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IMPACT ASSESSMENT

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COMMUNICATION FROM THE COMMISSION TO THE COUNCIL, THE EUROPEAN PARLIAMENT, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

TOWARDS A SPACE STRATEGY FOR THE EUROPEAN UNION THAT BENEFITS ITS CITIZENS

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Executive Summary

NASA *Spinoff* highlights the Agency's most significant research and development activities and the successful transfer of NASA technology, showcasing the cutting-edge research being done by the Nation's top technologists and the practical benefits that come back down to Earth in the form of tangible products that make our lives better. The benefits featured in this year's issue include:

Health and Medicine

Image-Capture Devices Extend Medicine's Reach

Johnson Space Center, Henry Ford Hospital in Detroit, and Houston-based Wyle Laboratories collaborated on NASA's Advanced Diagnostic Ultrasound in Microgravity (ADUM) experiment, which developed revolutionary medical ultrasound diagnostic techniques for long-distance use. Mediphan, a Canadian company with U.S. operations in Springfield, New Jersey, drew on NASA expertise to create frame-grabber and data archiving technology that enables ultrasound users with minimal training to send diagnostic-quality ultrasound images and video to medical professionals via the Internet in near-real time—allowing patients as varied as professional athletes, Olympians, and mountain climbers to receive medical attention as soon as it is needed.

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Medical Devices Assess, Treat Balance Disorders

Dr. Lewis Nashner's NASA-funded, pioneering work in the 1980s on balance assessment and rehabilitation led to the invention of the EquiTest computerized dynamic posturography system, used by Johnson Space Center to evaluate astronauts' balance upon their return to Earth's gravity. Commercialized by NeuroCom International Inc., of Clackamas, Oregon, the EquiTest has since been joined by a wide range of other balance-related medical devices and options. NeuroCom now has over 2,000 systems in use around the world in a variety of medical fields, including neurology, geriatrics, orthopedics, and sports medicine.

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NASA Bioreactors Advance Disease Treatments

Houston-based biotechnology firm Regenetech Inc. acquired the licenses for NASA bioreactor technology from Johnson Space Center. The NASA bioreactor, which allows for the rapid cultivation of healthy cells in simulated weightlessness, is now the foundation of Regenetech's thriving intellectual property business that is providing researchers with the tools to make adult stem cell therapy—a potential source of treatment for conditions like heart disease, diabetes, and sickle cell anemia—viable for the public.

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Robotics Algorithms Provide Nutritional Guidelines

Using robotics expertise gained while working as an engineer for a major telerobotics program funded by NASA Headquarters, Joe Graves founded a unique, online nutrition company called Vitabot, based in Beltsville, Maryland. Making use of some of the same concepts and style of algorithms Graves developed for NASA's Ranger Neutral Buoyancy Vehicle robot, Vitabot helps users set health goals, plan balanced meals, and lose weight through proper nutrition. Available through corporate wellness programs and health clubs, Vitabot now has nearly 1,000 company clients and has experienced over 1,500-percent growth in the health club industry—as its users have been shedding pounds through healthy eating.

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'Anti-Gravity' Treadmills Speed Rehabilitation

A former Ames Research Center engineer, Dr. Robert Whalen, invented a treadmill that he licensed to a Menlo Park, California, company, Alter-G Inc. The company's G-Trainer is an enclosed treadmill that uses air pressure to help patients feel up to 80-percent lighter, easing discomfort during rehabilitation. A patient desiring more weightlessness during a workout can simply press a button and the air pressure increases, lifting the body and reducing strain and impact. The U.S. Food and Drug Administration cleared the G-Trainer for medical use in January 2008, and researchers are now assessing the G-Trainer's effectiveness in aiding patients with various neurological or musculoskeletal conditions.

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Crew Management Processes Revitalize Patient Care

In 2005, two physicians, former NASA astronauts, created LifeWings Partners LLC, in Memphis, Tennessee, and began using Crew Resource Management (CRM) techniques developed at Ames Research Center in the 1970s to help improve safety and efficiency at hospitals. According to the company, when hospitals follow the LifeWings training, they can see major improvements in a number of areas, including efficiency, employee satisfaction, operating room turnaround, patient

advocacy, and overall patient outcomes. LifeWings has brought its CRM training to over 90 health care organizations, and annual sales have remained close to $3 million since 2007.

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Hubble Systems Optimize Busy Hospital Schedules

Don Rosenthal, a former Ames Research Center computer scientist who helped design the Hubble Space Telescope's scheduling software, co-founded Allocade Inc., of Menlo Park, California, in 2004. Allocade's OnCue software helps hospitals reclaim unused capacity and optimize constantly changing schedules for imaging procedures. After starting to use the software, one medical center soon reported noticeable improvements in efficiency, including a 12-percent increase in procedure volume, 35-percent reduction in staff overtime, and significant reductions in backlog and technician phone time. Allocade now offers versions for outpatient and inpatient magnetic resonance imaging (MRI), ultrasound, interventional radiology, nuclear medicine, positron emission tomography (PET), radiography, radiography-fluoroscopy, and mammography.

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Web-Based Programs Assess Cognitive Fitness

The National Space Biomedical Research Institute, based in Houston and funded by NASA, began funding research for Harvard University researchers to design Palm software to help astronauts monitor and assess their cognitive functioning. The MiniCog Rapid Assessment Battery (MRAB) was licensed by the Criteria Corporation in Los Angeles and adapted for Web-based employment testing. The test battery assesses nine different cognitive functions and can gauge the effect of stress-related deficits, such as fatigue, on various tasks. The MRAB can be used not only for pre-employment testing but also for repeat administrations to measure day-to-day job readiness in professions where alertness is critical.

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Electrolyte Concentrates Treat Dehydration

Wellness Brands Inc. of Boulder, Colorado, exclusively licensed a unique electrolyte concentrate formula developed by Ames Research Center to treat and prevent dehydration in astronauts returning to Earth. Marketed as The Right Stuff, the company's NASA-derived formula is an ideal measure for athletes looking to combat dehydration and boost performance. Wellness Brands also plans to expand with products that make use of the formula's effective hydration properties to help treat conditions including heat stroke, altitude sickness, jet lag, and disease.

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Transportation

Tools Lighten Designs, Maintain Structural Integrity

Collier Research Corporation, of Hampton, Virginia, licensed software developed at Langley Research Center to reduce design weight through the use of composite materials. The first license of NASA-developed software, it has now been used in everything from designing next-generation cargo containers, to airframes, rocket engines, ship hulls, and train bodies. The company now has sales of the NASA-derived software topping $4 million a year and has recently received several Small Business Innovation Research (SBIR) contracts to apply its software to nearly all aspects of the new Orion crew capsule design.

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Insulating Foams Save Money, Increase Safety

Scientists at Langley Research Center created polyimide foam insulation for reusable cryogenic propellant tanks on the space shuttle. Meanwhile, a small Hialeah, Florida-based business, PolyuMAC Inc., was looking for advanced foams to use in the customized manufacturing of acoustical and thermal insulation. The company contacted NASA, licensed the material, and then the original inventors worked with the company's engineers to make a new material that was better for both parties. The new version, a high performance, flame retardant, flexible polyimide foam, is used for insulating NASA cryogenic propellant tanks and shows promise for use on watercraft, aircraft, spacecraft, electronics and electrical products, automobiles and automotive products, recreation equipment, and building and construction materials.

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Polyimide Resins Resist Extreme Temperatures

To combat the high temperatures in aerospace applications, Dr. Ruth Pater of Langley Research Center developed RP-46, a polyimide resin capable of withstanding the most brutal temperatures while still being lightweight (less than half the weight of aluminum), chemical and moisture resistant, strong, and flexible. Designed as an environmentally friendly alternative to other high-temperature resins, the RP-46 polyimide resin system was

awarded a 1992 "R&D 100" award, named a 2001 "NASA Technology of the Year," and later, due to its success as a spinoff technology, 2004 "NASA Commercial Invention of the Year." Unitech LLC, of Hampton, Virginia, received a nonexclusive license from NASA for commercialization of the material, and it is now in widespread industrial use.
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Sensors Locate Radio Interference

After receiving a NASA SBIR contract from Kennedy Space Center, Soneticom Inc., based in West Melbourne, Florida, created algorithms for time difference of arrival and radio interferometry, which it used in its Lynx Location System (LLS) to locate electromagnetic interference that can disrupt radio communications. Soneticom is collaborating with the Federal Aviation Administration (FAA) to install and test the LLS at its field test center in New Jersey in preparation for deploying the LLS at commercial airports. The software collects data from each sensor in order to compute the location of the interfering emitter.
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Surface Operations Systems Improve Airport Efficiency

With SBIR contracts from Ames Research Center, Mosaic ATM Inc., of Leesburg, Virginia, created software to analyze surface operations at airports. Surface surveillance systems, which report locations every second for thousands of air and ground vehicles, generate massive amounts of data, making gathering and analyzing this information difficult. Mosaic's Surface Operations Data Analysis and Adaptation (SODAA) tool is an off-line support tool that can analyze how well the airport surface operation is working and can help redesign procedures to improve operations. SODAA helps researchers pinpoint trends and correlations in vast amounts of recorded airport operations data.
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Nontoxic Resins Advance Aerospace Manufacturing

The 2008 "NASA Commercial Invention of the Year," PETI-330, is a polyimide matrix resin that performs well at high temperatures and is easily processed into composites in a simple, short-curing cycle. Invented by scientists at Langley Research Center, PETI-330 is now licensed to Ube Industries Ltd., based in Japan with its American headquarters in New York. In addition to being durable and lightweight, the resin is also nontoxic, which makes it safe for workers to handle. PETI-330 was created specifically for heat-resistant composites formed with resin transfer molding and resin infusion, which formerly could only be used with low-temperature resin systems.
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Public Safety

Sensors Provide Early Warning of Biological Threats

Early Warning Inc., of Troy, New York, licensed powerful biosensor technology from Ames Research Center. Incorporating carbon nanotubes tipped with single strands of nucleic acid from waterborne pathogens, the sensor can detect even minute amounts of targeted, disease-causing bacteria, viruses, and parasites. Early Warning features the NASA biosensor in its water analyzer, which can alert organizations to potential biological hazards in water used for agriculture, food and beverages, showers, and at beaches and lakes—within hours instead of the days required by conventional laboratory methods.
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Robots Save Soldiers' Lives Overseas

Marshall Space Flight Center mobile communications platform designs for future lunar missions led to improvements to fleets of tactical robots now being deployed by the U.S. Army. The Multi-function Agile Remote Control Robot (MARCbot) helps soldiers search out and identify improvised explosive devices. NASA used the MARCbot to test its mobile communications platform, and in working with it, made the robot faster while adding capabilities—upgrading to a digital camera, encrypting the controllers and video transmission, as well as increasing the range and adding communications abilities. They also simplified the design, providing more plug-and-play sensors and replacing some of the complex electronics with more trouble-free, low-cost components. Applied Geo Technologies Inc., a tribally-owned corporation in Choctaw, Mississippi, was given the task of manufacturing the modified robots. The company is now producing 40 units per month, 300 of which have already been deployed overseas.
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Apollo-Era Life Rafts Save Hundreds of Sailors

To keep life rafts holding astronauts and frogmen from capsizing from the downdraft of rescue helicopters after Apollo-era splashdown landings, engineers at NASA's Johnson Space Center designed and patented a self-righting life raft capable of resisting tipping in choppy seas and fierce winds. Givens Marine Survival

Co. Inc., of Tiverton, Rhode Island, patented this invention and now manufactures and markets the rescue rafts—under the name Givens Buoy Life Raft—in a variety of sizes and models for everything from sailboats to larger ocean-going vessels. To date, Givens has sold several thousand of the ballasted, inflatable life rafts, and this space-age technology is credited with saving the lives of over 450 sailors.

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Circuits Enhance Scientific Instruments and Safety Devices

In 1996, Thomas Crowe and William Bishop founded Virginia Diodes Inc. (VDI), based in Charlottesville, Virginia. VDI now has over 30 full-time employees and grows 30 percent per year, growth Crowe credits to its terahertz products developed under SBIR contracts with Goddard Space Flight Center. Because of the unique characteristics of terahertz radiation—such as its ability to image hidden items and to detect and identify a wide range of chemicals—there is a growing demand for terahertz components. Applications include security imaging systems, hazardous chemical and biological-agent detectors, plasma diagnostic instruments, and industrial process monitors. The company has over 200 customers in over two dozen countries.

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Tough Textiles Protect Payloads and Public Safety Officers

In order to create the Mars Pathfinder's mission-critical airbags in the 1990s, NASA's Jet Propulsion Laboratory collaborated with New Ipswich, New Hampshire's Warwick Mills Inc. to weave multilayer textiles for the airbags for both Pathfinder and the Mars Exploration Rovers. Warwick Mills applied techniques from the collaboration to its puncture- and impact-resistant TurtleSkin product line. The company's metal flex armor (MFA) vests offer stab protection comparable with rigid steel plates, and over 50,000 of the vests have sold. The SoftPlate body armor offers protection from handgun bullets, and like the MFA, is designed to be more comfortable than rigid vests. International public safety and military customers are now benefiting from the TurtleSkin products.

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Consumer, Home, and Recreation

Forecasting Tools Point to Fishing Hotspots

Private weather forecaster WorldWinds Inc., of Slidell, Louisiana, has employed satellite-gathered oceanic data from Marshall Space Flight Center to create a service that is every fishing enthusiast's dream. The company's FishBytes system uses information about sea surface temperature and chlorophyll levels to forecast favorable conditions for certain fish populations. Transmitting the data to satellite radio subscribers, FishBytes—with about 8,500 subscribers so far—provides maps that guide anglers to the areas where they are most likely to make their favorite catch.

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Air Purifiers Eliminate Pathogens, Preserve Food

NASA-funded researchers produced an ethylene reduction device for a plant growth unit. KES Science and Technology Inc., a Kennesaw, Georgia-based company specializing in sustaining perishable foods, licensed the ethylene scrubbing technology. KES partnered with Akida Holdings, of Jacksonville, Florida, which now markets the NASA-developed technology as AiroCide. According to the company, it is the only air purifier that completely destroys airborne bacteria, mold, fungi, mycotoxins, viruses, volatile organic compounds (like ethylene), and odors. What's more, the devices have no filters that need changing and produce no harmful byproducts, such as the ozone created by some filtration systems.

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Fabrics Protect Sensitive Skin from UV Rays

Late Johnson Space Center engineer Dr. Robert Dotts headed a team to develop cool suits for children suffering from life-threatening sun sensitivities. Dotts hoped to develop ultraviolet-blocking technology in a fabric that—unlike in a bulky space suit—could remain comfortable, light, and breathable in the sun and heat. The team worked with the Solar Protective Factory Inc. (SPF), of Madison, Wisconsin, to design ultraviolet-blocking cool suits, which protect sun-sensitive patients and enable them to experience life outdoors safely. Using knowledge gained during the NASA collaboration, SPF created an entire line of ultraviolet-blocking apparel.

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Phase Change Fabrics Control Temperature

Originally featured in *Spinoff* 1997, Outlast Technologies Inc. (formerly Gateway Technologies Inc.) has built its entire product line on microencapsulated phase change materials developed in SBIR contracts with Johnson Space Center after initial development for the U.S. Air Force. The Boulder, Colorado-based company acquired the