3 cooling system specialists
- Spacecraft fluid distribution specialists
- High pressure gas storage and distribution system specialists

Infrastructure and Ground Processing operations and maintenance
(E – 4%, T –68%, M – 5%, A – 23%) Includes:
- Heavy equipment operators
- Toolmakers and machinists
- HV AC specialists
- Riggers

Test, Safety and Inspection (E – 45%, T –29%, M – 14%, A – 12%) Includes:
- Test conductors
- NDE specialists
- Safety professionals Quality assurance specialists
- Environmental protection technicians

Systems engineering support (E – 60%, T –0%, M – 20%, A – 20%) Includes:
- Design Engineers (materials, processes, structures for operations)
- Ground Equipment engineers/technicians (GSE support/process improvement)

Power Management (E – 11%, T –65%, M – 6%, A – 18%) Includes:
- Power distribution technicians
- Power and data cable manufacturing specialists

Maintenance and Trouble-shooting / Fault Isolation
(E – 16%, T –46%, M – 7%, A – 32%) Includes:
- Vehicle wiring installation / repair / protection specialists
- Vehicle avionics installation / troubleshooting specialists

Welding and brazing of complex materials and shapes specialists
Materials specialists

Spacecraft Assembly / Processing and Integration
(E – 8%, T –68%, M – 5%, A – 19%) Includes:

Ordnance specialists
APU (N2H4 fueled) technicians
Vehicle thermal protection systems design, manufacture and installation specialists
Vehicle structural assembly, repair and maintenance technicians
Vehicle environmental and life support specialists

Support Staff (E – 0%, T –0%, M – 50%, A – 50%)

*Percentages based **only** on the original anticipated 3,500 unemployed workers in these areas.

Appendix D
Skill Area Requirements
For
Engineering & Technician Training in Support of Next Generation Systems

The following listing represents a more detailed breakout of skill areas and disciplines required in next generation spacecraft and launch systems. The skills difference as the nation retires the Shuttle and moves to a newer class of launch and spaceflight system will be most visible in the use of much advanced technology in materials, avionics, environmental systems, extensive use of micro-processors, and a culture of "less and easier" handling and processing for flight readiness. Engineering and technician support skills will be required in the following areas:

General Design

Spacecraft systems engineering and integration design
Launch and propulsion systems engineering
Design reliability/maintainability
Flight hardware accident prevention
Hazardous materials prevention
High pressure systems
OIS/communications
Emergency life services apparatus
Respirator life support design
Air filtration/recycle systems
Advanced battery systems
Foreign object debris remediation

Move Certifications/Hardware Handling

Move/transportation cycle planning
Handling and hoisting
Tow vehicle operations
Hydra-set/seal
CM/SM stack
Motorized handling equip
Aerial platform operations
Fuel systems certification
Crane certification

Test and System Monitoring

Test discipline
Proof/leak testing
Electrical testing
Connector check-out
Space craft operator
Cautions and warnings
Vehicle power configuration
Communications & guidance
Crew interfaces
Test conductors
Mission testing
LAS/SM interface
Weight & center of gravity
Altitude chamber

Flight hardware

Hatch certification
Heaters design, maintenance and rebuild
Structures, design
Wire harness installation
Coaxial fiber optic
Structure buildup and repair
Fasteners technology
Sheet metal processes
Electric bonding
Structural bonding
Layout design
Cold plate/box installation
Pyrotechnic handling
Flight crew systems
TPS/TCS/MMOD blankets
Composites maintenance

Tube fabrication and Install
Seals and connectors
Installation clamping

Facility
Doors
Operating processes
SAP
Paper processing

Composites
Advanced materials technology
Forms/Tool design
Mixing/heat treat processes
Operations/joining processes
Layering/processing
Polyurethane long fiber technology

Avionics
Micro-processor architecture
Design/test discipline
Micro-processor design/fault testing
Electrical/electronics testing
Inter-subsystem networking
Advanced display technology

Contamination Control
CWA plan
GOX
Methane
Portable clean room

Tooling
Configuration and use
Maintenance
Calibration
ECS purge air
Proof load
Integration

Tech Baselines
Torque & safety wire
Connector mating
Electrical grounding

Quality
Receiving Inspection
Tech work verification
Surveillance inspection
Closeout inspection

Vehicle Access
Platforms
Tooling
Entry
Confined spaces

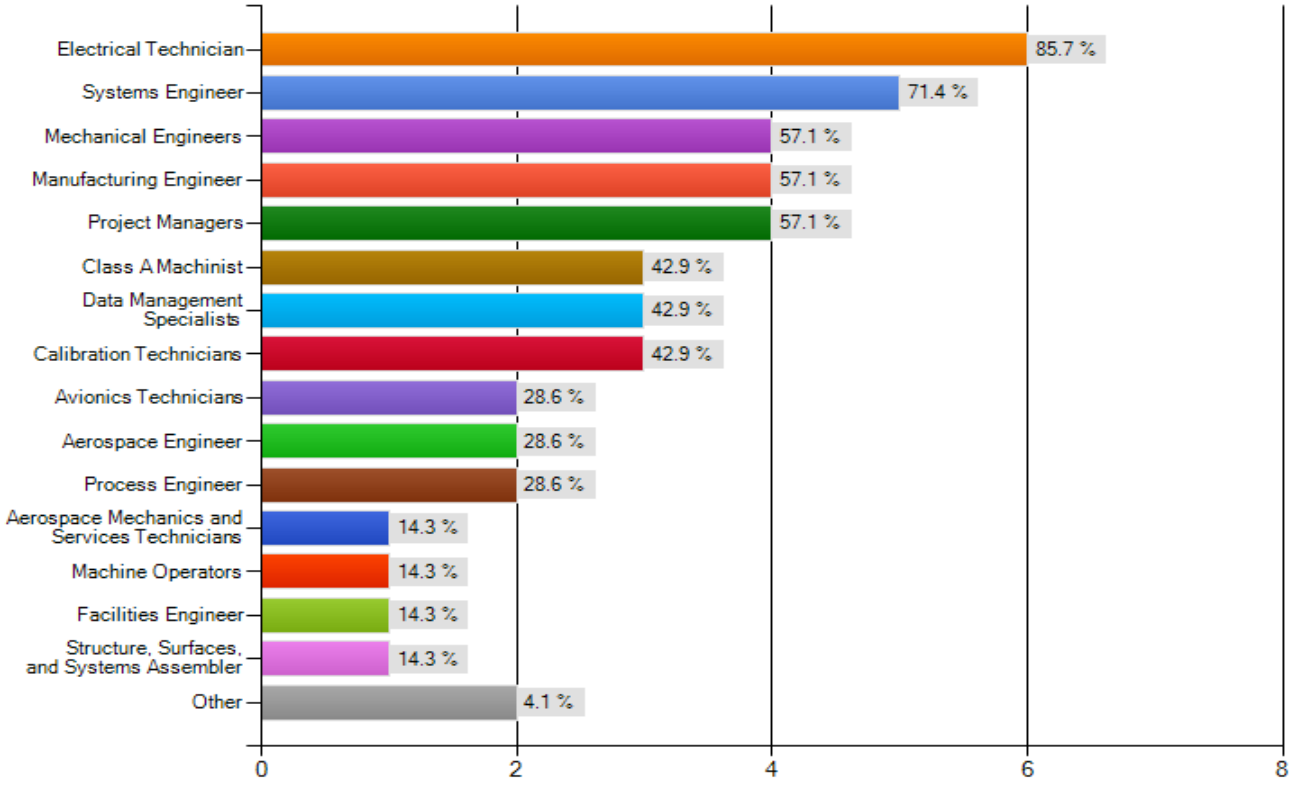
Advanced Life Support Systems
Air Purity/circulation systems design
Environmental contamination remediation / monitoring
Water purification/hydraulics
Waste processing/disposal
Microprocessor – sensor/displays

Appendix E

Regional Aerospace Workforce Initiative

Survey Results – Aerospace Occupations Compatible with Industry Needs

Which positions listed below do you believe are compatible with skill set needs in your industry or organization?



SPACE AND TECHNOLOGY

SUPPORT policies, investments, and advocacy that clearly identify Florida as the best location for the next generation of federal and commercial Space opportunities.

SUPPORT retention and development of Florida's Space industry with science, technology, engineering and math (STEM) education; university based research and applied technology; workforce transition training; Space launch infrastructure; business development and incentives; and state/federal partnerships.

- **SUPPORT** state assistance to communities that could be adversely affected by federal Space program realignment or closure actions similar to BRAC as defined in FS 288.98.
- **SUPPORT** creation of a research and development tax credit that will encourage economic development and creation of high-wage jobs in the state.
- **SUPPORT** establishment of Space Florida's Commercial Launch Zone, similar to a foreign trade zone that includes economic incentives for launch, manufacturing, and research and development to enhance the commercial Space industry in Florida.
- **SUPPORT** authorizing legislative leadership requests for cost benefit analysis of incentives and other legislation that affect the Space industry.
- **SUPPORT** aerospace workforce retention incentive that will support the Space industry and preserve the high-tech, high-wage jobs through the shuttle transition.
- **SUPPORT** the statewide expansion of, and resources necessary to sustain, the Aerospace Workforce Transition Program that is currently mitigating the loss of jobs associated with the NASA shuttle retirement and the CEV launch gap.
- **SUPPORT** expansion of Spaceport eligibility criteria to match airport criteria in SIS five year plan.
- **SUPPORT** a Congressional request asking NASA to retire one orbiter in the State in recognition of Florida's significant contributions to Space exploration and to NASA's Shuttle program.
- **SUPPORT** a Congressional request for full support of the Space program to enable the development of exploration systems, life science research, and new technology.
- **SUPPORT** the mission, activities and resources needed for Space Florida to attract and expand Space industry business and to improve Florida's Space infrastructure.

***Funding/Costs**:* Continue Aerospace Workforce Transition Program - $3.2 million requested from Penalties and Interest Trust Fund or other non-restricted fund. Space Infrastructure - $9,982,302 from Transportation Trust Fund or other non-recurring source for Exploration Park, Ransom Road extension, and Launch Complex 46. Maintain Space Florida operations - $3.894 million requested in Governor's budget but $7 million needed to implement strategic plan beyond shuttle retirement;

Legislators, groups, coalitions, associations, etc. that SUPPORT this issue: Aerospace Career Development Council, Associated Industries of Florida, Brevard County Council of Chambers, Brevard Workforce Development Board, Central Florida Regional MPO Alliance, Citizens for Space, Economic Development Commission of Florida's Space Coast, Florida Association of Counties, Florida Chamber of Commerce, Florida Space Day Committee, Space Coast League of Cities, Space Florida

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2009/2010 Space Advocacy Agenda (DRAFT 11-10-09)

SUPPORT policies, investments, and advocacy that clearly identify Florida as the best location for the next generation of federal and commercial Space opportunities.

SUPPORT retention and development of Florida's Space industry with science, technology, engineering and math (STEM) education; workforce transition training; Space launch infrastructure; business development and incentives; and state/federal partnerships.

ISSUE	SUPPORT	HOUSE	SENATE	KEY POINTS
Industry Retention	SUPPORT Space economic emergency response			Provide necessary means to assist communities that could be adversely affected by federal program realignment or closure actions similar to BRAC as defined in FS 288.98.
Incentives	SUPPORT Research and Development Tax Credit	Rep. Scott Plakon H#	Sen. John Thrasher S#	Stimulate the development of scientific and technological advances by targeted industries, increasing their competitiveness and creating high-wage research jobs in Florida. The Florida tax credit is modeled after the federal research tax credit in Title 26 U.S. Code section 41 available in 30 states.
	SUPPORT Space Commercial Launch Zone (CLZ)	Rep. Ralph Poppell H#133	Sen. Thad Altman S#	Similar to a foreign trade zone that includes a package of economic incentives for launch, manufacturing, and research and development to enhance the commercial Space industry in Florida. Co-sponsor: Plakon
	SUPPORT Cost Benefit Analysis of Legislation	Reps. Steve Crisafulli and Matt Hudson H#93		Authorizes legislative leadership to request special impact sessions of Revenue Estimating Conference to consider cost & benefit analysis of legislation. CoSponsors: Carroll, Dorworth, Eisnaugle, Kelly, McBurney, Murzin, Plakon, Precourt, Weatherford, Workman
	SUPPORT Aerospace Workforce Retention Incentive		Sen. Thad Altman S#	Provides tax incentives to businesses for training and hiring displaced aerospace workers.
Workforce	SUPPORT Aerospace Workforce Transition Program	$3.2 million requested from Penalties and Interest Trust Fund or other non-restricted funds		Expand aerospace transition program statewide to mitigate the loss of jobs associated with the NASA shuttle retirement. • Workforce analysis to match current skills/new employers' needs. • Training - Upgrade skills and transition to new occupations • Career counseling, supportive services, employment placement. Supported by Space Florida and funded in PY 2009-10 by Workforce Florida
Infrastructure	SUPPORT Space and Aerospace Infrastructure Enhancement	$9,982,304 requested from Transportation Trust Fund or other non-recurring source		Continue annual investment to improve Space infrastructure • Exploration Park: $5,070,000 for road system, utilities, drainage, borrow pit • Launch Complex 46: $3,912,304 for data communication, rail truck and trac • flame duct, vehicle support • Ransom Road: $1,000,000 for utilities to Phase II of Exploration Park
	SUPPORT revised Spaceport eligibility criteria	FDOT rule change		Expand project eligibility criteria for Spaceports to match requirements proposed for airports during the current revision of the SIS five-year master plan
Operations	SUPPORT Space Florida operations	$3.894 million* in Governor's budget		Support the mission, activities and resources needed for Space Florida to continue economic development activities as proposed in Governor's budget. **$7 million needed to implement strategic plan beyond shuttle retirement*
State/Federal Partnerships	SUPPORT Shuttle Orbiter Retirement in Florida	Rep. Ritch Workman H#253	Sen. Thad Altman S#	Memorial urging Congress to direct one of retiring space shuttle orbiters be preserved and placed on permanent display at Kennedy Space Center.
	SUPPORT NASA Budget Increase	Rep. H#	Sen. Thad Altman	Memorial urging Congress to fully support the Space program and to enable the development of exploration systems, life science research, and new technology.