

NASA Human Health and Performance Strategy

Exploring Space | Enhancing Life

July 1, 2012

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1.0 EXECUTIVE SUMMARY

In May 2007, what was then the Space Life Sciences Directorate, issued the 2007 Space Life Sciences Strategy for Human Space Exploration. In January 2012, leadership and key directorate personnel were once again brought together to assess the current and expected future environment against its 2007 Strategy and the Agency and Johnson Space Center goals and strategies. The result was a refined vision and mission, and revised goals, objectives, and strategies. One of the first changes implemented was to rename the directorate from Space Life Sciences to Human Health and Performance to better reflect our vision and mission.

The most significant change in the directorate from 2007 to the present is the integration of the Human Research Program and Crew Health and Safety activities. Subsequently, the Human Health and Performance Directorate underwent a reorganization to achieve enhanced integration of research and development with operations to better support human spaceflight and International Space Station utilization. These changes also enable a more effective and efficient approach to human system risk mitigation.

Since 2007, we have also made significant advances in external collaboration and implementation of new business models within the directorate and the Agency, and through two newly established virtual centers, the NASA Human Health and Performance Center and the Center of Excellence for Collaborative Innovation. Our 2012 Strategy builds upon these successes to address the Agency's increased emphasis on societal relevance and being a leader in research and development and innovative business and communications practices.

The 2012 Human Health and Performance Vision is to lead the world in human health and performance innovations for life in space and on Earth. Our mission is to enable optimization of human health and performance throughout all phases of spaceflight. All HHPD functions are ultimately aimed at achieving this mission. Our activities enable mission success, optimizing human health and productivity in space before, during, and after the actual spaceflight experience of our crews, and include support for ground-based functions. Many of our spaceflight innovations also provide solutions for terrestrial challenges, thereby enhancing life on Earth.

Our strategic goals are aimed at leading human exploration and ISS utilization, leading human health and performance internationally, excelling in management and advancement of innovations in health and human system integration, and expanding relevance to life on Earth and creating enduring support and enthusiasm for space exploration.

2.0 INTRODUCTION

In May 2006, what was then the Space Life Sciences Directorate (SLSD) solicited input from its NASA and contractor leadership teams to develop a long-range plan aligned with Agency and Johnson Space Center (JSC) strategies and goals. These efforts resulted in the 2007 Space Life Sciences Strategy for Human Space Exploration.

In January 2012, leadership and key directorate personnel were once again brought together to assess the current and expected future environment against its 2007 Strategy and the JSC 2012 Strategic Implementation Plan. The result was a refined vision and mission, along with revised goals, objectives, and strategies. One of the first changes implemented was to rename the directorate from Space Life Sciences to Human Health and Performance, and this new name will be used throughout this document.

3.0 HUMAN HEALTH AND PERFORMANCE DIRECTORATE (HHPD) VISION and MISSION STATEMENTS

Vision

“The HHPD leads the world in human health and performance innovations for life in space and on Earth”

Mission

“HHPD capabilities enable optimization of human health and performance throughout all phases of spaceflight”

All HHPD functions are ultimately aimed at achieving this mission. Our activities enable mission success, optimizing human health and productivity in space before, during, and after the actual spaceflight experience of our crews, and include support for ground-based functions. Many of our spaceflight innovations also provide solutions for terrestrial challenges, thereby enhancing life on Earth.

4.0 SITUATION ANALYSIS

A situation analysis was conducted to determine where we are today relative to our mission and vision, and to identify the factors most likely to influence our strategy development and affect achievement of our goals and objectives. Our assessment of the current situation, our stakeholders, trends in life sciences and spaceflight, and our internal and external environments is presented below and in Appendices A, B, C and D.

4.1 Current Situation (2012)

The most significant change in the directorate from 2007 to the present is the integration of the Human Research Program (HRP) and Crew Health and Safety activities into HHPD, with oversight of Level II functions by the Human Exploration and Operations Mission Directorate (HEOMD). This aligns with HEOMD's desire to achieve greater integration of research, development with operations to support human spaceflight, and enables a more effective and efficient approach to human system risk mitigation. Our 2012 strategies and goals are also well aligned with the JSC 2012 Plan as shown in Appendix A.

We have made significant advances in external collaboration and implementation of new business models within the directorate and the Agency, and through two newly established virtual centers, the NASA Human Health and Performance Center (NHHPC) and the Center of Excellence for Collaborative Innovation (CoECI). The NHHPC was envisioned in our 2007 plan, was established two years ahead of the planned schedule, and has more than 110 diverse member organizations.

The Agency is placing an increasing emphasis on societal relevance, International Space Station (ISS) utilization, and focused research and development activity. Commercial and non-ISS partner nation spaceflight capabilities are growing, and NASA is increasingly dependent on partners (ISS and commercial) for access to spaceflight. Our funding streams are changing, but have remained relatively stable since 2006, and our current stakeholders are shown below. Appendix B includes details of the situation analysis.

2012 Stakeholders include the HEOMD (Human Spaceflight Capabilities, ISS, Commercial Spaceflight Development, Advanced Exploration Systems, Space Life and Physical Sciences Research and Applications, and Exploration Systems Development), Office of the Chief Health and Medical Officer, Office of the Chief Technologist, and Office of the Chief Scientist; Flight Crew Operations, Mission Operations, Engineering, and Safety and Mission Assurance Directorates at JSC; JSC Management; other NASA centers; our international partners: the European Space Agency (ESA), the Canadian Space Agency (CSA), the Japanese Space Agency (JAXA), and the Russian Federal Space Agency (Roscosmos); NHHPC and CoECI members; NASA Advisory Committees (National Institutes of Health, National Academies of Science, Institute of Medicine, and National Research Council); The U.S. Executive Branch, Congress, and the American public.

4.2 What We Expect to Change in the Next Five to Ten Years

We expect many changes in human spaceflight in the next five to ten years. Over a ten-year period, Administration and Agency missions will change. Our current funding streams will likely be further reduced and become more diverse across smaller projects,

and we will rely more on traditional and new partnerships to achieve our strategic goals. Commercial spaceflight will become a reality, both to support NASA and international partner missions and to expand access to space via space tourism. We will create new advances in external collaboration and new business models to more effectively drive innovation. Appendix C specifies the full list of what is expected to change over the next five years.

4.3 Trends

The most significant trends in human spaceflight that we see emerging are the growing number of participants and capabilities in the human spaceflight arena including commercial entities and non- ISS partner nations. Trends within NASA include a reduction in funding from historical revenue streams and an emphasis on affordability, a focus on exploration beyond low earth orbit (LEO), and an aging workforce and facilities that will influence expertise and capabilities. Additionally, there are trends in terrestrial life sciences that will drive changes in human spaceflight practices and processes such as advances in commercial diagnostic and treatment modalities, environmental monitoring, and information management. Further, the underlying technologies to solve problems for spaceflight are closely linked to solutions for health and environmental issues in remote areas on earth. This similarity opens up the opportunity for co-creation among many seemingly diverse organizations (e.g., NASA and many of its NHHPC partners). Appendix C specifies the full list of trends identified.

4.4 SWOT Analysis (Strengths, Weaknesses, Opportunities, and Threats)

To identify the key strategies and objectives to pursue goals and the resources and capabilities required to achieve these goals, we conducted a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis. According to the HHPD leadership team, our greatest strengths are our people and the breadth and depth of their expertise; second is our leadership in collaborative innovation. As compared to 2007, we have made progress improving our ability to collaborate, communicate with, and leverage resources of external organizations, but need to continue to emphasize improvement of internal processes, integration, and communication (although in some cases internal processes were identified as both a strength and a weakness). The SWOT analysis is presented in Appendix D.

5.0 KEY STRATEGIES

Cross-cutting strategies developed in 2007 were assessed and refined to address the current environment—these apply broadly to all strategic goals. Goal-specific strategies and objectives are specified in Section 6.0 below.

- Optimize the integrated human system risk management process and continue to use the system to prioritize risks and execute tasks
- Define, develop, and maintain core capabilities and competencies
- Expand and strengthen strategic relationships
- Define, communicate and implement a customer-focused business model within the directorate
- Improve our customer focus
- Enhance internal and external communication in terms meaningful to our stakeholders, customers, and the general public

6.0 GOALS AND SPECIFIC OBJECTIVES

Goal 1: Lead Human Exploration

1A. Utilize the ISS to advance life sciences research, technology development, and operations to enable exploration at LEO and beyond.

2012-2016:

- By 2014, update HRP knowledge gaps, establish metrics, and identify gaps that can be closed by 2020
- Establish occupational surveillance programs to support astronaut health by 2013
- Baseline the Transition to Operations (TTO) process and establish a system to track number and performance of deliverables successfully transitioned to operations by 2013
- Secure human productivity data and define metrics to demonstrate gains in crew productivity by 2015
- Improve crew efficiencies on-orbit by 10% (time savings of task completion) by 2016
- Participate in ongoing Design Reference Mission (DRM) planning and development throughout the life cycle of mission design.

2017-2021:

- Develop optimized, autonomous health care systems and practices for exploration missions by 2017
- Implement three technology demonstration projects on ISS by 2017

- Develop one-year ISS human mission capability by 2017
- Participate in Mars simulation mission planning for 2017
- Be established as the global medical provider for missions beyond ISS by 2017
- Complete preparation for continued ISS operation beyond 2020 by 2018
- Transfer 50% of research products to operations for approved DRMs by 2017 and 75% by 2019
- Complete baseline data collection for lunar crew and deep space exploration by 2020

1B. Leverage HHPD experience and provide services to facilitate successful commercialization of LEO

2012-2016:

- Establish three HHPD commercial space operators customer agreements by 2014

2017-2021:

- Develop a joint lessons learned database with private industry and other federal agencies by 2019

1C. Expand and leverage strategic relationships and collaborative efforts to advance human health and performance innovations that enable extended human exploration

2012-2016:

- Identify and select best practices and technologies in collaboration with the military and industry to refine our Human System Integration (HSI) strategy by 2013
- Expand our customer portfolio by 20% including Advanced Exploration Systems, Office of Chief Technologist, commercial space, and non-traditional markets by 2015

2017-2021:

- Develop agreements with emerging partners and their biomedical community

Goal 2: Lead Internationally

2A. Lead and integrate international community human health and performance capabilities to advance space exploration through established ISS working groups and the NHHPC

2012-2016:

- Fully participate in and contribute to ISS Team 5 activities for ISS utilization by 2013
- Support Global Exploration Roadmap activities for the human system by 2014
- Engage international and commercial partners to develop a consolidated evidence base of human spaceflight data by 2014
- Involve all ISS International Partners (IPs) in HRP data collection and exchange by 2014
- Engage new IPs by 2014 with a focus on India
- Expand NHHPC international member relationships to 10% By 2015

2017-2021:

- Develop a consolidated evidence base of human spaceflight data in collaboration with international and commercial partners by 2017
- Develop agreements with new partners' biomedical community as new partners emerge

2B. Maintain and cultivate cooperation with international space life science organizations and stakeholders to enhance the Agency Global Exploration Roadmap

2012-2016:

- Present a plenary and ten papers at the annual Global Space Exploration Congress (GLEX) by 2016
- Present one plenary and ten papers at the annual International Astronautical Congress (IAC) in collaboration with international partners and with an emphasis on enhancing the Agency Global Exploration Roadmap by 2016

2017-2021:

- Establish a new symposium series at IAC in collaborative innovation by 2017
- Continue to participate in the annual GLEX and IAC in collaboration with IPs and with an emphasis on enhancing the Agency Global Exploration Roadmap

Goal 3: Excel in Leadership, Management, and Innovation

3A. Develop, maintain and leverage core capabilities and world-class expertise in human health and performance and management

2012-2016:

- Define core capabilities to compare against human system risks and perform gap analysis by 2012. Train, hire, and collaborate to fill the gaps by 2016
- Establish a system for documenting and tracking expertise by 2013
- Develop a process to identify and track all new and existing HHPD legal vehicles for collaborations by 2013
- Establish a structured project management approach to be applied to all integrated operational, development, and research projects by 2013
- Develop and implement an expansion and utilization plan for Human System Academy by 2013
 - Develop HSI training courses for JSC by 2012
 - Increase number of Human System Academy students completing programs by 20% by 2014
 - Launch an online Human System Academy by 2014
- Establish formal succession planning options (e.g., cross-training experiences, part-time opportunities for employees per their expertise) by 2014
- Increase peer reviewed publications and patents annually by 5% beginning in 2014
- Establish availability of web-based Graduate Life Sciences training at the University of Houston open to all accredited universities by 2015

2017-2021:

- Open Human System Academy to external participation by 2017

3B. Drive advances in human health and performance

2012-2016:

- Develop an HSI strategy by 2012 and implement it by 2016
 - Identify and select best practices/technologies to refine HSI strategy by 2013
 - Complete integration of HSI into Systems Engineering Handbook by 2013
 - Establish an HSI Splinter Group by 2013
 - Integrate HSI into Employee Resource Group manual by 2013
- Conduct a workshop by 2013 to identify most critical HHP projects with potential to impact relevance to life on Earth

- Collect metrics on research and development projects that explicitly identify terrestrial benefits (e.g., number of Phase III—Technology Infusion—Small Business Innovation Research (SBIR) projects by 2014
- Aggressively pursue human health and performance innovative technical and business approaches that drive affordability, sustainability, and accountability; identifying and establishing three approaches by 2014
- Finalize definitions of all known risks and link all human system requirements to risks by 2014
- Collect and analyze research deliverables (e.g., quality, quantity, stage of development, where in the pipeline, used to inform community, extent to which it mitigated risk, etc.) as they are generated to inform risk management process

2017-2021:

- Ensure HSI operations concepts are captured for extraterrestrial missions by 2018
- Reduce required resupply by 50% to support human health and performance by 2018
- Reduce ground-based real-time support for on board medical and environmental activities by 2018

3C. Define and implement comprehensive information architecture, data management, and website integration plans

2012-2016:

- Fully define the information architecture by 2013
- Identify all existing sources of NASA data supporting human health and performance by 2013
- Develop process to address requests from public regarding human health and performance data by 2013 (Lifetime Surveillance of Astronaut Health team)
- Benchmark current capabilities and practices for data management and distribution (internal and external) by 2014
- Complete development of integrated HHPD website by 2014

2017-2021:

- Automate the process for dissemination of data emerging from users/customers (technically how and what) by 2017
- Implement best practices for data management and distribution (internal and external) based on benchmark by 2017
- Data will be readily available electronically for public use by 2018

- 3D. Lead and promote the use of innovation methodologies (e.g., prizes) to advance human health and performance innovations and foster a NASA culture that embraces collaborative innovation

2012-2016:

- Secure agency funding line to support innovation and use of innovative methodologies (including implementation) for FY13 and out years
- Define methods to quantify innovations and return on investment (value) to human health and performance by 2013
- Define needed processes and develop capability to share data resources to support innovations by 2013
- Conduct five external open innovation challenges annually by 2014
- Develop a framework for strategic decision-making by 2013; evaluate and revise to final product by 2014
- Develop two processes that facilitate utilization of innovation methodologies and tools by 2014
- Continue to operate NASA@Work with 20 challenges annually, and produce an annual report of results and metrics for the NASA workforce
- Provide staff support to the JSC Innovation Day annually, leading at least one committee or interactive exhibit
- Pursue three HHPD Innovation Charge Account (ICA) innovations annually
- Develop metrics for use of strategic decision-framework by 2016

2017-2021:

- Continue to operate NASA@Work with 20 challenges annually
 - Produce an annual report of results and metrics for the NASA workforce
- Implement and expand availability of the strategic decision framework across the Agency, and incorporate into project management classes by 2017
- Conduct five external open innovation challenges annually
- Develop return on investment analysis of open innovation strategies by 2017
- Provide staff support to the JSC Innovation Day annually, leading at least one committee or interactive exhibit
- Incorporate ICA awards into task orders to continue advancement of human health and performance innovations

Goal 4: Expand Relevance to Life on Earth

- 4A. Utilize the CoECI to leverage resources and promote the use of collaborative innovation and prizes across the U.S. Federal Government

2012-2016:

- Develop promotional material (handouts and web based) to create awareness of and promote use of innovation methodologies by 2012
- Create a repository of best practices and applications of collaborative innovation methods to be shared with all Federal Agencies by mid-2013
- Define and implement operational practices to rapidly respond to and facilitate the use of open innovation methodologies in other Federal Agencies by mid-2013
- Continue to promote collaboration and co-development of projects that cannot be conducted effectively by a single agency per the White House Office of Management and Budget (OMB) and White House Office of Science and Technology Policy (OSTP) June 2012 memorandum

2017-2021:

- CoECI is self-sustaining through reimbursable Space Act Agreements by 2017
- Establish public access forum for “Collaborating with the Government” through the CoECI to demonstrate project collaborations between government entities and the public sector by 2017

4B. Utilize the NHHPC to leverage resources and expand collaborative innovation projects, co-development efforts, and communication of benefits to Earth

2012-2016:

- Support 2012-2013 development and execution of a human health and performance related NASA Grand Challenge (if selected) as encouraged by the memorandum on Science and Technology Policy Priorities issued by the OMB and OSTP in June 2012
- The NHHPC engages the CoECI to conduct a prize in support of grand challenges by 2015 (a public-private prize)
- Conduct two NHHPC workshops per year that address applications benefiting both space exploration and life on Earth
- Continue to promote collaboration and co-development of projects that cannot be conducted effectively by a single organization
- Increase international participation in the NHHPC by one organization per year in 2012, 2013, and 2014
- Conduct six Member-to-Member Connect webcasts per year

2017-2021:

- Continue to promote collaboration and co-development of projects that cannot be conducted effectively by a single organization

- Conduct two NHHPC workshops per year that address applications benefiting both space exploration and life on Earth
- Develop one international collaborative project by 2017
- Conduct six Member-to-Member Connect webcasts per year
- Establish a collaborative agreement with :envihab by 2017

4C. Enhance communications and events to promote and demonstrate relevance to life on Earth and create public support and enthusiasm for human space exploration

2012-2016:

- Develop a strategic communications and marketing plan to promote and demonstrate relevance of HHPD, NHHPC, and CoECI by 2012
- Collaborate with NASA Headquarters Office of Communications and other Agency offices to participate in Agency-level efforts for outreach and communication to the public
- Integrate HHPD external website to promote relevancy of HHPD efforts and to attract business from external commercial entities by 2014
- Continue to use Twitter and other relevant social media formats to convey the goals and objectives of the NHHPC, CoECI and the HHPD
- Establish the “human as a system” presence on the JSC homepage and external websites by 2013
- Conduct four Innovation Lecture Series events for HHPD, NHHPC and CoECI participants

2017-2021:

- Hold NASA HHPD supported Science Fair or other educational activity to increase public awareness by 2018
- Pursue and establish partnership with educational publisher to provide content for HHP-related text by 2018
- Incorporate other virtual publication formats into the HHPD publication process (example: eBooks on iTunes)
- Host the first HHPD tweet-up focused on health aspects of human spaceflight
- Create YouTube HHPD library that promotes facilities, core capabilities and technical accomplishment of the directorate

4D. Use HHPD world-class expertise to promote Science, Engineering, Technology and Math (STEM) education and create opportunities to inspire the next generation of life scientists

2012-2016:

- Develop an external package for workforce to use in Education and Outreach (E&O) initiatives by 2012
- Assess and coordinate all existing educational activities in human health and performance within the Agency, Office of Education, and supported institutions by 2013
- Develop K-12 education contests that highlight NASA-generated HHP innovations by 2013
- Infuse NASA Education with STELLAR made available to their educators and via nasa.gov by 2013
- Develop a concerted effort with JSC E&O to leverage NASA Headquarters E&O funding/support and identify education funding opportunities by 2014
- Document and track current E&O efforts currently conducted by HHPD civil servants and contractors by 2014 and build into an overall strategy for HHPD E&O by 2014

2017-2021:

- Wherever practical and appropriate, embed E&O in HHPD projects

Appendix A: Human Health and Performance Directorate Line of Sight with the JSC Strategy

	JSC 2012	HHPD 2012
Vision	<ul style="list-style-type: none"> JSC leads a global enterprise in human space exploration that is sustainable, affordable, and benefits all humankind. 	<ul style="list-style-type: none"> The HHPD leads the world in human health and performance innovations for life in space and on Earth
Mission	<ul style="list-style-type: none"> JSC provides and applies the preeminent capabilities to develop, operate, and integrate human exploration missions spanning commercial, academic, international, and US government partners. 	<ul style="list-style-type: none"> HHPD capabilities enable optimization of human health and performance throughout all phases of spaceflight
Goal 1: Lead Human Exploration	<ul style="list-style-type: none"> Exploit the ISS as a cornerstone of human exploration Enable the commercialization of LEO Extend human exploration beyond LEO 	<ul style="list-style-type: none"> Utilize the ISS to advance life sciences research, technology development, and operations to enable exploration beyond LEO Leverage HHPD experience and provide services to facilitate successful commercialization of LEO Expand and leverage strategic relationships and collaborative efforts to advance human health and performance and innovations to extend human exploration
Goal 2: Lead Internationally	<ul style="list-style-type: none"> Leverage ISS experience to lead international community participation in human space exploration Guide development of Agency Global Exploration Roadmap 	<ul style="list-style-type: none"> Lead and integrate international community human health and performance capabilities to advance space exploration through established ISS

	<ul style="list-style-type: none"> • Champion international participation in the development of exploration capabilities 	<p>working groups and the NASA Human Health and Performance Center (NHHPC)</p> <ul style="list-style-type: none"> • Maintain and cultivate cooperation with international space life science organizations and stakeholders to enhance the Agency Global Exploration Roadmap
<p>Goal 3: Excel in Leadership, Management, and Innovation</p>	<ul style="list-style-type: none"> • Lead through innovative technical and business management practices • Lead by fully engaging the human spaceflight team 	<ul style="list-style-type: none"> • Develop, maintain and leverage core capabilities and world-class expertise in human health and performance and management • Drive advances in human health and performance • Define and implement comprehensive information architecture, data management, and website integration plans • Lead and promote the use of innovation methodologies (e.g., prizes) to advance human health and performance innovations and foster a NASA culture that embraces collaborative innovation
<p>Goal 4: Expand Relevance to Life on Earth</p>	<ul style="list-style-type: none"> • Intertwine JSC in mutually beneficial partnerships to maximize economic and societal impact • Inform, educate and engage all generations to advance human space exploration • Strategically communicate 	<ul style="list-style-type: none"> • Utilize the CoECI to leverage resources and promote the use of collaborative innovation and prizes across the U.S. Federal Government • Utilize the NHHPC to leverage resources and expand collaborative innovation

	<p>JSC's relevance in terms meaningful to our stakeholders</p>	<p>projects, co-development efforts, and communication of benefits to Earth</p> <ul style="list-style-type: none"> • Enhance communications and events to promote and demonstrate relevance to life on Earth and create public support and enthusiasm for human space exploration • Use HHPD world-class expertise to promote Science, Engineering, Technology and Math (STEM) education and create opportunities to inspire the next generation of life scientists
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Appendix B: Situational Analysis—Current Situation 2012

- The Human Research Program and Crew Health and Safety have been integrated into HHPD; HRP and CHS report to HHPD with oversight of Level II functions by HEOMD
- Funding
 - Funding from STS and Cx ended, current funding comes from ISS, MPCV, Comm Space, AES, COECI, HRP, CHS, CM&O, and OCT
 - HRP, CHS FY 12 budget has remained relatively flat compared to FY 06
 - Budgetary and decision authority remain the responsibility of the program managers
- There is an increased emphasis on ISS utilization, and biomedical support and utilization of ISS has been established through 2020
- There is an increased emphasis on societal relevance
- There is an ongoing expectation for focused research and development activity and crew member occupational healthcare
- Affordability requirements are driving systems engineering, program management, human rating, and requirements policies for practices
- We have made significant advances in external collaboration and implementation of new business models within the directorate and the Agency, and through the NHHPC and COECI.
- There is a lack of unified understanding of the Agency's direction and significant uncertainty with our customer base, including commercial customers and partnerships
- With the conclusion of the Space Shuttle Program, there is now a perception by the general public that a human space program no longer exists
- Commercial crew development program has been established
- There is a perceived loss of American leadership in human spaceflight with the loss of American space transport and the increased spaceflight capability by non-partnered nations like China and India
- Health and Medical Technical Authority for Human Space Flight programs resides in HHPD
- The 2012 HHPD Strategic Plan is aligned with JSC 2012 Plan

Appendix C: Trends and What We Expect to Change in the Next Five to Ten Years

1. Trends in human spaceflight practices and processes

- Commercial development is playing an increasingly significant role in spaceflight
- Funding from historical revenue streams are changing and likely to decrease, and there is a focus on 'affordability' and optimizing core capabilities to meet budgetary constraints
- There will be fewer flight opportunities, less cargo capabilities (up and down mass), and exclusively long duration (6 months+) missions vs. short duration missions
- We are seeing an increased emphasis on ISS utilization and utilization for exploration
- There is a growing agency emphasis on beyond LEO exploration and technology development
- NASA will have more involvement with non-traditional aerospace organizations, e.g., our interaction with Chilean miners, NHHPC members, etc.
- There is a growing shift from contractor to civil servant project/program support and a move to matrixed personnel
- A divide between NASA administrative and Congress relative to risk aversion is emerging
- The public is becoming decreasingly interested in spaceflight with the ending of the Space Shuttle program
- Public and stakeholder perceptions of government (bad) vs. commercial space (good) or vice versa are growing
- International Partners are seeing increased utilization and responsibility of ISS
- NASA has more international dependencies
- There is a changing Agency philosophy in how we ensure mission safety (oversight vs. insight) and a focus to reduce standards and requirements
- There is a desire to keep all NASA centers healthy
- NASA's facilities are aging
- NASA's workforce is aging and centers are downsizing resulting in a loss of core expertise
- FAA will be becoming increasingly involved with NASA due to commercial activities
- The use of incentive prizes is increasing within and outside of the Agency
- We're seeing an increased utilization of analogs, data sharing and data mining efforts, and proactive risk management
- Vehicle and mission designs are changing and morphing
- There will be many small projects with multiple funding sources
- Increased competition for funding

2. Trends in terrestrial life sciences that will drive changes in human spaceflight practices and processes

- Interest in STEM fields continues to decline
- Greater access to remote medical care, telemedicine, non-invasive techniques
- Autonomous field science capability and medical care and operations
- Off the shelf technology advances aligned with spaceflight needs: portability, user-friendliness, remote guidance, miniaturization, robotics integration
- Advances in diagnostic and treatment modalities
- Biomedical technology breakthroughs: stem cells, genetics, bio-robotics, nanotechnology, pharmaceutical advancements
- Corporate advances that influence NASA, e.g., the race car industry
- Instant access to information/immediate communication/teaming
- Genetically based medical care/ability to identify individual susceptibility to risk enabling personalized treatment
- A focus on green/organic/sustainability
- Increasing amounts of digital data
- Less emphasis on face-to-face communication and personal interaction

3. What we expect to change in the next 5 to 10 years

- The U.S. and NASA Administration will change
- Funding from historical revenue streams will decrease, the need for and funding from new streams will emerge (e.g., OCT, non-federal sources), and our budget will become increasingly more complex
- Our mission will change (e.g., exploration destination), spaceflight will become more autonomous, and we will develop capabilities for in-situ analysis
- The ISS national lab will become active; NASA, IP, and commercial utilization of ISS will grow; there will be an increased IP management of ISS; however there is a potential for termination of ISS in this timeframe as well
- Commercial crew and cargo will become operational, and there will be growth in commercial space access
- Space tourism will be launched and grow, fliers will be from a broader population and the number of fliers will increase, and the need and possibility of funding for NASA expertise to support it will grow
- NASA will exchange medical information with commercial orbital and suborbital operators and others
- The spaceflight capabilities of other nations will grow, and they may experience significant advances (e.g., a moon landing by the Chinese)

- The U.S. and/or its partners may establish new cooperative agreements or partnerships with other nations such as China and India. No American Space transport Reduction in the number of NASA centers
- Our customer base will change and grow, as will our external partnerships, and we will have an increased reliance on external expertise to advance our goals
- We will create new advances in external collaboration and new business models
- Human system requirements for commercial human spaceflight will be better defined from an operational perspective

Appendix D: SWOT Analysis

The SWOT analysis reflects the outcomes of five different HHPD leadership breakout sessions grouped into themes and prioritized (from top to bottom) for each SWOT category on the basis of frequency of occurrence. They are not listed in any particular order within each theme.

Strengths (internal, present factors)

People: core capabilities/corporate knowledge

- Breadth and depth of domain knowledge
- We hold “the” database for effects and performance for humans in space, the leading experts and the expertise for spaceflight.
- Experience in human spaceflight with past successes
- World leadership roles in the work we do
- Knowledge base, subject matter experts, experience in spaceflight
- Same as 2007: (Our greatest strengths lie in our core capabilities: the unique space life sciences research, technology development, and operations knowledge, skills, and experience that define us as an organization.)
- Extremely competent and dedicated workforce—civil servant and contractor
- Have leading ability to find answers and build research to solve the problems/questions
- Dedication of the people
- Diverse and talented work force
- Workforce (diverse, devoted, capable, skilled, adaptability, flexibility, world class expertise)
- Employees interested in participating in Education and outreach
- Education outreach at every level

Leaders in collaboration and innovation

- Collaboration is moving to be the norm
- Open to collaboration and innovation
- Strong external collaborations (NSBRI, academia etc)
- We integrate the international life sciences community
- Good connections to the external communities

Resources/resource management (funding and people)

- Project Management

- Pathfinder, forward-looking
- Excellent facilities for research
- Flexibility has allowed the organization to evolve and to survive
- Mature processes

Risk management

- Serious approach to risk management
- Interdisciplinary atmosphere to solve problems
- Operations and research housed in one directorate—mission and risk focused (drives operations and research)
- Applied research produces deliverables

HRP specific

- Well managed and structured HRP
- HRP utilization of station

Weaknesses (internal, present factors)

Management/Processes

- Not sure Life Sciences skill set the right skill set for the mission we have now, how do we manage this skill set in the next 5 years. Don't have the flexibility to hire and fire like private business, how do we utilize what we have and prep/train them to get there.
- Project Management
- Resource management (funds and people)
- Bureaucracy
- Mature workforce (caps, ceilings)—how to manage?
- Inability to maintain corporate knowledge
- Inability to replace corporate knowledge (e.g., lack of succession plan)
- Poor internal education (corporate knowledge management)
- Poor career development
- Transitioning of applied research (deliverables) into operations
- Hardware development
- Poor metrics for determining value
- Ourselves
- Lack of knowledge management
- Need to utilize and tap into our work force
- Lack of unified direction for HHPD

Integration/Silos of people, data

- No singular SA culture (not speaking with one voice) – one team to external
- Lack of respect between research and medical worlds
- Poor internal information flow
- Accessibility of data, understanding and use of data, how usable is it really? Silos of research and ops data is an issue other organizations don't do this to this extent
- What are we doing to optimize and apply to our own programs, for example data?
- Fractured nature of the organization too focused on particular areas of expertise. Difficult to navigate across the SA divisions, the program and HRP, how can we expect others to be able to?
- No unified approach
- Still stove-piped
- Cross-discipline integration
- Lateral ties between Ops and Research
- Communication between divisions, across directorate
- Lack of engagement across the directorate

Lack of recognition of the value of the human system*

** This is a perception management issue that addresses both an internal weakness and an external threat: internal re: our inability to "sell" the value, externally re: others' perception of that value, but was most often identified as an internal weakness by participants*

- Tech develop current situation, an issue for SA because not perceived on critical path and hard to obtain funds for development. Limitation if develop technology without consideration of human system in the critical path
- Lack of consideration for the human in the loop on the ground floor of all concept design. Competing priorities between budget and trying to show early progress.
- Lack of focus on Human performance characterization
- Disconnect between programs and HHP and understanding what is needed and HHP knowing how to communicate, speak the language and integrate to educate.
- Significant spaceflight development without SA (HMTA) involvement, a disaster waiting to happen- i.e. commercial crew development not enough resources to

really support compared to engineering tech authority they can deploy which we don't have

- Don't have an equivalent "Saturn rocket" display for Human Spaceflight, where is our display. How do we get people excited about the human element and not just focus on engineering

Disconnect with agency vision, our own strategy

- Personnel are feeling disconnected from the policies. Don't understand why space isn't addressed specifically in the mission.
- Is the gen Y really connected to what we are inspired by, are they more connected to the current mission statement than we are and we just don't see it?
- No buy-in for strategic plan
- Lack of unified direction for agency, center
- Directorate vision is not pervasive throughout the directorate
- Timeliness to implementation of vision

Disconnect with stakeholders

- Seems we have too many stakeholders, certain hierarchy of how we need to support. Reflective all specializations, maybe we do not have enough of consolidated focus to address stakeholders.
- The list of stakeholders- doesn't necessarily recognize themselves as stakeholders and recognize the need and relevance for HHP. We in turn are not sure why we should "care" about the stakeholder list. Thus, we may not be serving them appropriately,
- Directorate visibility is lacking with start-up initiatives
- Public outreach
- Demonstrate relevance and benefit to earth (JSC worse than other centers historically)

Risk-based approach misses other possible opportunities

Opportunities (external, future focused)

Collaboration/New Initiatives

- How to capitalize on structure with contractors to capitalize on support to commercial space, best ways to align to define goals with commercial space
- Continue building on external collaborative opportunities and capitalize the lead

- Become a recognized leader to external vendors
- Commercial space industry for partnership
- Potential for spin-offs and spin-ins
- Optimizing collaboration with terrestrial life science organizations
- Growth of international space access
- Establish collaboration with other government agencies
- Strong IP relationships – leverage
- Engage industry to increased partnerships – cutting edge technology, sustain core capabilities
- Texas Med Center growth – increased partnerships
- Commercial partners – increased national recognition (show our relevance)
- Skills and knowledge is needed by emerging customers (e.g., commercial, international)
- Leverage non-traditional domain knowledge to solve problems (e.g., ‘crowdsourcing’)
- Further integration with international partners (research and operations) (e.g., Russia)
- OZ restructuring (former payloads division in the ISS program office; disbanded with tasks assigned to other ISS offices, opportunity for us to provide a better integrated HHPD set of payloads, etc.)

Leadership/policy development

- Lead the integration and place ourselves in a position of leadership.
- Insert ourselves as leaders
- Reduce policies that inhibit leveraging success stories publicly for example medical stories, but still protect
- Rewrite of program management, system engineering, and human rating policies
- Exercise influence in our leadership roles over external programs e.g. HMTA
- Rebrand ourselves – enablers vs. obstacles/gatekeepers

Management/Processes needed to leverage opportunities

- Create more generalists
- Tap into diverse talent
- Empower our people
- Work well as a team.
- Integration between research and operations
- Sharing data and better integrate research and operations side of the house

- Creation of informative databases (occupational health and human performance)

Stakeholders/funding

- Diverse budget streams
- Having more than one customer
- Emphasizing human system with stakeholders
- Emerging programs and projects – OCT, AES
- Ability to identify alternative funding sources
- Integrate the Human System across many programs

Image/Image Enhancement

- NASA brand = good ☺
- External review is evaluated positively (e.g., IOM)
- Rebrand ourselves – enablers vs. obstacles/gatekeepers
- Interest of potential partners to take advantage of the NASA brand
- Better use of the brand
- Better communicate relevancy to general public

Threats (external, future focused)

Policy/Leadership

- Lack of unified direction for agency, center
- Govt policies impede our abilities
- Medical privacy rules prohibit good outreach via medical success stories
- Requirements validation on commercial space not leverage and NASA's role not clearly defined-ops concept HHP and certification of space craft
- Multi-center survival
- Laws and policies preventing us from acting like a business
- Rewrite of program management, system engineering, and human rating policies
- Lack of Clear space policies / direction
- Ending of ISS program
- Viability of RSA launch capability
- National direction changes – lack of five year plan that will stick!
- Space launch system branding issue within the organization
- Change of policy, mission, etc.

- Leadership gap in human spaceflight diminishing, other international organizations more willing to sell information than we are reducing the gap further

Competition/Commercial Space

- Commercial space have in-house capabilities that creates perception that NASA is not needed
- Competition and risk of losing competent and dedication of work force given current state of affairs
- In competition with contractors to support commercial space-what is NASA's role really?
- How will we cope with new commercial space work if we achieve commercial space opportunities successfully?
- National Labs
- Threat of losing SME's to external entities
- Commercial space industry for competition
- Growth of international space access
- How to capitalize on structure with contractors to capitalize on support to commercial space, best ways to align to define goals with commercial space.
- National labs assistance
- Commercial failures may impact NASA's image and success

Resources

- Core infrastructure aging (labs, facilities) requires funding
- Funding
- Dependence on HRP funding
- Budget uncertainty
- Losing core capabilities and aging workforce, aging facilities
- Budget

Public Image/Relevancy

- Public opinion and lack of support for space program
- E&O has no funding
- Perception of being risk averse
- Public interest
- Loss of the NASA brand

Limitations of current practices/models

- Are we sure the data is similar or better/ worse or just different?

- Cultural response to models (e.g., push-pull problem)
- Pace of technology advancement obsolescence
- Reliance on terrestrial research to mitigate our risks

Lack of recognition of the value of the human system **both an external threat and internal weakness, see note above under weaknesses*