USTAR

UTAH'S TECHNOLOGY CATALYST

2016 ANNUAL REPORT

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USTAR

UTAH'S TECHNOLOGY CATALYST


FLAMMABLE
KEEP FIRE AWAY
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CHAIRMAN'S MESSAGE

Dear Legislators, Stakeholders and Industry Partners,

As the Chairman of the Utah Science Technology and Research (USTAR) initiative Governing Authority, it is my pleasure to present our fiscal year 2016 annual report to you.

Throughout the past year, USTAR has embarked on what has been dubbed as a "programmatic tilt". This shift will allow USTAR to fill the gaps in Utah's innovation ecosystem. With Sen. Ann Millner's leadership, USTAR saw the passage of SB 166 which has realigned the agency's efforts with the original legislative intent. This marks the culmination of more than a year of evaluation, strategic planning and careful review of the many moving pieces that make up USTAR.

Governed by our mission and vision statements (see page 6), we are conscientious stewards of the state's resources to have the greatest affect on the technology community. With this as our goal, we have begun to implement recommendations from SRI International, a nonprofit independent research group that assessed our ecosystem, and the result has been an increase in transparency and accountability on financial and performance measures. Additionally, it allowed for two successful pilot programs, which demonstrated a shift in the way USTAR funds projects. The Technology Acceleration Program (TAP) and the University Technology Acceleration Grant (UTAG) both saw early success as competitive pilot programs for startup communities and academic institutions, and are now integral pieces in the USTAR model. You can read more about these and our other new programs on page 42 of this report.

I truly believe that we will see the fruits of these labors in the near term. USTAR is an enduring testament to the efforts of our lawmakers and business community working together. Stories of past and present success are exciting. In this report you will find the work of researchers like Young-Min Lee and his team who are working to develop a Zika virus vaccine, or Aaron Quinlan and the other members of the USTAR Center for Genetic Discovery who continue to push boundaries and make remarkable breakthroughs in diagnosing rare diseases through large-scale genome analyses. You will also read about small startup companies engaged in everything from wireless communication advancements to low-cost micro navigation modules.

I am proud of the work that has been accomplished and the strategic direction of USTAR. I am excited about the boundless discoveries and technologies that are yet to come.

Sincerely,

Greg Bell
Governing Authority Chairman
Utah Science Technology and Research Initiative

USTAR OVERVIEW

Established in 2006, The Utah Science Technology and Research (USTAR) initiative reflects the leadership and vision of the Utah Legislature and the Governor to leverage science and technology innovation in support of Utah's economy. USTAR is the State of Utah's technology catalyst, accelerating the growth of the innovation ecosystem from invention through product development. Guided by Utah's economic clusters, USTAR supports technology entrepreneurs and innovators through training, funding, incubator and accelerator programs; brokering technology transfer by connecting capital, management and industry; addressing market gaps in Utah's technology ecosystem and strengthening the State's research capacity (see Figure 1).

UTAH VISION Utah will lead the nation as the best performing economy, and be recognized as a premier global business destination.

USTAR VISION Build a robust innovation ecosystem in the State of Utah.

USTAR MISSION USTAR's mission is to accelerate the commercialization of science and technology ideas generated from the private sector, entrepreneurial and university researchers in order to positively elevate tax revenue, employment and corporate retention in the State of Utah

KEY USTAR TASKS

1. Support technology entrepreneurs and innovators through training, funding, incubator and accelerator programs
2. Broker technology transfer by connecting capital, management and industry
3. Address market gaps in Utah's technology ecosystem
4. Strengthen Utah's research capacity

USTAR TECHNOLOGY ENTREPRENEURSHIP SERVICES

USTAR supports the pipeline of innovative technology ideas to establish new products and companies across the state. USTAR's services provide resources at every step of the development pathway for university researchers and technology entrepreneurs.

OUTREACH OFFICES

USTAR NORTH
New Location
Coming Soon
385.226.8457

USTAR EAST
423 Wakara Way, Ste 300
SLC, Utah 84108
801.585.9690

USTAR CENTRAL
815 W. 1250 South
Orem, Utah 84058
385.335.5300

USTAR SOUTH
35 N Main Street,
St. George, Utah 84770
435.216.8364

BIOINNOVATIONS GATEWAY
2500 S State St Rm. 224
So. Salt Lake, Utah 84115
385.646.4625

SBIR-STTR ASSISTANCE CENTER
SLCC – Miller Campus
Corp Partnership Center
9750 So. 300 W.Ste 214
Sandy, Utah 84070
801.597.5957

ustar.org
801.538.8622
ustarinfo@utah.gov

TECHNOLOGY ACCELERATION PROGRAM (TAP)

TAP provides funding to Utah-based science and technology startups and early stage companies to accelerate the development of new technologies in key technology industries in the state.

INDUSTRY PARTNERSHIP PROGRAM (IPP)

Promotes the development of technology to address technical gaps or challenges identified by industry partners. USTAR identifies research expertise from Utah's institutions of higher education to address identified gaps by Utah companies. The program is open to companies that have a substantial presence in Utah.

SBIR-STTR ASSISTANCE CENTER

Assists entrepreneurs and startup companies in preparing and submitting SBIR-STTR applications. The SBIR and STTR programs offer more than $2.5 billion dollars in federal funding annually. The Assistance Center helps technology oriented businesses gain access to this non-dilutive capital.

TECH INCUBATORS

USTAR manages two tech incubators to assist start-up companies in maturing and commercializing their technology by providing access to specialized equipment to serve life science and aerospace/defense technology sectors. USTAR also supports access to the Utah NanoFab and USU Synthetic Bio-Manufacturing Facility. USTAR focuses on providing support to early stage startups in developing their minimum viable product, proof of concept, prototyping, and product validation.

UNIVERSITY TECHNOLOGY ACCELERATION GRANT (UTAG)

Support research, discovery and innovation through competitive funding of individual researchers or ad-hoc teams at Utah colleges and universities. The R&D grants provide funding to accelerate science and technology development of commercially oriented technologies. Funded projects will have an identified market and/or commercialization path.

REGIONAL OFFICES

USTAR's Regional Outreach offices work with tech entrepreneurs to connect them with resources for developing their technology and growing their businesses. The centers are strategically located across the state to provide access to all communities. They work closely with partners at all regional universities, as well as local entrepreneurs, businesses and other resources. The regional outreach offices connect private investors to promising opportunities and maximize the economic impact of new technologies created in Utah.

SCIENCE & TECHNOLOGY INITIATION GRANTS (STIG)

With the goal of increasing external research dollars to Utah's universities, STIG provides funding to researchers to support development of data, conduct proof of concept or other precursor research activities required to pursue larger, commercially-oriented grants from a federal agency, grant making foundation or industry.

USTAR

UTAH'S TECHNOLOGY CATALYST

Figure 1

ACCOLADES

The State of Utah has been recognized for its flourishing economy, a young – well educated workforce, low unemployment rate and low taxes. Home to heavy hitters like Instructure, Canvas, Adobe, Qualtrics, Vivint, Novell, Ancestry.com, ATK, L3 Communications, Merit Medical, BioFire and the NSA's data storage center, Utah's vibrant technology ecosystem is giving Silicon Valley cause to take notice.

UTAH ACCOLADES 2015-16:

Brookings: 3 Cities Ranked in Top 15 of Advanced Industry Intensity (advanced industries' share of total employment)
CBRE Group: Salt Lake #10 in Tech Job Growth
Consumer Electronics Association (CEA): Utah ranked as an Innovation Champion
Milken Institute: Provo/Orem #3 Best Performing Large Cities
Milken Institute: Logan #9 Best Performing Small Cities
Nerdwallet: Provo #7 Innovative Tech-Hub
U.S. Chamber of Commerce: Utah #6 High-Tech Share of All Businesses
U.S. Chamber of Commerce: Utah #8 High-Tech Job Concentration
Bureau of Labor Statistics/Business Insider: Utah #1 Fastest-Growing Tech States (7.69% increase in tech jobs since start of 2016)
Bloomberg: Utah #20 Most Innovative State

NOTABLE HEADLINES:

Adweek: Why Utah Is Poised to Be America's Next Tech and Creative Hub
The New Yorker: How Utah Became The Next Silicon Valley
BuzzFeed News: A Surge Of Startups Is Changing Life In Utah
CNBC: A High-Tech Mecca Rises To Rival Silicon Valley

USTAR's mission to grow the technology ecosystem requires public-private partnerships. Our partners include:

Governor's Office of Economic Development
BUSINESS • TOURISM • FILM

UTAH OFFICE OF ENERGY DEVELOPMENT
Advancing Utah's Energy Future

WORLD TRADE CENTER® UTAH

U.S. AIR FORCE

UtahStateUniversity

THE UNIVERSITY OF UTAH

Utah SBDC network
Small Business Development Centers

GROW UTAH

SUSTAINABLE startups

BIOUTAH
UTAH'S INDEPENDENT LIFE SCIENCE ASSOCIATION

SALT LAKE CHAMBER
EST. 1887
UTAH'S BUSINESS LEADER

CHURCH & STATE
ECONOMIC EVANGELISTS
1893 2014

women tech council

IMPACT HUB

TVC

UTC
UTAH TECHNOLOGY COUNCIL

MW
MountainWest Capital Network

UTAH'S INNOVATION ECOSYSTEM

Utah's innovation ecosystem is stimulating economic growth in the State by supporting new technology companies and the expansion of existing technology companies. Healthy innovation ecosystems all share similar characteristics including idea generation, a culture of innovation, strong networks, talent base, risk capital and leadership.

USTAR collaborates with public and private entities in the State to strengthen the innovation ecosystem. As a State entity, USTAR addresses market gaps through services and programs for university researchers, startup companies and existing science and technology companies in the State. USTAR measures its impact by examining the change in tax revenue from entities that work with USTAR.

Figure 2. Adapted from SRI, 2015.


QIAGEN
Buffer QC
Wash buffer
240 ml

YEAR IN REVIEW

Winston Churchill said, "To improve is to change, to perfect is to change often." Since 2014 USTAR has undergone significant and almost continuous change. Fiscal year 2016 was notable for the significant changes made to USTAR's governing code. In 2015, USTAR had an independent assessment of its programs and the state's innovation ecosystem. This assessment resulted in specific recommendations to restructure the USTAR initiative aligning programs to better address the gaps in Utah's Innovation ecosystem, introduce best practices in the management of programs and establish meaningful and measurable metrics.

During the 2016 Legislative General Session, Senator Ann Millner and Representative Brad Wilson introduced Senate Bill 166, which pivoted USTAR's programs to address Utah's innovation ecosystem gaps. These changes have led to the establishment of new programs and a strategic redistribution of funding to address these gaps. In FY16, we implemented two pilot programs and initiated four new competitive funding programs for FY17. These grant programs provide risk capital to startup companies and universities to accelerate technology development that will result in economic impact for the state (see figure 3). Three programs target technology

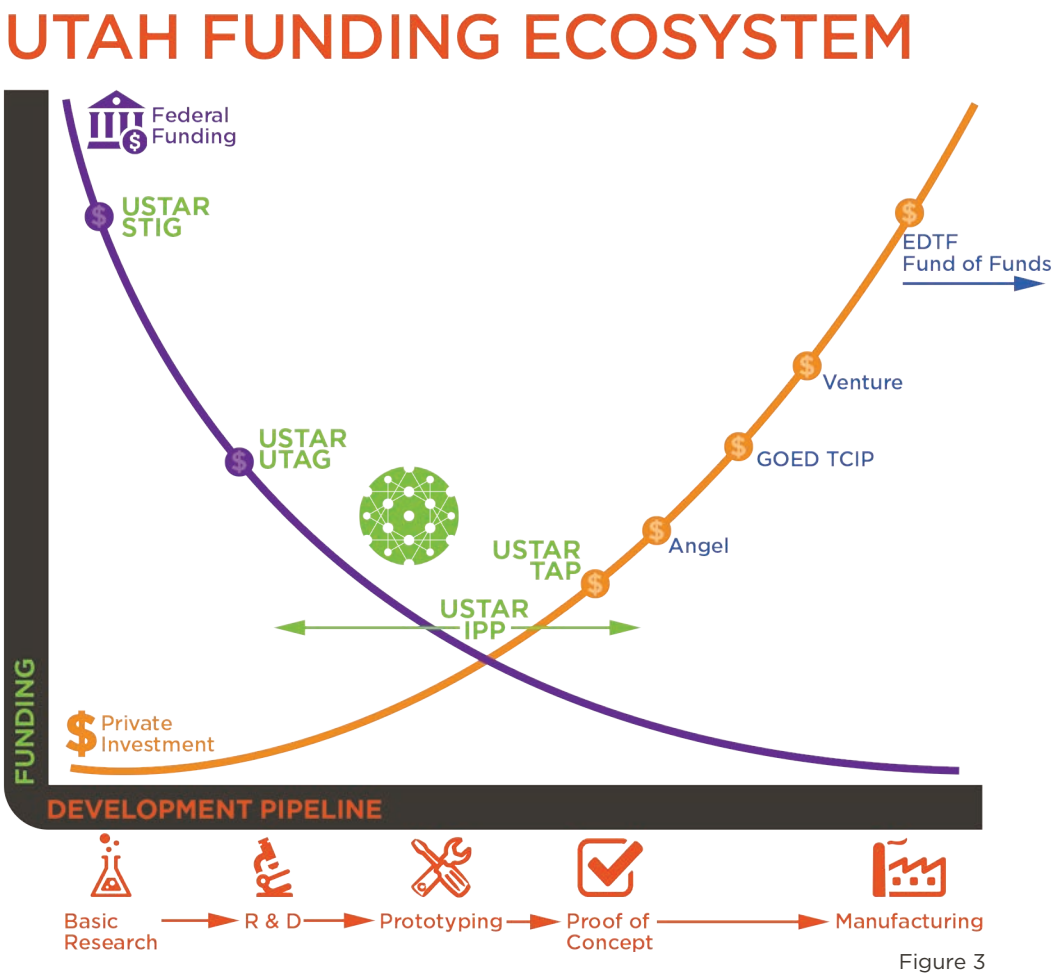


Figure 3

YEAR IN REVIEW

in the so called “valley of death” where federal funding is not available, but the technology is not mature enough to attract private investment.

The two pilot programs in FY16 were the foundation for the Technology Acceleration Program (TAP) and University Technology Acceleration Grant (UTAG). TAP provides funding for startup companies that require additional technology development. This pilot program funded 12 startups with small grants tied to reaching technical milestones. This allows for greater accountability with state funding. The second pilot was conducted with Utah State University, where faculty from across the university competed for small grants to advance technology developments. This pilot illustrated the breadth and depth of commercializable ideas that are generated across campus and not just by USTAR recruited faculty. This became the foundation for UTAG.

In addition, USTAR is expanding the resources and capacity of our outreach program. Our incubation enterprise program, which provides space, specialized equipment and training for emerging technology companies has undergone a significant overhaul with the introduction of a robust curriculum, milestones and a competitive application process to increase the productivity of the client companies. Our SBIR/STTR Assistance Center, which assists companies with applying for Small Business Innovative Research grants from federal research and development agencies has adopted new metrics and activities to expand their reach and increase the number of companies they assist. Our regional outreach offices in St. George and Orem have initiated a strategic realignment to better serve their communities.

Finally, under the new statute, the University of Utah and Utah State University will continue to receive funding to support the researchers recruited through the USTAR program. The metrics for performance of these researchers have been revised and the onus of reporting has been shifted to the universities. You will find their reporting on pages 48-73 of this report.

The new metrics for all USTAR programs provide both early indicators of success, such as follow on funding, as well as measuring standard economic development indicators, such as revenue, sales and job creation. As most of the companies USTAR works with are pre-revenue when USTAR engages them, data is collected for at least five years to capture the economic impact to the state of these early-stage funding mechanisms. For the first time, USTAR will report the estimated change in tax revenue for the state using IMPLAN, a well established economic model that uses economic development metrics as the input for the model. Over time, we expect this impact to grow as companies that USTAR works with mature and become revenue producing and as USTAR pivots to later stage, shorter term grants over the next several years.

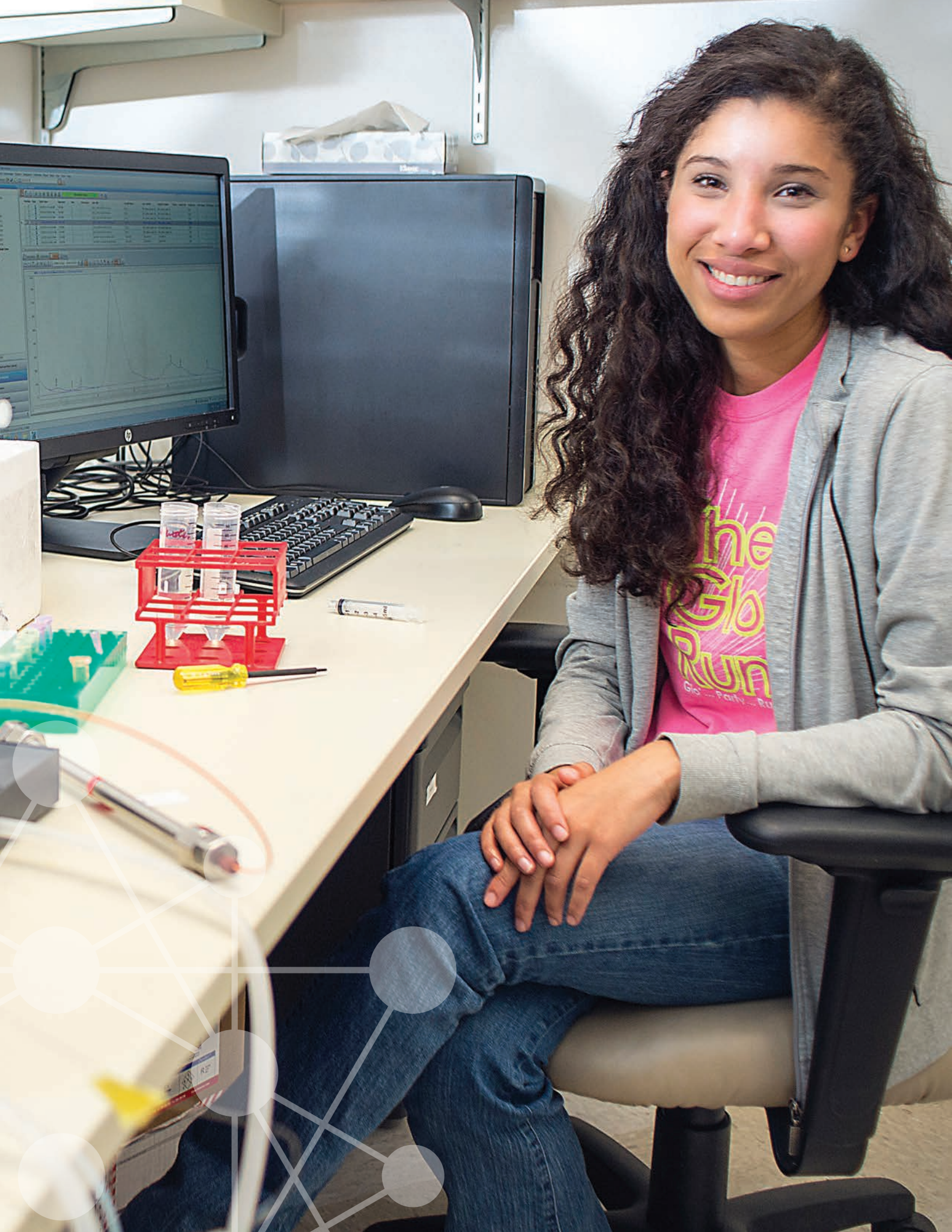
For this annual report, data from the University of Utah and Utah State University reflect the data provided by the institution. USTAR did not have the ability to audit the information, but did review and request clarifications where there were inconsistencies. The University of Utah provided the majority of data by fiscal

YEAR IN REVIEW

year with some calendar year reporting. These differences are noted in the data presented on page 75.

As required by statute, an independent third party, SRI International, was employed to survey the companies that USTAR worked with, provided funding to, or that the U or USU licensed USTAR generated technology to in 2015. Due to the nature of required reporting, calendar year data was deemed to be more accurate as commercial companies provide revenue and sales data on an annual basis, rather than the state fiscal year. This data and methodology for collecting the data can be found on page 81.

As USTAR implements the changes enabled by SB166, we will continue to change to address the gaps in Utah's innovation ecosystem while maintaining the transparency and accountability that is required with the use of public funds.



USTAR GOVERNING AUTHORITY

Greg Bell
Governing Authority Chairman

Greg Bell was appointed Chair of the USTAR Governing Authority by Governor Gary Herbert in December 2013. Before his appointment, Bell served as Utah's 7th Lt. Governor from Sept. 2009 until October 2013. He also practiced law with Kirton & McConkie and Fabian & Clendenin in real estate finance and was a self-employed developer. He was elected to the Utah Senate representing central Davis County in 2002 and re-elected in 2006. While serving as a state senator, Bell's colleagues elected him to Senate Leadership as Asst. Majority Whip, and he served on several committees, including the Higher Education Appropriations subcommittee, Capital Facilities, Judiciary, and the Health Reform Task Force. Gov. Gary Herbert appointed Bell as Lieutenant Governor on September 1, 2009 and they won re-election in Nov. 2010 and Nov 2012. In October, 2013, Bell resigned to take a position as CEO/President of the Utah Hospital Association.

Bell graduated from Weber State University in 1972 with a BA., and from the University of Utah College of Law in 1975 with a J.D.

Val Hale
Governing Authority Vice Chair

Before accepting the position as executive director of the Governor's Office of Economic Development, Hale served for two years as president and CEO of the Utah Valley Chamber of Commerce, leading efforts in business community issues— including regional economic development and branding initiatives. Hale was vice president (2010-2012) for university relations at Utah Valley University (UVU), overseeing legislative affairs, marketing and public media and community relations. From 2006-2010, Hale worked as advancement vice president at the university, responsible for fund raising and all university external activities. During this time, Hale played a key role in transitioning Utah Valley State College into Utah Valley University. Hale started at UVU as the assistant vice president for external affairs (2005-2006), where he served as legislative liaison and oversaw community relations and economic development activities. Hale received his bachelor's degree in public relations in 1981 and a master's degree in communications in 1987—both from BYU. Hale worked as a reporter at the Daily Herald from 1981-1982, covering business, government and BYU.

USTAR GOVERNING AUTHORITY

David Damschen
Governing Authority

David Damschen is the 25th Utah State Treasurer, where he is responsible for the state's banking, cash and debt management, investment of public funds (including the $11 billion Public Treasurers' Investment Fund), and the administration of the state's Unclaimed Property Division. David also serves by statute on nineteen boards and commissions, including Utah Retirement Systems, the School and Institutional Trust Fund, Utah Housing Corporation, Permanent Community Impact Board, Utah Navajo Trust Fund, and the Utah Capital Investment Board. Before his appointment in December 2015 as treasurer, David served for seven years as Utah's chief deputy state treasurer. Prior to joining the treasurer's office, he was Senior Vice President and Director of Treasury Management Services at AmericanWest Bank. He spent most of his 20 years in the banking industry in the institutional trust & custody, treasury management, and retail divisions of U.S. Bank.

A veteran of the U.S. Coast Guard, David holds a Bachelor of Arts in Finance from the University of Washington's Foster School of Business and the Certified Treasury Professional (CTP) credential. He is a past president of the Association for Financial Professionals of Utah, and spends his winter weekends serving as a volunteer member of the Powder Mountain Ski Patrol. David and his wife Jody raised their three children in Layton.

Jennifer Hwu
Governing Authority

Jennifer Hwu is president, CEO and co-founder of InnoSys, a Utah microelectronics company that supplies both the USG and commercial sector. She received her M.S. and PhD in electrical engineering from UCLA and was a tenured faculty member and associate chairwoman of the department of electrical and computer engineering at the University of Utah. Hwu previously worked for Walsin Lihwa as deputy CTO and TRW, Electronics and Technology Division as a member of the technical staff. She consults for many companies including MM Wave Technology, E-Systems, Micron Technology and others, and also has a large number of patents. She has received numerous prestigious awards including the US White House Presidential Early Career Awards for Scientists and Engineers (PECASE) and was named a US White House Presidential Faculty Fellow. She has also received many business awards and recognitions, including Business Woman Visionary (2004), Best Business Award (2010), Technology Entrepreneur Award (2011), Women Business Owner of the Year (2013) and Utah Innovation Award (2015).

USTAR GOVERNING AUTHORITY

Richard Kendall
Governing Authority

Richard Kendell, former commissioner of the Utah System of Higher Education and a retired district superintendent, also served as Southern Utah University's interim president during their search for a new president in 2013. He was an associate dean for two different schools in Utah. He was also the deputy to Governor Michael O. Leavitt for public education, higher education and economic development, among other various positions throughout his career. He earned a Bachelor of Science in English at Weber State, then a Master's degree and PhD in Leadership and Policy at the University of Utah. He has worked as a high school English teacher and as a faculty member and associate dean in both the College of Education and the Graduate School at the University of Utah. He served as Superintendent of Davis School District in Farmington, Utah and as Utah Associate Superintendent of Public Instruction. Richard has also worked in private industry as research and development director for WICAT Educational Systems and as a project manager for hospital and health care facilities for the Boyer Company.

On a more personal level, Richard and his wife Joan are the parents of four married children. Children and spouses, with one exception, hold degrees from the University of Utah. They have 15 grandchildren. Based on Utah logo wear alone there is little doubt that these grandchildren will follow in their parents (and grandparents) footsteps at the University of Utah.

Rich Lunsford
Governing Authority

Rich Lunsford presently serves as Vice President of Healthcare Solutions, and has served previously as Corporate Vice President and General Manager, Cardiac Surgery Systems since joining Edwards Lifescience in February 2011. Lunsford has more than 25 years of experience in the medical device industry, including extensive experience in global sales and marketing. Before joining Edwards, Lunsford was president and CEO of Anulex Technologies, a Minnesota-based manufacturer of minimally invasive technologies used during spinal surgery. He has also served as president/CEO of Acorn Cardiovascular, president of commercial operations at ev3 and has held leadership positions at Scimed Life Systems/Boston Scientific, Allergan Medical Optics and Spinetech Inc. Lunsford has been a board member for USTAR, Acorn Cardiovascular Inc, Anulex Technologies, Endius Inc, and Tutogen Medical. He received his bachelor's degree in multinational business operations from Florida State University.

USTAR GOVERNING AUTHORITY

Ron Mika
Governing Authority

Ron Mika is a Managing Partner and Co-Founder of Sorenson Capital. Ron has played an integral part in the fundraising, investing and portfolio management of Sorenson Capital's first three private equity funds which represent over $1 billion of investment capital. Prior to Sorenson, he spent 13 years at Bain Capital during which time he served as a Managing Director. Early in his career he also served as a Consultant at Bain & Company. Ron was also a Co-Founder and Managing Director with Huntsman Gay Global Capital (HGGC), a mid-market private equity firm. In all, Ron has been involved in the management of over $15 billion in private equity funds. Throughout his 25-year private equity career Ron has invested in many industry verticals including manufacturing in aerospace, automotive and consumer products; home construction; network infrastructure; medical instrument supply; fossil fuel and clean energy service providers; industrial procurement and distribution; retail; and several software and hardware technology-related companies.

Ron received a Master of Business Administration degree with honors from the Harvard Business School in 1989 and a B.S. in Chemical Engineering, magna cum laude, from Brigham Young University in 1985.

Derek Miller
Governing Authority

Derek Miller is the president and CEO of the World Trade Center Utah, an organization dedicated to expanding international business for the State of Utah. Prior to his current position, Miller served as chief of staff to Governor Gary Herbert, overseeing the Governor's Office, the Governor's Cabinet and state operations. He has also served as managing director of the Governor's Office of Economic Development (GOED) where he was responsible for recruiting new businesses to the state and helping existing Utah businesses to expand. While at GOED, Miller supervised the International Trade and Diplomacy Office and the Rural Development Office. He has also served as director of the Utah Division of Real Estate. Before moving back to his home state of Utah, Miller worked in Washington D.C. for the U.S. House of Representatives as legal counsel and for Arthur Andersen as a management consultant. He is a graduate of the J. Reuben Clark Law School at Brigham Young University, and also holds a Master of Public Administration from the University's Romney Institute of Public Management.

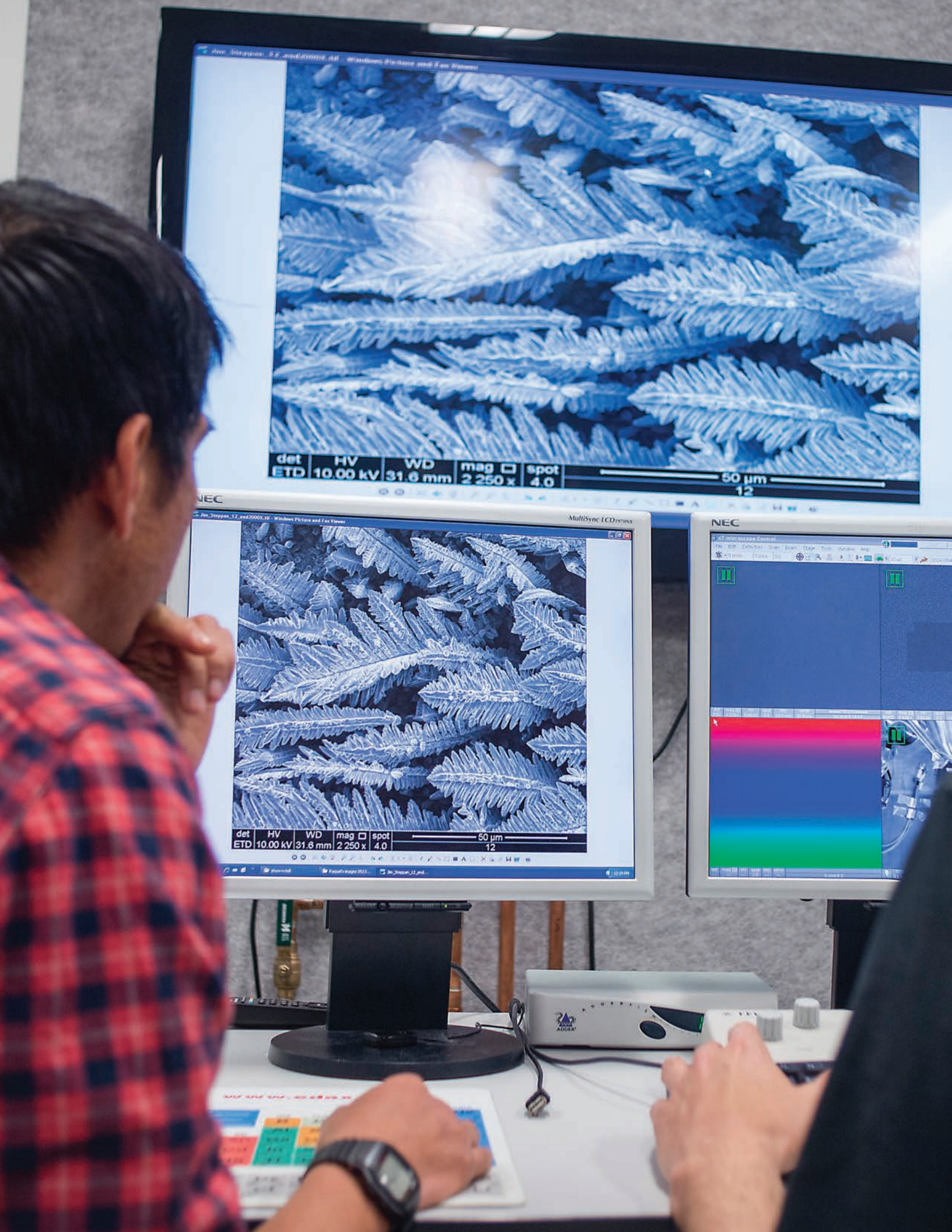
USTAR GOVERNING AUTHORITY

Susan Opp
Governing Authority

Susan D. Opp is the Sector President, Space and Power Sector, which provides a variety of Defense and Commercial RF and Communications Products to various customers. In 1986, Opp began her career as an associate engineer with Sperry Univac and has held positions of increasing responsibility in engineering, product and business development and program management with L-3 Communications, culminating in her current Sector President role. She earned a Bachelor of Science in electrical engineering from South Dakota School of Mines & Technology, and has a Master of Business Administration from the University of Utah.

Will West
Governing Authority

Will West is the CEO of SilverVue, a post-acute care platform that facilitates the transition from traditional fee-for-service healthcare to the new world of accountable care. Prior to founding SilverVue, he was the founder, CEO, and chairman of Control4 (NASDAQ: CTRL). He took the company public after surpassing $100 million in annual revenue. Will retired from Control4 in early 2014 to devote his entire focus to SilverVue. In 1998, he co-founded iBAHN (then called STSN). Under his leadership as the CEO, the company became the worldwide leader in broadband services for business travelers, serving millions of customers in thousands of hotels. Prior to founding iBAHN, Will was CEO and co-founder of PHAST Corporation, a manufacturer of high-end home automation equipment. Like his subsequent companies, PHAST became the leader in its field under his direction. He holds a degree in finance from the University of Utah, and an MBA from the Wharton School at the University of Pennsylvania. He also holds the CFA designation. Will retired last year as the chairman of the board of the Utah Capital Investment Corporation (the State of Utah's "Fund of Funds") where he served for close to 10 years.


det HV WD mag spot
ETD 10.00 kV 31.6 mm 2 250 x 4.0
50 µm
12
NEC
MultiSync LCD1970NX
det HV WD mag spot
ETD 10.00 kV 31.6 mm 2 250 x 4.0
50 µm
12
NEC

USTAR EXECUTIVE LEADERSHIP

Ivy Estabrooke, PhD
Executive Director

Ivy V. Estabrooke, PhD, leads the Utah Science Technology and Research (USTAR) initiative, the State of Utah's technology based economic development program, managing competitive research and development programs that fund public and private sector technology organizations. Prior to joining USTAR, Estabrooke was a science and technology program officer for the Office of Naval Research where she managed programs that delivered technology solutions to the US Marine Corps and Special Operations communities.

Estabrooke earned her PhD in neuroscience from Georgetown University, an MS in National Security Strategy and Resource Management from the Eisenhower School of the National Defense University and a BA in Biological Sciences from Smith College. She is an active member of multiple state and national boards.

Outside of the office Ivy enjoys chasing her daughters in Utah's mountains.

Thom Williams
Managing Director

Marine Corps Col. Thomas M. Williams (Retired) joined USTAR as managing director in July 2015. He commanded at all levels within the Marines during his 31 years of service, and traveled extensively in the Pacific, Europe, the former Soviet Union and the Middle East. Thom served several combat tours in Saudi Arabia, Iraq and Afghanistan as well as Bosnia and Kosovo in the Balkans. His additional assignments in the area of acquisitions for the Department of Defense have proven an asset to his work for USTAR. He served in the Missile Defense Agency (MDA) as a Concepts Planner, helping to guide the agency's $15 billion budget. At the Office of Naval Research he served as the Military Department Head, leading the portfolio of over 500 advance technology programs for the Marine Corps and Navy SEAL's. He has a B.S. in Aeronautics from San Jose State University and M.A. in Economics from the University of Oklahoma.

SBIR-STTR ASSISTANCE CENTER

USTAR's SBIR-STTR Assistance Center (SSAC) provides statewide services to Utah science and technology small businesses, assisting in all aspects of applying for and winning non-equity position federal funds through the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) program.

USTAR launched the SSAC in June 2008 and today it has helped bring more than $18 million to Utah companies with a better than 25% win rate, nearly twice the national average. To date, 33 companies from Box Elder to Washington County have won these prestigious grants with the help of the SSAC.

The SSAC offers a range of services at no charge to include consultations, finding the right solicitation or topic for companies, communicating with Program Managers, editing, reviewing and guidance throughout the submission process. Mary Cardon, SSAC Director and Linda Cabrales, Associate Director, are available to answer questions and review materials on SBIR-STTR at any time.

Workshops and seminars are provided regularly throughout the state on a variety of topics from introductory to specific elements of submission. The SSAC also sponsors outside experts to present in the state to provide their expertise to the community. Previous workshops include *Budget and Audit Tips* and *Phase II Do's and Don'ts* as well as several with an emphasis on Phase I submissions.

Working closely with the Small Business Development Centers and Business Resource Centers as well as technology outreach at Utah State University, University of Utah and Brigham Young University, the SSAC staff works hard to assure all of Utah's companies are aware of the SBIR-STTR funding opportunity as well as the state resource.

The SSAC also works with funding resources to include venturecapital.org and Utah's Angel community. With participation in the Women's Tech Council, Utah Tech Council and BioUtah, the team assures awareness of the program across multiple sectors.

Figure 4. Facing page.

National Win Rate

15%

USTAR

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SSAC Win Rate

25%

FY16 SSAC Winning Companies

$3,223,752 of Non-Equity Federal Funding to Utah

i5 Technologies
North Logan, UT
$225,000
SBIR Phase I

T3S Technologies
Salt Lake City, UT
$225,000
SBIR Phase I

InnoSys, Inc.
So. Salt Lake City, UT
$150,000
SBIR Phase I

MotionPort
St. George, UT
$125,000
SBIR Phase I

Silicon Technologies
Salt Lake City, UT
$125,000
SBIR Phase I

3Helix
Salt Lake City, UT
$149,623
SBIR Phase I

Xandem Technologies
Salt Lake City, UT
$225,000
STTR Phase I

EntryPoint
Salt Lake City, UT
$999,173
SBIR Phase II

InnoSys, Inc.
So. Salt Lake City, UT
$999,956
STTR Phase II

SBIR-STTR ASSISTANCE CENTER

Mary Cardon
SSAC Director

Mary Cardon leads the USTAR SBIR/STTR Assistance Center (SSAC), located at and operating in partnership with the Salt Lake Community College Miller Resource Center in Sandy, Utah. The center works with Utah's technology companies exclusively on SBIR/STTR grants and currently has a better than 25% success rate for grants they assist with.

Mary brings three decades of management experience to the center, coming most recently from GE Money, where she led the proposal writer team. While there, GE Money won the GSA travel and procurement award in 2007 as well as many multi-million dollar state and private sector programs. Prior to joining GE, Mary worked in management and communications, with more than 20 years in newspapers and small business in Idaho, California and Utah.

Her experience includes project management, training, writing, marketing and sales. She is active in the community, volunteering with organizations improving the lives of women, children and the under-represented.

email: mcardon@utah.gov **phone:** 801.957.5249

Linda Cabrelas
Associate Director

Linda joined USTAR in 2013 as the associate director of the SBIR-STTR Assistance Center (SSAC). She previously worked in management consulting, marketing and investment banking, as well as co-founding a successful small business. She has government experience that includes working in the U.S. Congress for Representative Dan Marriott and the Federal Reserve Bank.

Linda brings expertise in strategic business planning, project management, technical writing, product development, and recruiting and hiring practices with small businesses to the SSAC and USTAR.

Linda holds a Bachelor's degree in communication, with an emphasis in public relations and organizational communication from Brigham Young University and a Master's degree in organizational management from University of Phoenix.

email: lcabrelas@utah.gov **phone:** 801.957.5239

COMPANY PROFILE: i5 TECHNOLOGIES

On September 11, 2001, massive communication failures played a devastating role during the terrorist attacks and ensuing chaos. Entire networks were brought down due to system overloads, which resulted in confusion among emergency response teams. This sparked a race to develop new technologies to increase communication bandwidth for emergency situations. i5 Technologies, a startup from North Logan, Utah, is developing new smart antenna systems that significantly increase the coverage and capacity of today's wireless networks.

i5 Technologies was founded in September of 2014 by Bedri A. Cetiner, professor at Utah State University, with a vision to deliver fast, cost-effective and highly reliable wireless service. The company's innovative multi-functional reconfigurable antenna (MRA) technology overcomes the challenges of legacy systems and delivers significant performance gains with reduced cost and space efficiency. MRAs are capable of dynamically adapting frequency, radiation pattern and polarization based on the requirements of the environment and the communication network.

The frequency band, radiation pattern and polarization properties of an antenna directly impact the coverage, capacity, and quality of service achieved by wireless networks. Traditional antenna solutions for a multi-band transmission technology (e.g., cellular LTE/LTE-A, Wi-Fi) include the use of multiple fixed antennas each supporting some fixed frequency range, radiation pattern and polarization capability. Upcoming fifth generation (5G) and beyond wireless technologies are required to enable wireless connectivity for everybody and everything at any place and any time with reduced cost and size. A typical 5G application scenario with constantly varying channel conditions calls for an intelligent and adaptive wireless communication system, where antenna and signal processing parameters can be jointly optimized. Current state of the art technology does not address these issues effectively; particularly legacy antenna technologies, which are highly inadequate for meeting demand. i5's patented Multifunctional Reconfigurable Antenna (MRA) technology offers the ability to dynamically adjust operating frequency, radiation pattern and polarization in order to mitigate interference, maximize data throughput and expand coverage.

i5's smart antenna system continuously seeks to improve reliability and throughput rate by monitoring the network environment and intelligently selecting the best channel to allow efficient delivery of services & data. "This is what makes our antennas 'smart,'" said Cetiner.

Recently, The USTAR SBIR/STTR Assistance Center (SSAC) helped i5 put together an SBIR Phase 1 grant. In June of 2016, i5 was awarded $225,000 from the NSF, which will help i5 continue research and development on their "smart antennas." Also, i5 is already working together with some heavy-weight cellular network infrastructure players where the goal is to test i5's MRA technology in real-life scenarios. The broader impact/commercial potential of this project is enormous. It has the potential to revolutionize antenna systems in terms of agility, performance, power consumption, cost, and size. "This technology will provide a better user experience and help develop infrastructure for future emergencies," said Cetiner.

USTAR INCUBATION ENTERPRISE

USTAR's Incubation Enterprise consists of the USTAR Innovation Center in Clearfield, the USTAR Life Science Incubator located at the Granite School District in South Salt Lake, the Utah Nanofab located in the James L. Sorenson USTAR Molecular Biotechnology building on the U's campus and the Synthetic Biomanufacturing facility located on the USU Innovation Campus.

The USTAR Innovation Center will accommodate innovators, entrepreneurs, university researchers and students, federal, state and industry partners in Northern Utah. The Center will focus on the needs of the aerospace and defense, outdoor products and the advanced materials communities. In addition, the Innovation Center supports the requirements and programs of the Hill AFB Sustainment Center through an open partnership. USTAR supported the Mission to Mars program sponsored by the College of Applied Science and Technology at Weber State and the Air Force STEM Outreach Program at Hill Air Force Base. Mission to Mars is a program to get fifth grade students excited and thinking about science, technology, engineering and math.

USTAR INNOVATION CENTER OVERVIEW

The Innovation Center (a high-tech incubator) – will provide technology companies maximum flexibility while working closely with them to identify areas of improvement and locating needed resources. The incubator program is for a term of two to five years for startup technology companies. Resources and services are provided on an as-needed basis with agreed-upon milestones to assist company growth and success in the incubator in order to graduate to space located within the northern region or surrounding areas within the State of Utah. The Innovation Center's new location is currently under construction at the Falcon Hill Research Park in Clearfield.

USTAR LIFE SCIENCE INCUBATOR OVERVIEW

USTAR's Life Science Incubator (The BioInnovations Gateway) program is an incubator and educational and workforce training program. USTAR, in partnership with the Granite School District, provides access to laboratories, specialized equipment, office and cubicle space, resources and support programs for entrepreneurs to develop next-generation life science technologies and train the next-generation of entrepreneurs and scientists. An important distinction, this program is also designed to work with high school students within the Granite School District to provide hands-on real-world experiences and introduce students to wet labs, rapid prototyping labs, and clean rooms.

USTAR LIFE SCIENCE INCUBATOR USAGE:

Historical data indicates number of users since opening.

Training
Historical: 52
FY 2016: 10

Resident Companies
Historical: 23
FY 2016: 14

Non-Resident Facility Users
Historical: 6
FY 2016: 2

USTAR INCUBATION ENTERPRISE

UTAH NANOFAB

The Utah Nanofab is located in the James L. Sorenson Building on the University of Utah Campus. The building was constructed under the USTAR initiative to provide research space for premier investigators to develop products and business startups to enhance Utah's economic base.

The Utah Nanofab is accessible to all Utah-based academics and companies at the same base pricing levels provided to U researchers through programs supported in partnership with USTAR. USTAR has extended the popular "preliminary data seed fund" program, giving swift access to the Utah Nanofab to assist all Utah researchers applying for federal grants, including academic grants, and companies applying for SBIR/STTR programs. Other USTAR supported programs in the Utah Nanofab include a program to support students who want to fulfill their own dreams and visions through the resources of the Utah Nanofab.

This multi-purpose facility provides the clean environment, expertise, and equipment necessary for micromachining, microfabrication, and nano-scale semi-conductor materials and device research. The research labs offer an extensive array of process equipment with advanced capabilities in pattern generation, photolithography and thin film deposition. Characterization capabilities include surface analysis and nano-imaging. The teaching labs strengthen undergraduate microfabrication curricula and train graduate students in the fundamentals of micromachining, microsystems design and characterization, microsensors and actuators, and microelectronic devices.

For additional information or to apply to use the facility please visit:
www.nanofab.utah.edu

UTAH NANOFAB USAGE:

Training

Students in lab-based credit courses: 105
Students taking short courses: 49
Individuals trained: 51
Students trained as lab techs/aides: 8

Off-Campus Facility Users

New *FY16 Off-Campus Users:* 30
Total FY16 Off-Campus Users: 63
27% increase from FY15

UTAH STATE UNIVERSITY SYNTHETIC BIOMANUFACTURING FACILITY

The USU Synthetic Biomanufacturing Facility located on USU's Innovation Campus is a world-class scale fermentation facility. The facility has been designed and staffed to conduct proof of concept, optimization, and pilot scale studies for the production of synthetic bioproducts through bacterial fermentation. A primary purpose of the facility is to generate substantial quantities of biomolecules for commercialization and scale-up performance data.

For larger scale fermentations, the facility houses two New Brunswick BioFlo Pro 500 liter fermentors, which have a variety of setup options and data collection resources

USTAR INCUBATION ENTERPRISE

that allow process optimization. A 125 liter New Brunswick BioFlo 610 fermentation system, which is also fully automated and sterilizable in place, is available to serve as a seed reactor. For cell and product recovery, several sizes of centrifuges are available including a CEPA Z101 continuous centrifuge. Purification equipment in the facility makes it possible to purify production quantities of proteins. The capabilities of this fermentation facility enable scale-up optimization of fermentation bioproducts that can be grown and analyzed under a variety of growth conditions for maximum product yield and quality with the ability to add additional equipment as demand increases. Demonstrating the ability to scale from 125 liter to 500 liter fermentation is a critical step in commercializing bioproducts.

We anticipate continued work with faculty members and private industry partners to conduct proof of concept and optimization studies. Upon successful completion of these initial studies we expect to further develop production protocols, and if feasible produce bioproducts under contract.

USTAR INCUBATION ENTERPRISE

Teresa McKnight
Director

Prior to coming to USTAR, Teresa was executive director of the Montana State University Innovation Campus, CEO of the South Dakota State University Growth Partnership, executive director of the South Dakota State University Innovation Campus and director of the Utah State University Innovation Campus.

During Teresa's 24-year tenure developing university-related research parks, she raised more than $39 million in federal grants, state grants and private funding, developed three research parks totaling more than 360 acres, and recruited more than 90 high-tech companies to Utah, South Dakota and Montana.

Teresa serves on the national board of The Association of University Research Parks (AURP). She has held various positions on city economic development councils, Chamber of Commerce boards, advisory boards, and science and technology councils. She is a graduate of Utah State University with a degree in business and administration and a minor in organizational communication.

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Scott Marland
Life Science Incubator Director

Scott Marland, PhD has over fifteen years of experience in innovative research, product development and design. Scott has significant experience in manufacturing, supplier management, leading cross-functional teams and project management. Scott has a PhD in mechanical engineering, an M.S. in engineering science and mechanics and B.S. in mechanical engineering, all from the University of Tennessee.

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REGIONAL OFFICES: EAST

USTAR's role in the community focuses on assisting to de-risk technologies that are too advanced for basic federal research funds yet not quite mature enough to attract outside investment. USTAR East, one of USTAR's regional outreach offices, is strategically located in a technology dense region of Utah, and supports the USTAR mission by directing its focus on energy and clean tech. The East office has expertise in energy and natural resources but is eager to support the larger technology commercialization needs of businesses, researchers, and entrepreneurs in the community.

FY16 in Review

Energy Research Triangle: A collaboration with the Governor's Office of Energy Development, promotes collaboration among Utah's institutions of higher education and develops the next generation of energy research leadership capable of addressing future energy issues of Utah.

- Professor topics: Uintah Basin Air Quality, Uintah Basin Waxy Crude Flow, CO2 to Methanol
- Student Topics: EV Batteries, Hydrogen Fuel Cells, Solar Power Design, Waste Heat to Electricity
- Student published 8 papers, 2 patents
- 2 journal covers
- Media coverage including: KSL, FOX13 News, BYUtv, KUTV
- Partner agencies: Governor's Office of Energy Development, Department of Workforce Services

7th Annual Waxy Crude Workshop: One-day event held at the Duchesne County Event Center. Hosted by USTAR to find solutions for the technical hurdles to production and transportation of Uintah Basin's high-quality crude oil. April 14th, 2016

- Topics: air quality, new cavitation technology, pipelines and rail infrastructure and export
- 13 presenters including Sen. Ralph Okerlund, Seth Lyman and Laura Nelson, PhD
- 200+ in-person attendees and 70+ virtual attendees
- Partner entities: Governor's Office of Energy Development, Governor's Office of Economic Development, Division of Oil Gas and Mining and Rural Planning Group

CleanTech Open Kickoff: Event to mark the opening of the CleanTech Open incubator program. March 17th, 2016

- 50+ in-person attendees
- Presenters including Dick Franklin and Korri Stainbrook
- Partner entities: Stoel-Rives, Sustainable Startups, Renewable Tech Ventures and CleanTech Open

Petroleum Engineering Field Study: Industry tour of Utah-based petroleum companies to identify technological needs.

- 15 attendees – University of Utah Petroleum Engineering Masters students and professors
- 13 industrial sites visited including: ConocoPhillips (Drunkard's Wash), Fidelity (Cane Creek), Rocky Mountain Power (Lakeside), and Questar (Clay Basin)

REGIONAL OFFICES: EAST

Andrew Sweeney, PhD
Director

Andrew is the director of the USTAR East regional office, which focuses on de-risking technologies in the energy and natural resource sectors. Andrew is also the director of the Utah Energy Research Triangle (ERT), which is a competitive grant program aimed at fostering coordination among Utah universities in order to advance energy innovation and development in Utah.

Before joining USTAR, Andrew received a B.S. in Chemistry from Virginia Tech, where he earned the Hypercube Scholar award for his research on chemical warfare agents. He later received a PhD in Physical Chemistry from the University of Utah where his research on copper and natural gas systems was recognized by the International Journal of Mass Spectrometry for producing the "Best Fundamental Student Paper of the Year."

Andrew brings to the office deep technical fluency and a collaborative spirit bolstered by research experience in Amsterdam and Prague. He has conversational command of French, a knack for wrecking his mountain bike, and a growing collection of paperback books. He was recently named to "20 in their 20s" by *Utah Business Magazine*.

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Tyson Todd
Assoctiate Director

Tyson is the associate director for the USTAR East regional office. Prior to coming to USTAR, he operated a service rig in Utah's oil and gas industry. Tyson was hired to support technology development in the oil and gas sector, but is also an advocate for alternative forms of energy. He plans and executes the Petroleum Engineering Field Study, the annual Waxy Crude Workshop, and assists with administering the Energy Research Triangle and other competitive grant programs.

He holds B.S. degrees in economics and political science from Utah State University, and is currently pursuing his M.S. degree in International Affairs and Global Enterprise at the University of Utah.

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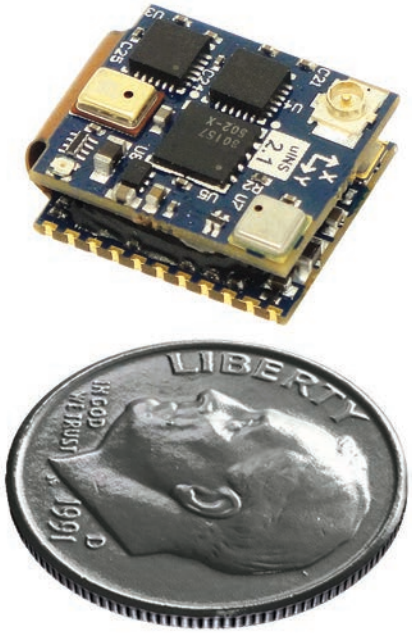
COMPANY PROFILE: INERTIAL SENSE

Seemingly overnight, drone use has changed from hobbyist flights and amateur photography to national security, professional mapping, search and rescue, warehousing, precision agriculture and Hollywood cinematography. This transition has developed a need for accurate, low-cost micro navigation modules, and Inertial Sense, a startup based in Salem, Utah, is helping meet that demand. Recently, the company was awarded USTAR TAP (Technology Acceleration Program) funding to make their navigation modules 40x more accurate than current industry standards.

Currently, Inertial Sense manufactures the smallest and lightest GPS aided micro inertial navigation system module on the market. These tiny devices, with a dime sized footprint, track a number of measurements, such as angular rate, linear acceleration, barometric altitude and global position, to calculate velocity, altitude and position in dynamic environments. In addition to drones, these modules are used in a number of different ways. For example, they can be used in fitness monitors to help athletes better analyze their performance by measuring their exact orientation, velocity, and position in time and car navigation systems can utilize micro sensor, and navigation modules when passing through a tunnel or between skyscrapers when GPS signals are dropped.



Founder Walt Johnson began developing these micro sensors when he saw a unique industry opportunity. Johnson noticed that all drone autopilot systems share common predefined and mandatory integrated sensors. These sensors could be more efficiently produced and calibrated as a separate component and later added to the drone circuit board. Johnson said, “Most companies that use inertial navigation and measurement technology spend valuable time and resources engineering their own IMU/INS, each recreating the same common widget. They do this because there is no low-cost, off-the-shelf solution available for them.” As a result, Johnson and his team created several different specialized micro sensor and navigation modules. The company produces Inertial Navigation Systems, Attitude Heading Reference Systems, and Inertial Measurement Units.

Inertial Sense used their TAP funding to develop a new Real Time Kinematic Differential GPS aided micro Inertial Navigation System (RTK/µINS-3) that will service the consumer and commercial drone industries. By coupling RTKGPS with an INS, Inertial Sense will create a navigation solution that is more than 40 times more accurate for GPS/INS solutions, improving GPS accuracy from ~2 meters to ~5 centimeters. Incredibly, their patent-pending design allows the RTK/µINS-3 to be no larger than a stack of 3 dimes.

REGIONAL OFFICES: OREM

USTAR Central Regional Outreach Office, is located in Orem, UT at the Vivint Business Resource Center (at UVU), which is an incubation and acceleration space, housing startup companies, a state of the art Vivint SMART lab for marketing and sales, and several small business assistance agencies in one place. USTAR Central works with entrepreneurs, innovators and the community to assist with the acceleration and commercialization of technologies in Utah.

FY16 in Review

In the last year, USTAR Central has worked in product prototyping with the Rapid Development Center at UVU and has also developed the Robotics and Internet of Things (RIoT) program. After two years of operation, the Rapid Development Center closed in June 2016, serving some 30 clients to prototype both hardware and software in FY16. This joint program between USTAR and UVU was dissolved to allow the newly equipped 3D printing lab at Utah Valley University to serve both students and the community in a broad spectrum of endeavors.

The new RIoT program focuses on connecting device companies, home automation, virtual/augmented reality technology, high-speed Internet advances, and other related innovations. During FY16 the program reached over 400 innovators and entrepreneurs via a monthly newsletter, educational workshops in Salt Lake and Utah County, and an industry specific event held in February at UVU. At the RIoT Event, speakers came from across the United States to inform Utah companies and entrepreneurs about the opportunities in the Internet of Things (IoT) and related fields. Sprint and PTC/Thingworx were some of the national brands involved in the event. Utah companies participating included Vivint SmartHome, Monnit, VPI Engineering, and Wovyn.

An IoT Challenge sponsored by Grow Utah Ventures at this first ever RIoT Event attracted professional engineers from the Wasatch front to compete for $1,000 in prize money. By bringing engineers, investors, and innovators together, USTAR Central has identified and commenced to support economic development in an extremely high-potential technology market.

FY16 Highlighted Activities

- Produced the first industry event centered on Robotics and the Internet of Things at UVU in February.
- Oversaw the creation of educational workshops on IoT in both Orem and SLC.

REGIONAL OFFICES: OREM

Donna Milakovic
Director

Before joining the USTAR team, Donna Milakovic was executive vice president at the Utah Valley Chamber of Commerce and worked more than five years in non-profit management and government advocacy. Her chamber role included assisting community and government leaders to further the goals of economic and community development for Utah County. Donna has a BA in English with a minor in Korean from Brigham Young University and is IOM certified through the US Chamber of Commerce Institute for Organization Management. Her professional career has run the gamut from government affairs and journalism to executive management.

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Peter Jay
Associate Director

Peter is a Utah Attorney with an MBA and several years experience in international business (corporate counsel, regulatory compliance, and financial management), real estate (commercial leasing, title insurance, and escrow), and litigation (antitrust, consumer protection, securities, family law, probate). As corporate counsel, Peter managed contract negotiations and drafting, domestic and international corporate compliance, intellectual property, and litigation, and created complex financial business models for commercial contracts.

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REGIONAL OFFICES: ST GEORGE

The USTAR South regional outreach office, headquartered in downtown St. George, drives and supports the diverse and growing Southern Utah innovation ecosystem to significantly contribute to Utah's economy.

Uniquely positioned to support and foster the new regional economic focus on technology, USTAR South assists and connects entrepreneurs across 11 counties with training, mentoring, research and industry expertise, funding, and other local, state and federal resources to help them accelerate technology development and grow their companies.

The USTAR South team also actively engages with local community and business leaders to create and implement sustainable economic development strategies and initiatives to drive science and technology-based economic growth.

FY16 in Review

In the past year, USTAR South underwent significant transition, including hiring a new director in August 2015. The new team spent considerable time engaging with and learning from the Southern Utah science and technology community. This listening tour identified gaps in regional services and support, strengthened the framework for developing innovative solutions, and helped create meaningful collaboration between industry, academic and community leaders. Several new strategic initiatives supporting technology sector economic development are now underway.

In February 2016, USTAR South relocated their office to historic Main Street in downtown St. George. The new location was pivotal in communicating USTAR's expanded mission to the community and strengthening USTAR's role as a key strategic partner in science and technology economic development. The new space provides a unique atmosphere for meetings and events that facilitate and catalyze the growth of the region's science and technology innovation culture.

FY16 Highlighted Activities

- The USTAR South team coached and supported two Technology Acceleration Program (TAP) awardees from Southern Utah, Helidyne and MetaShield, to meet their technology development milestones. These companies exemplify the innovative talent in Southern Utah.
- H2@USTAR, a bi-monthly gathering of previously siloed science and technology innovators and entrepreneurs who – by coming together, sharing resources and information, and building new relationships – are stimulating innovation and commercialization, and strengthening the Southern Utah technology ecosystem.
- The Runway at Tech Ridge is a planned 160 acre high-tech complex on the old airport plateau overlooking St George City. USTAR South influenced the convening of a committee that worked with City leadership to help define the needs this complex will serve, and continues to participate in planning for this development.

REGIONAL OFFICES: ST GOERGE

Shirlayne Quayle
Director

Shirlayne is experienced in connecting public-private interests to foster innovation. Prior to joining USTAR, she developed programs and international partnerships in clinical research, technology development, innovation, entrepreneurship and global leadership at the University of Utah. After moving to southern Utah in 2012, she founded Q3 International, LLC, and worked and taught at Dixie State University. Shirlayne holds a B.S. in Anthropology and an MBA from the University of Utah, is an expert reviewer and mentor for the U.S. State Department's Global Innovation in Science and Technology (GIST) program, and is inspired daily by her spunky family and the dramatic southern Utah landscape.

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Jared Goodspeed
Associate Director

Jared has been part of the USTAR team since 2013. His broad experience in entrepreneurship, industry and academics blend perfectly for his role as associate director of the USTAR South outreach team. A lifetime resident of southern Utah, Jared has scaled and successfully exited two local startups and earned his Bachelors of Science in finance from Dixie State University. He continues to participate as a technology project mentor for DSU's Experiential Learning and Leadership Institute. An outdoor enthusiast, you'll find him in the off hour taking full advantage of Utah's unrivaled backcountry.

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5391
5391
PENDLETON
173 MI.
SPOKANE
305 MI.
BOISE
393 MI.
UNION PACIFIC
PORTLAND
35 MI.
TACOMA
177 MI.
SEATTLE
210 MI.

COMPANY PROFILE: IDT SERVICES

According to the American Association of Railroads (AAR), over half a million railcars moved around the U.S. in the first week of February in 2016. With so much equipment in transit, how do companies like Union Pacific track their railcars or know when they need servicing? With help from USTAR, IDT Services, a small company from southern Utah, created the perfect solution. They developed an automatic equipment identification reader system (AEI reader) and an improved heat-sensing RFID hub tag system that tracks railcars and determines when equipment needs servicing. In fact, the company's solution was so successful that Union Pacific recently acquired the company's IP portfolio and has collaborated with founder Jason Pitts on another project.

When IDT Services was founded, the company was a team of two programmers located in Caliente, Nevada. After founding, the company partnered with Union Pacific Railroad to improve railcar tracking hardware and software. This collaboration resulted in the development of IDT's AEI reader system. After successfully creating the AEI reader, IDT set out to develop new heat-sensing RFID hub tags. It soon became evident that their second project would require additional resources. The company founders reached out to Southern Utah University (SUU) and opened an office in Cedar City. Soon after, IDT hired four computer science majors from SUU to help them develop and test their RFID hub tags.

In 2011, IDT applied for and won their first Technology Commercialization Grant (TCG) from USTAR, which helped the company begin the early stages of research and development. Later that year, IDT and SUU won a second round of funding from USTAR, bringing the award amount to $40,000. With the additional funding, IDT completed its RFID hub tag system, which records high wheel temperatures for maintenance and safety purposes. After completing the project, IDT's hub tags successfully outperformed all other heat detection systems on the market and have since been implemented on all Union Pacific's AEI reader systems.

Eventually, however, IDT became too successful for the size of the company. This technology became an important component for Union Pacific, leading to their purchase of IDT's IP portfolio. Union Pacific has now gone back to Pitts to collaborate on a new project to develop a system for tracking rail maintenance equipment. Pitts founded T3Ri in St George, Utah, to develop this new system. This new project presents a number of unique challenges, one of the biggest challenges involves the lack of ability to use permanent reading stations like it did with its AEI reader and RFID hub tag system. "Unlike railcars, rail maintenance equipment does not stay on tracks," said Pitts. "It is moved on trucks to different locations, making it more difficult to track."

To solve this problem, T3Ri is developing a Bluetooth tracking system. Working over the past year and a half, T3Ri has successfully tested Long-Range Bluetooth Low Energy (BLE) iBeacons. Previous beacons had limited range and were primarily designed for indoor deployment. The new long-range BLE iBeacons are read by mobile devices that record their location to a centralized database accessed by a simple web interface. They are currently piloting the solution with Union Pacific in Utah, Nevada and Idaho.

GRANT PROGRAMS OVERVIEW

USTAR's competitive grant programs support the creation of new and advanced science and technology companies by bolstering the economy and keeping the state vibrant and competitive. Our programs support private sector technology development, university-based research and development of technologies with significant commercial potential, partners industry with university researchers to address specific technology challenges, and assists university researchers in developing preliminary data. These new programs are the result of the SB166 statute changes. (See Figure 1, page 7).

TECHNOLOGY ACCELERATION PROGRAM (TAP) [New Program FY17; Pilot FY16]

The Technology Acceleration Program (TAP) is a USTAR competitive grant program that supports private sector technology development for Utah-based companies. While designed for startups and early stage companies, mature companies can apply to TAP for development of a new technology or product. Proposed work can include, but is not limited to, research and development, proof of concept, product validation, and product development.

UNIVERSITY TECHNOLOGY ACCELERATION GRANT (UTAG) [New Program FY17; USU Pilot FY16]

UTAG supports research and development of specific technologies that have significant commercial potential but need additional development before they can be spun out from the university setting. This funding addresses an innovation ecosystem gap between federal research dollars and angel investment, the "valley of death."

INDUSTRY PARTNERSHIP PROGRAM (IPP) [New Program FY17]

Promotes the development, acceleration and commercialization of technology and innovation by teaming industry and university research expertise to address specific technology problems or gaps identified by a company. The program is open to companies that have a substantial presence in Utah, have identified a specific technology challenge whose solution would result in economic impact for the state.

SCIENCE & TECHNOLOGY INITIATION GRANTS (STIG) [New Program FY17]

STIG is intended to assist university researchers develop preliminary data or proof of concept experimentation in order to compete for center grants and large multi-center or interdisciplinary federal grants, or private funding (i.e. foundation or nonprofit).

Energy Research Triangle (ERT) [Collaboration with OED]

ERT is a competitive grant program aimed at fostering energy innovation across Utah's universities. The program offers two categories of grants - one that encourages collaboration among research professors across the state, and another for university students designed to elevate the next generation of energy researchers.

FY16 REPORT KEY:


USTAR Funding


Milestones


Jobs Created during TAP participation

FY 16 TAP PILOT ROUND COMPANIES

APPLIED BIOSENSORS

Applied Biosensors produces multi-analyte, cost-effective, single-use biosensors and corresponding analytics software used to monitor levels of different biomarkers, which help control pharmaceutical production and to monitor chronic diseases.

$67,392 | 2 | 2

FARHANG WIRELESS

Farhang Wireless is developing next generation MIMO (multiple-input and multiple-output) wireless technology, a system that uses multiple antennas to improve data speed and accuracy for WiFi and LTE cellular markets.

$36,145 | 4 | .5

G3 ENGINEERING

G3 Engineering supports the advanced composite industry with composite part design (3D Modeling), product analysis, tool design, tool fabrication, process development, part fabrication and processing equipment design and fabrication.

$50,000 | 3 | 0

HELIDYNE

Helidyne's primary focus is the development and manufacturing of a planetary rotor expander – a machine used to expand pressurized gas. Helidyne is also developing a modified expander for waste heat recovery applications.

$25,000 | 5 | 0

INERTIALSENSE

InertialSense designs and produces micro navigation systems. Their products assist unmanned vehicles maintain stability in dynamic environments, travel to specific waypoints, track motion, and create a better user experience.

$59,000 | 3 | 0

KNUDRA TRANSGENIC

Knudra Transgenic uses RecombiRED technology (patent pending) to increase the speed of genetically engineered model production allowing for competitive pricing in a high-margin service market.

$150,000 | 3 | 3

FY 16 TAP PILOT ROUND COMPANIES

KP BIOSCIENCES

KP Biosciences is a broad-spectrum, antiviral research company developing treatments for some of the world's most problematic infectious diseases, including pox viruses and herpes viruses.

 $24,185  3  0

METASHIELD

Metashield is quickly becoming a leading innovator in Metamaterials. Their primary product is an ultra-thin, flexible, glass-based coating that has the ability to absorb and diffuse impacts using a complex matrix of nanoparticles.

 $78,790  4  2

POLLEN SENSE

Pollen Sense produces a device that automates the collecting, imaging, identifying and quantifying of airborne pollen and airborne particles. This device can image pollen and other particles down to less than 5µm in real-time.

 $35,304  8  0

T3S TECHNOLOGIES

T3S provides the most advanced bacterial expression system on the market, capable of providing fully secreted and active proteins. These advanced therapies unlock the ability to treat and possibly eradicate devastating diseases.

 $38,588  2  3

TURNER INNOVATIONS

Turner Innovations is a dynamic tech and product development company that uses theoretical research to engineer products with real-world application. The company aims to bridge the gap between basic university research and the marketplace.

 $50,000  3  0

VERITAS MEDICAL

Veritas Medical's first to market product, The Light Line™ Catheter, is an innovative medical device that uses a proprietary visible light phototherapy system designed to sterilize catheters.

 $25,000  2  2

FY 16 TAP PILOT ROUND

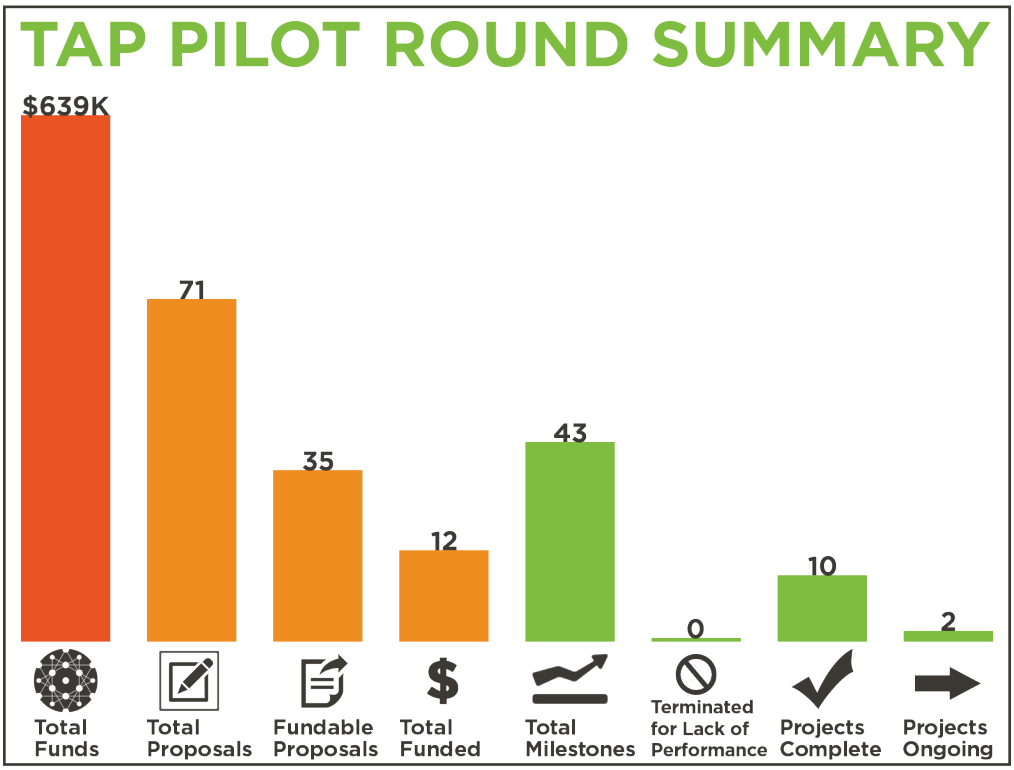

Figure 5. Summary data for TAP pilot. Ongoing projects will be completed by Oct 4, 2016.

Elenor Gomberg
Program Manager

Elenor is USTAR's special programs manager, and oversees the various programs such as TAP as well as overseeing the guidelines for the organization and its programs. Elenor earned her degree in strategic communication from the University of Utah, and has more than eight years of experience in journalism and communications. Before coming to USTAR, Elenor worked at the Enterprise Business Newspaper for six years as production manager and copy editor.

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COMPANY PROFILE: KNUDRA

Knudra Transgenics is a genome-engineering company founded in 2009. The team at Knudra has transformed a passion for genome engineering into a first-in-kind contract research service. Since the first client project was completed in early 2010, the Knudra team has been supplying researchers and private companies with custom-designed transgenic organisms. They use the latest advances in genome engineering to build important platforms for medical discovery.

Chris Hopkins, PhD, founded Knudra after working with in the Erik Jorgensen lab at the University of Utah, as a post doctorate. While working with Jorgensen, Hopkins helped innovate the MosSCI transgenesis technique in the C. elegans model organism. The CEO, Trisha Brock PhD, is a Harvard trained biologist who joined Hopkins shortly after company formation. Together, the team has expanded services into zebrafish and is now looking into other models for future service expansion.

The market for Genetically Engineered Models (GEMs) is booming and valued at $4 B. Knudra uses RecombiRED technology (patent pending) to increase the speed of GEM production allowing for competitive pricing in a high-margin service market. Customers can get human and animal disease models directly installed in their model organisms of choice for specialized medical research. Customers can send Knudra a pre-made injection mix and Knudra will return injected animal for customer screening or perform screening in house then send verified-transgenic results. Customers can also provide Knudra with a genome engineering idea and Knudra can make custom DNA.

As a new startup company, Knudra became a tenant at USTAR's BioInnovations Gateway (BiG), which provided Knudra with essential mentoring services and affordable office space. Knudra applied for and won TAP funding from USTAR, which is being used to take their proprietary technical advancements to market.

In September 2016, Knudra was awarded a National Institutes of Health (NIH) Fast-track SBIR grant. Fast-track incorporates a submission and review process in which both Phase I and Phase II grant applications are submitted and reviewed together as one application. Because both phases undergo review at the same time, the result is a reduced or eliminated funding gap between phases. The second phase is awarded following a review of metrics achieved, often in a much shorter period of time than a traditional second phase application. The company also worked with the USTAR SBIR-STTR Assistance Center while applying for this grant.

Knudra's award is expected to bring a total of $1.6 million to the company over the two phases of the grant. "This is amazing from a USTAR perspective because our TAP funding was absolutely critical in achieving the preliminary data that convinced NIH reviewers of the technical merit of the RecombiRED product development," said Hopkins. "Without TAP, we would not have received the Fast-track grant, which ultimately represents a 10.5x ROI on Knudra's TAP award."

The Team at Knudra has over 30 years of combined experience in making transgenic organisms. The company recently sent their 1000th transgenic and has over 200 clients. They were also recently published in Genetics, an important biomedical journal.


IP 3-1
3-3
IP 3-4
3-5
Cryo-
Gloves

USTAR PRINCIPAL RESEARCHERS

USTAR researchers generate ideas and new technology that over extended periods of time will result in business growth, higher paying jobs, an expanded tax base and a healthy economic future for the state of Utah. The quality of faculty increases educational opportunities and attracts other high-caliber faculty and competent graduate students to the state. The researchers recruited and funded by USTAR align to important industry clusters in the state in the areas of Energy, Life Sciences, Micro/Nano Systems and Big Data.

ENERGY pg 50

The energy sector in Utah is diverse and robust. USTAR professors at USU and the U are researching new technologies that will equip the state and the nation to better use our natural resources while developing the advanced energy system of the future. The diversity of ideas and disciplines include optimizing biological processes for energy recovery, converting biological materials to gasoline, geothermal energy recover, and wirelessly charged electric vehicles.

LIFE SCIENCES pg 53

The life sciences cluster in Utah is notable for the breadth of work and historic successes. The U has an outstanding Health Sciences system combining state of the art care with an extensive research network that has produced economic drivers ARUP, Myriad Genetics and BioFire, to name a few. USU, a land grant institution, is a leader in agriculture and veterinary sciences. The life science industry is capital intensive, highly regulated and requires a long development timeline.

MICRO/NANO SYSTEMS pg 66

Whether it's a miniature gas chromatograph for personal air pollution monitoring, the development of an artificial retina to restore partial vision to the blind, an implantable middle-ear microphone that could restore hearing to deaf patients without the external hardware necessary for today's cochlear implants, or the invention of a brain stethoscope that uses magnetomer arrays to detect neurons firing in the brain - the micro and nano communities in Utah are diverse and inventive.

BIG DATA pg 71

The burgeoning field of big data crosses many academic and industry domains. The USTAR program has numerous scientists that are addressing this emerging field focused on computational tools that allow physicians, researchers in diverse areas from petroleum engineering to neural networks, and policy makers to glean meaning from tetrabytes of data. In addition to finding the signal in the noise, researchers are developing tools to visualize results. As Big Data applications grow, new methods for examining the data must be developed.

FY16 REPORT KEY:


USTAR Funding


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Collaborations


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Patents Filed/Issued


Publications


Research Jobs

USTAR PRINCIPAL RESEARCHERS

Foster Agblevor, PhD
Utah State University
Energy

Foster Agblevor is currently a USTAR professor of biological engineering at Utah State University and director of the USTAR Bioenergy Center. Prior to joining USU in 2011, Agblevor was a professor of biological systems engineering at Virginia Tech. He worked as a chemical engineer at the National Renewable Energy Laboratory in Golden, Colo., and received his PhD in chemical engineering and applied chemistry from the University of Toronto. In his research, Agblevor has found ways to make innovative use of biological materials. He has developed pyrolysis chemical processes to make bio-crude oil from plant materials. Agblevor has also developed a pyrolysis processes to remove phosphorous from chicken litter. Agblevor's self-sustaining process transforms chicken litter into three products: a gas to fuel the pyrolysis reactor, bio-crude oil that can be refined into fuel or made into plastic, and fertilizer pellets. Agblevor recently received a Fulbright grant to research ways to convert grass into bio-crude oil for manufacturing plastics.

$304,627	$174,997	0	0	4	0/0	40	17

John McLennan, PhD
University of Utah
Energy

John McLennan is a USTAR associate professor of chemical engineering and senior research scientist at the Energy & Geoscience Institute at the University of Utah. McLennan attended the University of Toronto for his B.A.Sc. in geological engineering (1974), M.A.Sc. in Civil Engineering, Soil Mechanics (1976) and PhD in Civil Engineering, Rock Mechanics (1980). He has served in various capacities with the Society of Petroleum Engineers and was awarded the Rocky Mountain North America Regional Service Award in 2012. He is the current president of the American Rock Mechanics Association (ARMA). McLennan's recent work focuses on optimized production from shale and unconsolidated formations, fluid-rock interactions, geothermal energy recovery, in-situ microbial generation of natural gas and sustainable use of earth energy resources. His research interests also include geothermal energy extraction and carbon management.

$140,178	$155,313	18	0	2	0/0	5	15

USTAR PRINCIPAL RESEARCHERS

Brian McPherson, PhD
University of Utah
Energy

Brian McPherson joined the University of Utah as a USTAR professor of civil and environmental engineering from the New Mexico Institute of Mining and Technology. There, he formed the Southwest Partnership on Carbon Sequestration in 2003, one of seven regional partnerships funded by the U.S. Department of Energy to evaluate the science and technology of storage of atmospheric carbon in underground geological formations and surface soil and vegetation. McPherson's research focuses on groundwater hydrology, petroleum and energy resources engineering, numerical modeling of groundwater flow and coupled practices and rock mechanics measurements and modeling. The Department of Energy's National Energy Technology Laboratory (NETL) has provided ongoing funding to begin a deployment phase, which includes injecting 1,000,000 tons of CO2 into a geological formation and evaluating the approach for reduction of greenhouse gases in the atmosphere.

$191,921	$578,149	15	0	0	0/0	5	6

Shelley Minteer, PhD
University of Utah
Energy

Shelley Minteer, leads the USTAR Alternative Energy Cluster at the University of Utah and studies bio-inspired energy conversion as an alternative energy source. She is studying how chemical reactions in nature, like metabolizing table sugar, can fuel the future. Minteer pursued her bachelor's degree in chemistry at Western Illinois University and completed her PhD in chemistry at the University of Iowa. Minteer and her research group have created bio-batteries that work up to twice as long as lithium batteries found inside cell phones and computers. The ultimate goal is to have bio-batteries be 10 or 20 times as energy dense as current metal batteries. Minteer has also received a five-year grant from the Army Research Office to continue her alternative energy work in hopes of finding more efficient and lighter batteries for soldiers. In June 2015, she was awarded the Luigi Galvani Prize from the Bioelectrochemical Society.

$204,290	$1,582,880	7	0	2	0/0	27	17

USTAR PRINCIPAL RESEARCHERS

Manoranjan Misra, PhD
University of Utah
Energy

Manoranjan Misra is Chair of metallurgical engineering and USTAR professor of chemical and metallurgical engineering at the University of Utah. He is also director of the Roger and Dawn Crus Center for Renewable Energy, established in 2014. He received his B.Sc. and M.Sc in Chemistry from Utkal University in India, and then he received a M.S. in metallurgical engineering from South Dakota School of Mines and completed his PhD at the U. He has published two books and more than 250 technical papers and holds 12 patents. Misra has worked for 35 years in the field of energy and nano-materials development, Sensor/Sensing materials for radiation and environmental contaminants. Recently he is working on materials recycling and point of care diagnostics for TB and cancer using a nanotechnology based breath analyzer detection.

$640,053 $985,988 10 0 0 4/0 12 13

Caroline Saouma, PhD
University of Utah
Energy

Caroline Saouma is a USTAR assistant professor in the Department of Chemistry at the University of Utah whose research is focused on synthetic inorganic chemistry for catalysis, energy, and health. Applications of her work may lead to clean energy fuel cell and CO2 reduction technologies. Currently, Saouma's team is developing catalysts for electrocatalytic CO2 fixation and CO2 reduction to methanol; the ultimate goal is to recycle carbon dioxide back into fuels. After receiving her B.S. in chemistry at MIT in 2005, she moved to Pasadena to pursue a PhD at Caltech, where she was an NSF graduate fellow, and her dissertation focused on iron mediated reduction of CO2 and N2. She then went to the University of Washington as an NIH postdoc fellow (2011-2013) and worked on proton-coupled electron transfer reactions of metal clusters. She was awarded the ACS DIC Young Investigator Award in 2012, and began her career at the U in January 2014.

$182,203 $1,120 0 0 0 0/0 0 4

USTAR PRINCIPAL RESEARCHERS

Regan Zane, PhD
Utah State University
Energy

Regan Zane is a USTAR professor in the department of electrical and computer engineering at Utah State University (USU) and is director of USU's Power Electronics Lab. He studies how electric vehicles can recharge while in motion on the open road. Zane is expanding technology that will improve power conversion efficiency, power density and in-motion capacity of the wireless charging stations. There are many commercialization opportunities, but for now Zane hopes to demonstrate the safety and reliability of electric vehicles through tests. Their studies will influence the market to reduce costs so electric vehicles can be cheaper and better quality than common internal combustion vehicles.

He received his PhD in Electrical Engineering from the University of Colorado-Boulder in 1999. His research programs in power electronics span a wide range of applications and power levels for high efficiency, application of advanced digital control techniques, distributed, modular power converter systems and custom power management IC design.

$887,256	$91,927	0	0	0	0/0	16	50

Danny Chou, PhD
University of Utah
Life Science

Danny Chou is a USTAR assistant professor of biochemistry at the University of Utah. He was born and raised in Taiwan and completed his B.S. in chemistry at the National Taiwan University. He then continued to complete his PhD at Harvard. Chou is currently working on a new biotechnology called 'smart insulin' for patients who suffer from diabetes. Chou's 'smart insulin' actively regulates blood sugar throughout the day by only activating when glucose levels are too high. This means that diabetes patients would only need to inject insulin once each day, making the disease more manageable. Chou is also making components that could be used in an artificial pancreas to help treat diabetes patients. While similar research is taking place around the globe, Chou's research is unique because of its chemical approach as opposed to the typical biological one.

$150,920	$321,158	12	1	1	1/0	1	4

USTAR PRINCIPAL RESEARCHERS

Alan "Chuck" Dorval is a USTAR assistant professor of bioengineering at the University of Utah, studying how to fight and cure neurological diseases. Dorval studied electrical engineering at Rensselaer Polytechnic Institute in New York and continued his studies in biomedical engineering at Boston University, where he received his PhD. Dorval's research concentrates on a new, effective therapy for neurological disorders known as deep brain stimulation. With this new therapy, an electrode is placed deep into the brain during surgery and electrical signals are sent to stimulate target sections through quick shocks. This acts like a pace maker for the brain. In Dorval's lab, his team is shrinking deep brain stimulators down to the microscopic level. Age-based neurological disorders, including Alzheimer's, become more common as the population lives longer. Dorval hopes to alleviate symptoms and develop new treatments for these patients.

Alan Dorval, PhD
University of Utah
Life Science

$111,033	$209,490	12	0	0	0/0	7	5

Raphael Franzini is an Assistant Professor in the Department of Medicinal Chemistry at the University of Utah. He received his M.Sc. degree in Chemistry from EPF Lausanne in Switzerland and his PhD in Organic Chemistry from Stanford University under the guidance of Prof. Eric Kool. After continuing as a postdoctoral researcher at Stanford University, he joined the group of Prof. Dario Neri at ETH Zurich as a postdoctoral fellow. Franzini's research focuses on the interfaces of Chemistry, Biology and Medicine with the aim of developing novel types of therapeutic agents, imaging probes and diagnostic assays. He is especially interested in the advancement of DNA-encoded chemical libraries for drug discovery and the optimization of targeted therapeutics as anti-cancer agents. Franzini recently joined the U in October, 2015.

Raphael Franzini, PhD
University of Utah
Life Science

$201,890	$37,175	0	0	1	0/0	2	1

USTAR PRINCIPAL RESEARCHERS

Hamid Ghandehari, PhD
University of Utah
Life Science

Hamid Ghandehari is an expert in drug delivery and a professor of pharmaceutics and pharmaceutical chemistry, and bioengineering at the University of Utah. He directs the Utah Center for Nanomedicine and is a co-founder and co-director of the Nano Institute of Utah. Research in the Ghandehari lab involves the design and development of polymeric carriers for cancer therapy and investigation of nanoparticle toxicology. He is Editor in Chief of Advanced Drug Delivery Reviews, Fellow of the American Institute for Medical and Biological Engineering, the American Association of Pharmaceutical Scientists and the Controlled Release Society. Ghandehari serves on the scientific advisory boards of several national and international drug delivery organizations and is the chief scientific officer for TheraTarget, a University of Utah USTAR spinout company that specializes in oncology polymeric drug delivery. Ghandehari received his B.S. in pharmacy and PhD in pharmaceutics and pharmaceutical chemistry from the University of Utah.

$194,881	$427,680	29	0	1	3/0	12	14

Julie Korenberg, MD, PhD
University of Utah
Life Science

Julie Korenberg is a USTAR professor of pediatrics and director of the Center for Integrated Neuroscience and Human Behavior at the University of Utah. She came to the University of Utah in 2008 and has since founded the Down Syndrome Therapeutic Consortium and the Williams Syndrome Program. Her current research focuses on Williams syndrome, a genetic mutation that causes serious physical and behavioral deficiencies. With magnetic resonance imaging (MRI), Korenberg is decoding the genes to better understand the biological pathways of hyper-social behavior. Korenberg is a founder of the Department of Human Genetics, UCLA and established the Neurofibromatosis Clinic and Programs for Down syndrome and Williams syndrome at Cedars-Sinai Health System. She received her B.Sc. from McGill University in Montreal, Quebec and her M.S. in medical genetics from the University of Wisconsin, Madison. She then attended the University of Miami School of Medicine and obtained a joint PhD-M.D. degree.

$532,530	$1,034,221	40	0	0	0/1	7	23

PROJECT PROFILE: ZIKA

As the Zika virus (ZIKV) continues to spread, with one death already reported in Utah, USTAR professor Young-Min Lee is racing to develop a Zika vaccine that could protect billions of people. Lee is an associate professor in the Department of Animal, Dairy, and Veterinary Sciences and directs a molecular virology laboratory at Utah State University. His laboratory is at the forefront of viral research for Zika and Japanese encephalitis virus (JEV), both of which are clinically important emerging pathogens of global significance. Lee and his associates have recently made a major breakthrough in the fight against Zika. Lee's work has been supported by grants from USTAR.

Zika was first isolated in Africa in the late 1940s by a group of scientists studying the yellow fever virus (YFV). Instead, the scientists accidentally discovered Zika, named after the Zika Forest in Uganda, from a sentinel monkey they were monitoring for YFV. Later, it was also isolated in a human patient in Nigeria in 1954. Since then, the virus spread from equatorial Africa and Asia to the Pacific Islands and recently arrived in Latin America. Since April of 2015, there has been a large ongoing outbreak of Zika in the Caribbean and South and Central America. In February 2016, the World Health Organization declared a Public Health Emergency of International Concern.

Zika is a positive-strand RNA virus of the Flaviviridae family, closely related to JEV, YFV, West Nile virus, and dengue virus. The virus is spread among humans primarily through the bite of infected mosquitos, but it can also be transmitted from an infected mother to her child during pregnancy, by sexual contact or blood transfusion. Although symptoms of Zika infection are generally mild, it has been associated with a growing number of severe neurological disorders, including Guillain-Barré syndrome in adults and microcephaly in newborn babies.

Despite the recent emergence and rapid spread of Zika and its explosive pandemic potential, no vaccine or antiviral drug is available for Zika. Lee said that a key barrier to investigating Zika biology and to developing Zika vaccines is the lack of an infectious cDNA technology, a platform to rescue infectious Zika directly from a cloned cDNA. Without this powerful functional genomics tool, scientists have had trouble studying the molecular biology of Zika. Over the past half century, a limited number of Zika genomes were fully sequenced, and little is known about the genetic composition of the geographically and temporally distinct Zika strains isolated from Africa, Asia, and America. Without a map of fully sequenced Zika genomes, it is difficult to develop such an infectious cDNA technology for Zika.

Lee and his associates have made a major breakthrough by determining the complete genome sequences of the three historically important spatiotemporally distinct Zika virus strains. These include the first Zika virus isolated in Uganda in 1947, the first non-African strain isolated in Malaysia in 1966, and the current American epidemic strain isolated in Puerto Rico in 2015. Now that Lee has fully sequenced the three genetically unique strains of Zika, their previous work with JEV provides a solid foundation for the development of an infectious cDNA technology for Zika and offers a unique opportunity for the rational design of a live-attenuated chimeric virus vaccine against Zika, using his patented JEV vaccine platform. "Although there is still work to be done, we are well on our way to developing the first live vaccine for Zika," said Lee.

USTAR PRINCIPAL RESEARCHERS

Young-Min Lee, an associate professor in the Department of Animal, Dairy, and Veterinary sciences, directs a molecular virology laboratory at Utah State University. His research group is at the forefront of viral research for Zika virus and Japanese encephalitis virus, both of which are clinically important emerging pathogens of global significance. Lee's group has developed an "infectious cDNA technology" for manipulating those viruses. Using this functional genomics tool, Lee's research aims to understand the viral life cycle, an important step toward developing antiviral therapeutics and vaccines. He received his first B.S. degree in biology from Chung-Ang University (Korea) in 1991, and his second B.S. degree in biological sciences from the University of Minnesota in 1993. He completed his PhD in 1998 at Johns Hopkins University and then conducted post-doctoral research at Washington University.

Young-Min Lee, PhD
Utah State University
Life Science

$309,986	$0	0	0	0	0/0	8	7

Randy Lewis is a USTAR professor of biology at Utah State University, who is creating a new material from proteins in spider silk. Lewis received his B.S. in chemistry from the California Institute of Technology and received his master's degree and PhD in chemistry/biochemistry from University of California, San Diego. After, he completed a post-doctoral fellowship at Roche Institute of Molecular Biology in New Jersey. While there, he studied and discovered a new role for proteins secreted with adrenaline in severe stress-induced situations. In 1990, Lewis cloned the first spider silk gene, a feat he considers to be the highlight of his career. Lewis's current research collaborates with experts at different universities in the physical analysis of proteins and adhesive properties of spider silk and fabric assembly using electronic knitting machines.

Randy Lewis, PhD
Utah State University
Life Science

$1,249,363	$1,111,606	0	1	2	0/0	14	42

USTAR PRINCIPAL RESEARCHERS

Gabor Marth, PhD
University of Utah
Life Science

Gabor Marth is a researcher at the USTAR Center for Genetic Discovery, developing new insights into cancer, infectious diseases, genetic diseases and other medical mysteries through the development of his DNA sequence analysis software called IOBIO. IOBIO is a real-time, interactive web interface for analyzing genetic information. The IOBIO system uses only relevant "slices" of genetic data – for example, a single gene or a statistical sample – to look for meaningful information that can be rendered as a variety of colorful, easy-to-read charts and graphs. The data set can be analyzed in real-time from multiple perspectives, generating insights that would previously have required weeks or months of combing through tables. The IOBIO system has a variety of applications, but three of the most important are diagnosing infectious disease, identifying genetic disease and pinpointing effective cancer treatment.

$232,160	$1,269,037	17	1	1	0/0	5	8

Irina Polejaeva, PhD
Utah State University
Life Science

Irina Polejaeva is a USTAR professor in the Animal, Dairy and Veterinary Sciences Department at Utah State University. She is a member of the Veterinary Diagnostics and Infectious Diseases USTAR team. Originally from Russia, Polejaeva completed her master's program in animal science at the Kubanski Agricultural University after high school. She then pursued a PhD in developmental/stem cell biology at the National Institute of Animal Science in Moscow. In 1993, Polejaeva came to Utah State University as a postdoctoral fellow. After, she worked for nearly 15 years in the private sector and helped to develop a method called somatic cell nuclear transfer (SCNT). This work led to the world's first cloned pigs. She is currently working on improving cloning efficiency through understanding molecular mechanisms behind cloning. She is also collaborating with Dr. Young-Min Lee on a study focusing on understanding Zika virus replication and pathogenesis and vaccine development.

$287,912	$40,256	0	0	0	0/0	4	6

USTAR PRINCIPAL RESEARCHERS

Aaron Quinlan joined the USTAR Center for Genetic Discovery as associate director in 2015 and is currently associate professor of human genetics and biomedical informatics at the University of Utah. He received his B.S. in computer science from the College of William and Mary in 1997 and his PhD in biology from Boston College in 2008. He served as session Chair for the American Society of Human Genetics Meeting in 2014 and was a finalist for the Gordon and Betty Moore Data Driven Discovery Competition in 2014. He is an expert in computational genomics and data integration tools. Quinlan has developed several popular software packages for large-scale genome analyses and human disease studies. By combining genetics and genomics techniques with computer science and machine learning, his research group is developing new ways to understand genome biology and the genetic basis of traits.

Aaron Quinlan, PhD
University of Utah
Life Science

$200,108	$642,589	12	0	1	0/0	6	5

Perry Renshaw's work at the University of Utah's Brain Institute has led to clinical trials for treatments for methamphetamine addiction, depression and bipolar disorder, including natural substances as possible treatments. Current clinical trials are focused on the use of citicoline as a treatment for methamphetamine dependence, creatine as a treatment for depression, and uridine as a treatment for bipolar disorder. Renshaw's recent work focuses on brain chemistry changes that may increase depression and suicide for people living at high altitudes. Another of Renshaw's recent studies showed that methamphetamines damage adolescent brains more than adult brains. Renshaw has 12 patents and has 17 patents pending. He received his M.D. and PhD (biophysics) degrees from the University of Pennsylvania School of Medicine before completing his residency in psychiatry at the Massachusetts General Hospital in 1992.

Perry Renshaw, MD, PhD
University of Utah
Life Science

$325,000	$1,888,779	13	0	2	1/1	14	15

USTAR PRINCIPAL RESEARCHERS

Paul Sigala, PhD
University of Utah
Life Science

Paul Sigala is a USTAR professor at the University of Utah studying the general metabolic principles and adaptations governing the unique biology of the malaria parasite, Plasmodium falciparum. He uses genetic, chemical, and biophysical tools to develop novel therapeutic strategies to target this virulent pathogen. Sigala received his BS in Chemistry from UC San Diego, his PhD in Biochemistry from Stanford University and completed his postdoctoral fellowship in the Dept. of Molecular Microbiology at Washington University in St. Louis. He joined the Dept. of Biochemistry at the University of Utah School of Medicine in January 2016.

$211,312	$91,606	0	0	0	0/0	0	2

Matt Wachowiak, PhD
University of Utah
Life Science

Matt Wachowiak is an associate professor of neurobiology and anatomy at the University of Utah. Wachowiak's research focuses on sensory encoding and brain processing of olfactory information. Researchers in Wachoviak's lab use optical imaging to visualize neural activity in real time in the intact brain. A goal of this work is to understand how active behaviors such as sniffing and touching shape sensory processing in the brain. Potential commercial applications of his work include the development of "artificial nose" sensors to detect explosives, drugs or other substances. Wachowiak received his B.S. from Duke University and his PhD from the University of Florida in neuroscience. He was a postdoctoral fellow at Yale University School of Medicine in the department of molecular and cellular physiology. He was a faculty member at Boston University for eight years before joining the USTAR faculty at University of Utah in 2010.

$199,003	$960,630	8	0	0	0/0	4	11

PROJECT PROFILE: GENETICS

Using algorithms and computers to diagnose rare genetic disorders sounds like science fiction, but Aaron Quinlan and his team are making remarkable breakthroughs in diagnosing rare diseases using several software programs his laboratory has devised for large-scale genome analyses. Quinlan is currently an Associate Professor of Human Genetics and Biomedical Informatics at the University of Utah and joined the USTAR Center for Genetic Discovery as Associate Director in 2015.

Describing his research, Quinlan said that his laboratory marries genetics with genomics technologies, computer science and machine learning techniques to develop new strategies for gaining insight into genome biology and the genetic basis of human disease. His team has the ability to examine entire genome sequences with sophisticated detail using computer programs such as: BEDTOOLS, GEMINI, LUMPY, VCFANNO, PEDAGREE, and GQT.

Historically, diagnosing rare genetic disorders was extremely difficult. This is because the genomes of any two humans harbor roughly 3 million genetic differences, ranging from the very small to large differences in chromosome structure. This makes it difficult to isolate problematic differences. However, Quinlan's GEMINI software, which is central to his efforts, is helping identify which variances are linked to certain problems.

Recently, Quinlan applied his technology in a study with a group of infants who all had rare seizure disorders. Using his software, Quinlan uncovered the genetic causes behind nearly a dozen previously unsolved cases. He and his colleagues used several different computational methods to sequence the genomes of both the parents and the infants to find genetic mutations. Quinlan then used GEMINI to cross-reference all known pathogenic variants to isolate what was causing this disease phenotype. As a result, Quinlan and his team were able to help several families find answers that could have previously taken years to discover, and in the process have discovered new genes that, when mutated, cause this disease. The methods he and his laboratory have developed are the foundation for Base2 Genomics, a new startup that Quinlan has launched to develop and apply state of the art techniques for disease diagnostics based upon whole genome sequencing.

Quinlan is also using his technologies to help fight cancer. He is developing new methods to identify genomic changes that are responsible for clonal evolution, chemoresistance, and relapse. They do this through large-scale DNA sequencing, which has produced detailed maps of clonal variation in human cancer. This is helping doctors better understand the nature of cancer and how they can develop and apply new therapies that are personalized to the patient's tumor over the course of treatment.

Quinlan's work has been a boost to the Utah Genome Project. He said that he thinks that, "genome sequencing will be the standard course of care in the near future." Quinlan moved his lab from the University of Virginia to the University of Utah to collaborate with other members of the USTAR Center for Genetic Discovery, to study familial disease in hopes to build a database that will allow families to quickly and accurately diagnose rare disorders.

USTAR PRINCIPAL RESEARCHERS

Zhongde Wang, PhD
Utah State University
Life Science

Zhongde Wang is an associate professor in the Department of Animal, Dairy and Veterinary Sciences at Utah State University. Dr. Wang is also President, CSO and co-founder of Auratus Bio, a biotech company that specializes in animal genetic engineering. Dr. Wang's research team employs modern genome engineering tools and assisted reproduction technologies to create genetically engineered animal models with human diseases. His laboratory is also actively pursuing a better understanding of the epigenetics of stem cells. Current projects in Wang's laboratory include genetic engineering in golden Syrian hamsters to create animal models of the following three types of human diseases: 1) metabolic syndromes 2) cancers and 3) viral infections. His lab is also actively engaged in research activities with genetically engineered goats, sheep and dairy cattle. Dr. Wang received his PhD degree in molecular and cellular biology from University of Massachusetts at Amherst in 2000 and did his postdoctoral training at MIT.

$318,698	$77,785	0	0	2	0/0	8	4

Ayako Yamaguchi, PhD
University of Utah
Life Science

Ayako Yamaguchi is an associate professor in Biology at the University of Utah. She received her bachelor's degree in biology from Japan Women's University, and her PhD in animal behavior from the University of California at Davis. She also holds an MBA from the David Eccles School of Business at the University of Utah. Her lab focuses on the study neural basis of behavior using vocalization of African clawed frogs as a model with the ultimate goal to understand how neuronal circuits generate male and female specific behavior. Yamaguchi's team uses a variety of experimental techniques including electrophysiology, immunohistochemistry, pharmacology, behavior, and more recently, optogenetics to understand how neural circuits generate rhythmic motor programs underlying vocal behavior.

$36,352	$40,410	1	0	0	0/0	0	2

USTAR PRINCIPAL RESEARCHERS

Mark Yandell, PhD
University of Utah
Life Science

Mark Yandell is the co-director for the USTAR Center for Genetic discovery at the U and professor of human genetics and the technical director of the Utah Genome Project. He is an internationally recognized leader in software development for comparative genomics. Yandell received his PhD in molecular, cellular and developmental biology from the University of Colorado, Boulder. He spent three years at the Genome Sequencing Center at Washington University School of Medicine, St. Louis, and then three years at Celera. In 2004, Mark joined the Eccles Institute of Human Genetics at the U. Yandell's team works at the intersection of genetics and computer science, developing new computational models for analyzing genetic data and integrating patient genome information into health care. Four of the most significant software projects developed in Yandell's lab include MAKER, VAAST, Phevor and Taxonomer.

$0	$1,537,590	37	0	1	2/0	16	14

Deborah Yurgelun-Todd, PhD
University of Utah
Life Science

Deborah Yurgelun-Todd is a professor of psychiatry at the University of Utah School of Medicine, as well as the director of the university's Cognitive Neuroimaging Laboratory. Yurgelun-Todd's team at the Cognitive Neuroimaging Laboratory uses a variety of imaging techniques to identify brain changes related to healthy brain development, as well as traumatic brain injury and psychiatric disorders. The lab investigates irregularities in the brains of people who have or are at risk for developing a number of major psychiatric disorders including depression, substance abuse, bipolar disorder, and schizophrenia. This knowledge may eventually result in better and more personalized treatments for patients who have or who are vulnerable to psychiatric disorders, or patients affected by traumatic brain injury. Yurgelun-Todd has a PhD in neuropsychology from Harvard University.

$259,367	$1,926,782	14	0	0	0/0	16	15

USTAR PRINCIPAL RESEARCHERS

Haitao "Mark" Ji, PhD
University of Utah
Micro/Nano Systems

Haitao (Mark) Ji is an assistant professor in the Department of Chemistry and the Center for Cell and Genome Science at the University of Utah. Prior to his current position, Ji worked with Prof. Richard B. Silverman at Northwestern University as a postdoctoral fellow between 2002–2006 and a research associate professor between 2008–2010. While at Northwestern University, Ji proposed the concept of minimal pharmacophoric element and developed an approach for fragment-based de novo design, called fragment hopping. By using this strategy, Ji discovered highly potent and selective small-molecule inhibitors for neuronal nitric oxide synthase (nNOS). Ji's has published more than 80 research papers and five review articles in the peer-reviewed journals. In ISI web of knowledge more than 1130 publications have cited his research work. Ji holds 11 patents and has won several prestigious academic awards.

$152,080	$253,279	3	0	1	4/1	10	3

Hanseup Kim, PhD
University of Utah
Micro/Nano Systems

Hanseup Kim is a USTAR Associate Professor in Electrical and Computer Engineering at the University of Utah developing a wearable, wristwatch-sized pollution measurement system. He received his B.S. in electrical engineering from the Seoul National University in Korea and his M.S. and PhD degrees from the University of Michigan. Kim's wearable monitor is designed to analyze >40 designated air toxins, which requires miniaturizing a large number of components, most crucially a pump to regulate the flow of air molecules. A personal, wearable pollution monitoring system would vastly improve research on air toxins, because it would be able to create individualized, near real-time records of exposure to a wide variety of pollutants. These records could help connect specific air toxins to specific diseases for each individual in a way that is not currently possible.

$121,967	$271,855	19	1	3*	4*/0	3	7

* Two disclosures were shared with another USTAR faculty; 1 filed patent was with another USTAR faculty.

USTAR PRINCIPAL RESEARCHERS

Gianluca Lazzi, PhD
University of Utah
Micro/Nano Systems

Gianluca Lazzi, USTAR professor and Chair of the Department of Electrical and Computer Engineering at the University of Utah, received his D.Eng. in electronics engineering from the University of Rome "La Sapienza," in 1994 and earned his PhD in electrical engineering from the University of Utah in 1998. Lazzi has received various awards and honors, including the National Science Foundation CAREER Award in 2001, the IEEE APS Wheeler Award in 2006, the ALCOA Foundation Distinguished Engineering Research Achievement Award in 2009, and the R&D100 Award in 2009. For the past 17 years he has been researching the development of an artificial retina to restore partial vision to the blind and is the current principal investigator of an interdisciplinary and multi-institutional grant on multiscale modeling of neural stimulation supported by the National Institutes of Health (NIH). In 2015, Lazzi cofounded the company Bend LLC, which is headquartered in Research Park at the University of Utah.

$140,299	$503,740	5	0	0	3/2	14	12

Carlos Mastrangelo, PhD
University of Utah
Micro/Nano Systems

Carlos H. Mastrangelo is a USTAR professor in electrical and computer engineering and adjunct professor of bioengineering at the University of Utah. He is also the associate director of the Nanofab in the USTAR building at the University of Utah. His research focuses on microelectromechanical system applications and technology, microfluidic systems and integration, and design and modeling of MEMS fabrication processes. His research group is widely credited for pioneering the integration of DNA separation microchips with on-chip fluorescence detectors. He pioneered the fundamental theory of stiction (static friction) failure phenomena in MEMS, which aids in the manufacturing of air bag systems, MEMS based inertial guidance systems, MEMS RF switches, and MEMS-based Wii virtual reality handsets.

$290,600	$366,086	7	2	4*	1*/1	12	8

* Two disclosures were shared with another USTAR faculty; 1 filed patent was with another USTAR faculty.

USTAR PRINCIPAL RESEARCHERS

Rajesh Menon, PhD
University of Utah
Micro/Nano Systems

Rajesh Menon, USTAR associate professor in electrical and computer engineering at the University of Utah, combines his expertise in nanofabrication, computation and optical engineering to impact myriad fields including: super-resolution lithography, metamaterials, broadband diffractive optics, integrated photonics, photovoltaics and computational optics. He received his S.M. and PhD degrees in electrical engineering and computer science from MIT. He has also led several projects with support from DARPA, the NSF, US Air Force and the MIT Deshpande Center for Technological Innovation. Among his honors are a NASA Early Stage Innovations Award, an NSF CAREER Award and the International Commission for Optics Prize. He currently directs the Laboratory for Optical Nanotechnologies (http://lons.utah.edu/) at the University of Utah.

$158,806	$742,259	22	1	2	6/3	19	17

Marc Porter, PhD
University of Utah
Micro/Nano Systems

Marc D. Porter is a USTAR professor of chemical engineering and chemistry and adjunct professor in bioengineering and pathology at the University of Utah. Porter's laboratory is focused on the development and validation of diagnostic tests using magnetoresistance (MR) and surface-enhanced Raman scattering (SERS) detection methodologies. His work on detection of Category A pathogens, tuberculosis, dengue and pancreatic and prostate cancer and his research on TB has recently led to the formation of Porter Diagnostics. He also works with scientists and engineers at NASA's Johnson Space Center on a water quality assessment technology created in his laboratory, now deployed on the International Space Station. He has expertise in analytical chemistry, interfacial science and nanotechnology and is also director of the Nano Institute of Utah. He received his B.S. in chemistry and his M.S. in physical chemistry from Wright State University, and received his PhD in analytical chemistry from Ohio State.

$225,620	$1,196,853	9	0	0	2/0	4	14

USTAR PRINCIPAL RESEARCHERS

Saveez Saffarian, PhD
University of Utah
Micro/Nano Systems

Saveez Saffarian is an associate professor in the Department of Physics and Astronomy at the University of Utah and a member of the Center for Cell and Genome Sciences. He studies virus replication implicated in diseases such as HIV, Ebola, measles and rabies. His lab recently discovered a mechanism associated with the HIV virus that can be used to develop novel therapeutic agents against AIDS. Using computational biology techniques, his team has also identified a unique polymerase "sliding mechanism" that facilitates replication in NSS RSA viruses (which include Ebola and measles), which is a potential target for new anti-viral drugs. Saffarian pioneered visualization techniques using fluorescent light and advanced microscopes to capture digital video of cellular processes in live cells. He received his BS and graduate degrees in physics from Sharif University in Tehran and Washington University in St. Louis.

$161,468	$318,636	1	0	0	0/0	1	4

Massood Tabib-Azar, PhD
University of Utah
Micro/Nano Systems

Originally from Iran, Massood Tabib-Azar is a USTAR professor of electrical and computer engineering at the U. Tabib-Azar received his undergraduate and PhD degrees at Rensselaer Polytechnic Institute in Troy, New York. He then joined the faculty at Case Western Reserve University. While at Case, he started a company (Manufacturing Instrumentation Consultant Co.) that produced near-field microwave scanning microscope for high spatial resolution dielectrometry. While at the U, Tabib-Azar started Utah Wireless Health, LLC, which is developing on-the-body sensors for health monitoring, weight/fat reduction and wellness. Tabib-Azar's most promising project is the development of a special brain stethoscope to detect neuron firings in the brain as the person wearing the device conducts everyday activities. Another way Tabib-Azar's team is pushing the limits of electronic engineering is through the development of bio imaging sensors that have great potential in detecting shallow incipient cancerous cells.

$350,277	$399,044	3	0	2	5/2	8	12

USTAR PRINCIPAL RESEARCHERS

Darrin Young, PhD
University of Utah
Micro/Nano Systems

Darrin J. Young received his B.S., M.S., and PhD degrees from the Department of Electrical Engineering and Computer Sciences at the University of California at Berkeley. He joined the University of Utah's electrical and computer engineering department in 2009. Young heads the University of Utah's Wireless Microsystem Laboratory. One of Young's most promising projects is an implantable middle-ear microphone that could restore hearing to deaf patients without the external hardware necessary for today's cochlear implants. Young served as an associate editor of the IEEE Journal of Solid-State Circuits and the chair of the IEEE Electron Devices Society MEMS Committee. Young currently serves as an associate chair of the Electrical and Computer Engineering Department at the University of Utah, an editor of the IEEE Transactions on Electron Devices, and a member of the IEEE Sensors Council.

$271,643	$51,020	10	0	0	0/0	3	6

Ling Zang, PhD
University of Utah
Micro/Nano Systems

Ling Zang is a professor at University of Utah affiliated with the Departments of Materials science and Engineering, Chemistry and Nano Institute of Utah. He was previously an Alexander von Humboldt Fellow, NSF CAREER Award winner, and K. C. Wong Foundation Research Fellow. Dr. Zang earned his B.S. in physical chemistry from Tsinghua University and PhD in chemistry from the Chinese Academy of Sciences. His current research focuses on nanoscale imaging and molecular probing, organic semiconductors and nanostructures, optoelectronic sensors and nanodevices, with the long-term goal to achieve practical applications in the areas of security, renewable energy, and clean environment. Dr. Zang has been awarded various federal grants (from NSF, DHS, NASA, DOD, etc.) to support his broad range of research in nanoscience and nanotechnology. Since 2008 when he joined the faculty of University of Utah, more than fifteen IPs have been filed from his lab.

$0	$357,650	24	1	2	4/1	17	7

USTAR PRINCIPAL RESEARCHERS

Orly Alter, PhD
University of Utah
Big Data

Orly Alter is a USTAR associate professor of bioengineering and human genetics at the Scientific Computing and Imaging (SCI) Institute and the Huntsman Cancer Institute (HCI) at the University of Utah, and the principal investigator of a National Cancer Institute (NCI) Physical Sciences in Oncology U01 project grant. Inventor of the "eigengene," she pioneered the matrix and tensor modeling of large-scale molecular biological data, which, as she demonstrated, can be used to correctly predict previously unknown cellular mechanisms. Dr. Alter received her PhD in applied physics at Stanford University, and her B.Sc. magna cum laude in physics at Tel Aviv University. Her PhD thesis on "Quantum Measurement of a Single System," which was published by Wiley-Interscience as a book, is recognized today as crucial to the field of gravitational wave detection.

$87,174	$423,643	8	0	0	2/0	1	3

Craig Caldwell, PhD
University of Utah
Big Data

Craig Caldwell is a USTAR professor of film and media arts and adjunct professor of computer science at the U. Caldwell received the first creative Ph.D. in computer graphics and animation from the Advanced Computing Center for Art and Design at Ohio State University in 1989. He is currently game art track director of the Entertainment Arts and Engineering program at the U ranked number one by the Princeton Review. In the digital arts industry, Caldwell worked as a 3D technology specialist for Walt Disney Feature Animation in Burbank, CA, for films such as *Tarzan*, *Dinosaur*, *Chicken Little* and *Meet the Robinsons*. He also worked for Creative Training at Electronic Arts, the largest game company in the world. He has presented at various conferences including the Forum for Innovation (FMX) in 2013, the Special Interest Group on Graphics and Interactive Techniques (SIGGRAPH) in 2013 and 2014 in China, and the Mundos Digitales Conference on Animation, VFX, Videogames and Digital Architecture in 2014.

$7,770	$0	0	0	0	0/0	1	0

USTAR PRINCIPAL RESEARCHERS

Tom Fletcher, PhD
University of Utah
Big Data

Tom Fletcher is assistant professor in the School of Computing at the University of Utah. He received his B.A. in mathematics at the University of Virginia in 1999 and continued at the University of North Carolina at Chapel Hill to receive his M.S. (2002) and PhD (2004) in computer science. He joined the U first as a postdoctoral researcher in 2004 then became research assistant professor in the Scientific Computing and Imaging Institute. Fletcher's research is focused on creating novel methods at the intersection of statistics, mathematics and computer science to solve problems in medical image analysis. He examines non-Euclidean geometric data derived from medical imaging and is currently collaborating with researchers in Autism and Alzheimer's diseases at the University of Utah on the statistical analysis of combined imaging modalities, including structural MRI, DTI, fMRI and PET in longitudinal studies.

$154,283	$99,669	22	0	0	0/0	10	4

Miriah Meyer, PhD
University of Utah
Big Data

Miriah Meyer is assistant professor in the School of Computing and faculty member of the Scientific Computing and Imaging Institute at the U whose research focuses on designing systems that help people make sense of heterogeneous data. She develops visualization tools for scientists to integrate data with different structures and from different sources, allowing them to validate their data and models to develop new hypotheses and insights. She received her B.S. in astronomy and astrophysics at Penn State University in 1999 and earned a PhD in computer science from the U in 2008. Between 2008 and 2011 she was a postdoctoral research fellow at Harvard University. Among her honors are the 2014 NSF CAREER award, 2012 Microsoft Research Faculty Fellowship and 2009 NSF/CRA Computing Innovation Fellow award. She was included on MIT Technology Review's TR35 list of the top young innovators and Fast Company's list of the 100 most creative people.

$4,734	$295,107	10	0	0	0/0	6	5

USTAR PRINCIPAL RESEARCHERS

Tolga Tasdizen, PhD
University of Utah
Big Data

Tolga Tasdizen received a B.S. degree in electrical engineering from Bogazici University and his M.S. and PhD degrees in engineering from Brown University. From 2001 to 2004 he was a postdoctoral researcher in the Scientific Computing and Imaging Institute at the University of Utah. He is currently an Associate Professor in the Department of Electrical and Computer Engineering at the U. Dr. Tasdizen is also a USTAR faculty member in the Scientific Computing and Imaging Institute. His main area of research is image processing and pattern recognition with a focus on applications in biomedical and biological imaging. Dr. Tasdizen is the recipient of several awards including the NSF Early Career Award. He is a member of Bio Imaging and Signal Processing Technical Committee (BISP TC) of the IEEE Signal Processing Society. He has served as an Associate Editor for IEEE Signal Processing Letters and is currently serving as an Associate Editor for IEEE Transactions on Image Processing.

$240,168	$182,044	4	0	0	1/1	12	6

Cem Yuksel, PhD
University of Utah
Big Data

Cem Yuksel is an expert in computer graphics and an assistant professor in the School of Computing at the University of Utah. His research interests cover a wide spectrum of topics in computer graphics and related fields, including physically-based simulations, realistic image synthesis, rendering techniques, global illumination, sampling, GPU algorithms, graphics hardware, modeling complex geometries, knitted structures, and hair modeling, animation, and rendering. Commercial applications of his work include Hair Farm, a leading software plugin for Autodesk 3ds Max, used for CG hair and fur by production studios and independent artists. Yuksel has a BS in physics and MS in computer engineering from Bogazici University in Turkey. He received his PhD in computer science at Texas A&M University in 2010 and he was a postdoctoral fellow at Cornell University prior to joining University of Utah in 2012.

$272,297	$26,074	0	0	0	0/0	5	5

IMPACT METRICS SUMMARY DATA

USTAR was conceived as a long-term investment in the Utah innovation ecosystem that would, over time, provide an economic return to the State. Measuring this economic impact requires a long-term view as well. USTAR is designed to be early in the development cycle through both its funding of university researchers who will generate new ideas and intellectual property that has the potential for commercialization, and through early-stage grants for start-up companies, incubation tenants, and companies assisted through our outreach program. The early indicators of success that USTAR is required to report include external funding and/or follow-on funding for specific technologies. Measures of intellectual property (IP) generation that include the early indicators of disclosures, filed patents and received patents; and later stage measure of licensing agreements and the revenue generated for the Universities from these licenses. Later stage indicators that will be tracked annually for at least five years include sales, revenue, jobs created and wages for those jobs. In addition, the external funding data from the universities and the later-stage indicators are used as input variables to determine the contributions to the State tax base through the IMPLAN model. This is a commonly used economic model (see implan.com) that provides government programs an estimate of the impact of their programs.

The University of Utah and Utah State University are statutorily required to provide data on the productivity of the USTAR principal researchers, those recruited since 2006, and on the use of the USTAR buildings on their campuses. The reporting requirements are more extensive for the Principal Researchers, but all data is summarized in Table 1. More detailed data is available in the appendix available online at www.ustar.org or by request at ustar@ustar.gov.

USTAR is statutorily mandated to provide impact data, collected by a third party, on the impact on the Utah tax base of the companies that USTAR works with and the companies to which USTAR principal researchers IP has been licensed. SRI International conducted an online survey of the companies that USTAR, the University of Utah Technology & Venture Commercialization Office (TVC) and the Utah State University Technology Commercialization Office provided. If not completed online, SRI International attempted to follow up to collect information on the companies follow on investment, revenue, sales, jobs created and the average wages for those jobs. Summary data is presented in the tables on pages 75-80 and the detailed data is provided in the appendix.

The methodology for all of the data collection can be found on page 81.

UNIVERSITY SUMMARY DATA

Table 1. University Summary Impact Data. As defined by statute, this summary data provides early indicators of economic impact. The data is what was provided to USTAR by the universities and has not been audited by USTAR.

UNIVERSITY SUMMARY DATA

	UNIVERSITY OF UTAH*		UTAH STATE UNIVERSITY	
Total USTAR Funding**		$9,358,999.51		$4,907,116.24
	Principal Researchers	Non-USTAR Building Occupants	Principal Researchers	Non-USTAR Building Occupants
Number of Faculty	36***	14	6	6
Total Non-USTAR State Funding for Salaries	$1,282,738.81	N/A	$191,178.15	N/A
Federal Grant/Contract Funding^	$15,555,466.83	$5,341,905.80	$1,270,603.00	$233,337.00
Industry Contract Funding^	$2,696,736.89	$160,577.90	$182,712.00	$352,187.00
Philanthropic Grant/Contract Funding^	$1,442,129.98	$255,512.43	$43,256.00	$0
State Grant Funding (non-USTAR)^	$287,069.13	$535,389.80	$0	$0
TOTAL EXTERNAL FUNDING^	**$19,981,402.83**	**$7,839,394.86**	**$1,496,571.00**	**$585,524.00**
Publications	268	N/A	50	N/A
Collaborations	486	N/A	109	N/A
Disclosures	26	8	4	1
Patents (filed and issues)^^	57	2	0	0
License Agreements	7	0	0	0
Research Jobs (total/non-student)^^^	302/139	N/A	123/46	N/A

*The University of Utah (the U) provided all budgetary data on the fiscal year. Some of the other data was collected on the calendar year.

** Total USTAR funding reflects the total of invoiced and paid expenses in FY16. This includes USTAR principal investigator salaries and benefits, start-up funds, Center funding, administrative/overhead costs and equipment purchases.

*** Summary data includes 36 U faculty and three centers funded with USTAR funding. This reflects all faculty at the U that have an active memorandum of understanding (MOU) that commits USTAR support (32) and those that were recruited with an MOU that has now expired (4). Of the 36 researchers two have left the U but did have patents or funding reported by the U for this year.

^ Funding numbers provided by the U were expenditures, USU provided grants received.

^^ Patent data includes those filed domestically and internationally and may reflect multiple patents for the same technology.

^^^ Research jobs total included anyone paid for work within the principal researchers group. This included undergraduates, graduate students who are paid a stipend in addition to a tuition waiver, post-doctoral fellows and staff positions. This did not include those identified as collaborators. The non-student number is total jobs not including graduate students, undergraduates and work-study assistants.


USTAR

USTAR IMPACT DATA

USTAR IMPACT DATA

USTAR contracted SRI International, an independent, innovation policy non-profit, to conduct the data collection and analysis to determine impact. Per statute, SRI surveyed companies that worked with one or more of USTAR's outreach offices or had historically received funding through USTAR's Go-To-Market (G2M) program that ended in FY14. Private companies report revenue, jobs, wages and taxes on a calendar year. Many companies received more than one form of assistance from USTAR. The "Overall Impacts" section presents the data without double-counting. Table 4 provides the data by assistance program and therefore includes companies in each category of assistance they received. SRI also surveryed companies that had licensed intellectual property (IP) from a USTAR-supported faculty member at the University of Utah or Utah State University. Additional detail on the methodology employed can be found on page 81 and additional data in the appendix at www.ustar.org or by request to ustarinfo@utah.gov. All data was self-reported and the data has not been audited.

OVERALL IMPACTS FOR USTAR'S ECONOMIC DEVELOPMENT PROGRAMS

Companies that participated in one of USTAR's economic development programs reported the following impacts:

- Respondents received $19,128,685 in public and private sector follow-on investment.
- Respondents had annual revenues within the following ranges:

Table 2. Annual revenue received for companies that worked with USTAR

Annual Revenue	Pre-revenue	$0-$100,000	$100,000-$500,000	$500,000-$1,000,000	$1,000,000-$5,000,000	More than $5,000,000
Number of Companies	53	25	18	9	15	8

Note: Nine companies did not respond to the revenue question.

- Respondents generated $5,320,000 in sales from a recently commercialized product or service.
- Respondents added 54 new full-time and 45 new part-time jobs.
- Respondents added 45 full-time and 14 part-time new jobs over the 2015 average county wage.
- Respondents added $5,920,600 in new wages in from new jobs.
- Respondents generated $1,617,226 in state and local taxes from revenue and wages.

OVERALL IMPACTS FOR UNIVERSITY OF UTAH AND UTAH STATE UNIVERSITY LICENSEES

Companies that licensed a technology developed by a USTAR-supported faculty member at the University of Utah or Utah State University reported the following impacts:

- Respondents received $3,529,685 in public and private sector follow-on investment
- Respondents had annual revenues between pre-revenue to more than $5 million (see Table 3).

USTAR IMPACT DATA

Table 3. Annual revenue for companies that licensed IP from the U or USU.

Annual Revenue	Pre-revenue	$0-$100,000	$100,000-$500,000	$500,000-$1,000,000	$1,000,000-$5,000,000	More than $5,000,000
Number of Companies	7	1	1	2	2	2

Note: One company did not respond to the revenue question.

- Respondents generated $3,300,000 in sales from a recently commercialized product or service.
- Respondents added seven new full-time and six new part-time jobs.
- Respondents added two full-time new jobs over the 2015 average county wage.
- Respondents added $460,000 in new wages from new jobs.
- Respondents generated $320,000 state and local taxes from revenue and wages.

Table 4: OVERALL IMPACTS FOR USTAR CLIENT COMPANIES, BY USTAR PROGRAM

	SSAC Clients	BiG Clients	G2M Clients	USU Licensees	The U Licensees	20+ hours of training	Other outreach services
Number of respondents	44	32	19	5	12	28	34
Total number of companies	50	33	106	12	16	38	196
Response rate for group	88%	97%	18%	41.7%	75%	73.6%	17.3%
Total Follow-On Investment:	$10,330,685	$9,237,000	$258,000	$44,685	$3,485,000	$1,915,000	$645,000
New Sales:	$1,680,000	$642,000	$100,000	$3,100,000	$200,000	$78,000	$20,000
New Jobs: Full Time	21	11	1	0	7	12	12
New Jobs: Part Time	11	17	4	0	6	15	1
Revenue (# of companies in each range):							
Pre-Revenue	18	13	10	0	7	9	13
$0-$100,000	5	8	3	1	0	4	6
$100,000-$500,000	6	7	4	0	1	5	1
$500,000-$1,000,000	6	3	0	1	1	2	1
$1,000,000-$5,000,000	4	1	1	2	0	3	5
Greater than $5,000,000	1	0	1	1	1	4	3

Note: These programs are not mutually exclusive, and many companies that responded to the survey participated in more than one of the program listed in this table. Therefore, the impacts for follow-on investments, jobs, and sales from the individual USTAR programs contain some overlap and will sum to more than the total impacts reported. More information about the overlap between these programs can be found in the full SRI report. Also Note: USTAR's Go-to-Market Program (G2M) was discontinued in 2014. This program provided very small pre-seed grants ($2,500 to $10,000) to client companies through USTAR's Regional Outreach Centers.

USTAR IMPACT DATA

SBIR/STTR ASSISTANCE CENTER

USTAR's SBIR/STTR Assistance Center (SSAC) is a partnership with the Salt Lake Community College Miller Resource Center and assists small businesses in applying for federal SBIR/STTR grants.

Of the 44 SSAC client companies who responded to the survey, 21 of the companies also reported participation in other USTAR programs listed in this report: 14 companies also were tenants of the Bioinnovations Gateway, six received Technology Accelerator Program grants, three received more than 20 hours of training or mentoring from one of USTAR's Regional Outreach Centers, two were University of Utah licensees and two were Utah State University licensees (See Table 5).

TABLE 5. IMPACT FROM THE SSAC CLIENTS*

Response Rate:		88% (44 of 50 clients responding)
Follow-on Investment	Total	$10,330,685
	Commercial Lending	$239,000
	Private Investors	$2,249,000
	Strategic Partners	$344,685
	Institutionally Managed Venture Capital	$20,000
	Federal SBIR/STTR award	$5,584,000
	Other Federal grants or contracts	$1,000,000
	Other Utah Programs	$387,000
	Other sources	$507,000
Sales:		$1,680,000
Jobs:		
	# Full-time (Avg. Salary)	21 ($86,850)
	# Part-time (Avg. Salary)	11 ($30,818)
	# of Jobs above county average wage	19

*All companies that worked with the SSAC in 2015 were surveyed by an independent third party. See pg. 81 for detailed methodology.

THE USTAR LIFE SCIENCE INCUBATOR

The USTAR Life Science Incubator (the Bioinnovations Gateway or BiG) is a life science incubator for emerging biotech and medical device companies and is a collaborative effort between Granite School District and USTAR.

Of the 32 client companies who responded to the survey, 16 of the companies also reported participation in other USTAR programs listed in this report: 14 companies also were clients of the SBIR/STTR Assistance Center, five received Technology Accelerator Program grants, one received a Go-to-Market grant, three received more than 20 hours of training or mentoring from one of USTAR's Regional Outreach Centers,

USTAR IMPACT DATA

TABLE 6. IMPACTS FROM USTAR LIFE SCIENCE INCUBATOR CLIENTS*

Response Rate:		97% (32 of 33 clients responding)
Follow-on Investment	Total	$9,237,000
	Commercial Lending	$70,000
	Private Investors	$5,804,000
	Strategic Partners	$895,000
	Institutionally Managed Venture Capital	$420,000
	Federal SBIR/STTR award	$1,219,000
	Other Federal grants or contracts	$0
	Other Utah Programs	$242,000
	Other sources	$587,000
Sales:		$642,000
Jobs:		
	# Full-time (Avg. Salary)	11 ($74,222)
	# Part-time (Avg. Salary)	17 ($28,114)
	# of Jobs above county average wage	9

*Impact data for USTAR's Life Science Incubator (BioInnovations Gateway) clients. For methodology see 81.

two were University of Utah licensees and one was a Utah State University licensee (See Table 6).

TOTAL USTAR IMPACT ON STATE AND LOCAL TAXES:

Using IMPLAN modeling software, SRI estimated the total impact of USTAR on the tax base in the State to be $3,065,295 This estimate can be separated into the contribution from the university external funding, jobs and wages of $1,144,738, $320,000 in the impact of licenses and $1,600,487 from USTAR programs in State and local taxes. These are conservative values as they only model the direct impact based on the data collected. As USTAR continues it's "pivot" to supporting later stage research and companies, this impact should continue to grow. In addition, the majority of companies that USTAR worked with were pre-revenue, as these companies begin to produce revenue, the impacts will grow.

USTAR IMPACT DATA

UNIVERSITY DATA COLLECTION

USTAR requested the statutorily mandated data from the U and USU in August. Per statute, the data was due 1 September. The data provided by the U was collected through multiple mechanisms including from the College of Engineering annual reporting that each faculty provides on a calendar year basis, from the finance office, Office of Sponsored Projects, the Technology Venture Commercialization Office, from individual faculty members and data from the Academic Analytics database (www.academicanlytics.com). USU provided data collected through the Provost's office and the Technology Commercialization Office. This report contains the data provided by the universities but was not audited or verified.

SRI METHODOLOGY

The survey instrument used by SRI to collect the data found in this report is based on a survey SRI developed, in collaboration with USTAR, in 2015 to collect data from USTAR client companies. The 2015 survey was adjusted to align to USTAR's new statutory reporting requirements, which were adopted in 2016. The survey instrument seeks to collect data on follow-on investment, employment, wages, and revenue impacts in calendar year 2015. It also sought to collect information on:

- Characteristics of client companies, including their total employment and annual revenue.
- When and what type of assistance they received from USTAR.

The survey used well-tested methods to maximize response rates: the instrument was short (10 questions), with clear instructions and wording of the questions, and easily accessible online via an email invitation. A PDF of the online survey instrument is included as an Appendix to this report.

SRI received contact information from USTAR for companies that licensed a technology from a USTAR-supported faculty member at the University of Utah or Utah State University, received assistance from the USTAR SBIR/STTR Assistance Center (SSAC) in preparing grant applications, were tenants of USTAR's BioInnovations Gateway incubator (BiG), received funding through the Technology Acceleration Program (TAP) or Go-to-Market program (G2M), received mentoring, training or business services from one of USTAR's Regional Outreach Centers, or received other, non-financial assistance from USTAR. In total, SRI surveyed 425 companies.

The survey was launched on July 19, 2016, via personalized email invitations to the listed point of contact for each company. Follow-up emails to companies that had not yet responded were sent on July 20, 2016, and again on July 27, 2016. SRI conducted follow-up phone calls with client companies to further boost the response rate of client companies that:

- Had received TAP grants,
- Were tenant companies in the BiG incubator, and/or
- Had licensed a technology from a USTAR-supported faculty member at the University of Utah or Utah State University.

USTAR IMPACT DATA

DATA AGGREGATION METHODOLOGY

SRI strives to produce valid, conservative assessments of economic impact. Achieving credible impact estimates from a survey can be challenging given the likelihood of survey response bias. For example, those companies that perceive they benefitted more from their participation in the program may be more likely to take the time to respond to the survey, or it may be that more successful companies are less likely to respond because they are busier. Given the limited information available at the outset of the evaluation, it is not possible to adequately control for these biases using company or program characteristics. Therefore, rather than surveying a random sample of USTAR clients and seeking to extrapolate an average firm performance to the entire client population, SRI decided, in consultation with USTAR, to survey the entire USTAR client company population, achieve as high a response rate as possible, and directly aggregate and report these findings for the responding companies. No extrapolation or imputation was used for companies that did not respond or for item non-response (such as companies that did not report revenue).

DATA ESTIMATION METHODOLOGIES FOR SELECTED METRICS

Two of the metrics found in this report—jobs created above the average county wage and tax revenue—required additional information and estimation by SRI beyond the data collected directly via the survey.

Jobs created above the average county wage: SRI's survey instrument (Question 8c) asks respondents to indicate the salaries of both full-time and part-time employees for new jobs created in 2015. SRI used the Bureau of Labor Statistics average annual wage data for Utah's 29 counties from 2015 and compared those to the average annual wages reported for new jobs in the survey by USTAR client companies.

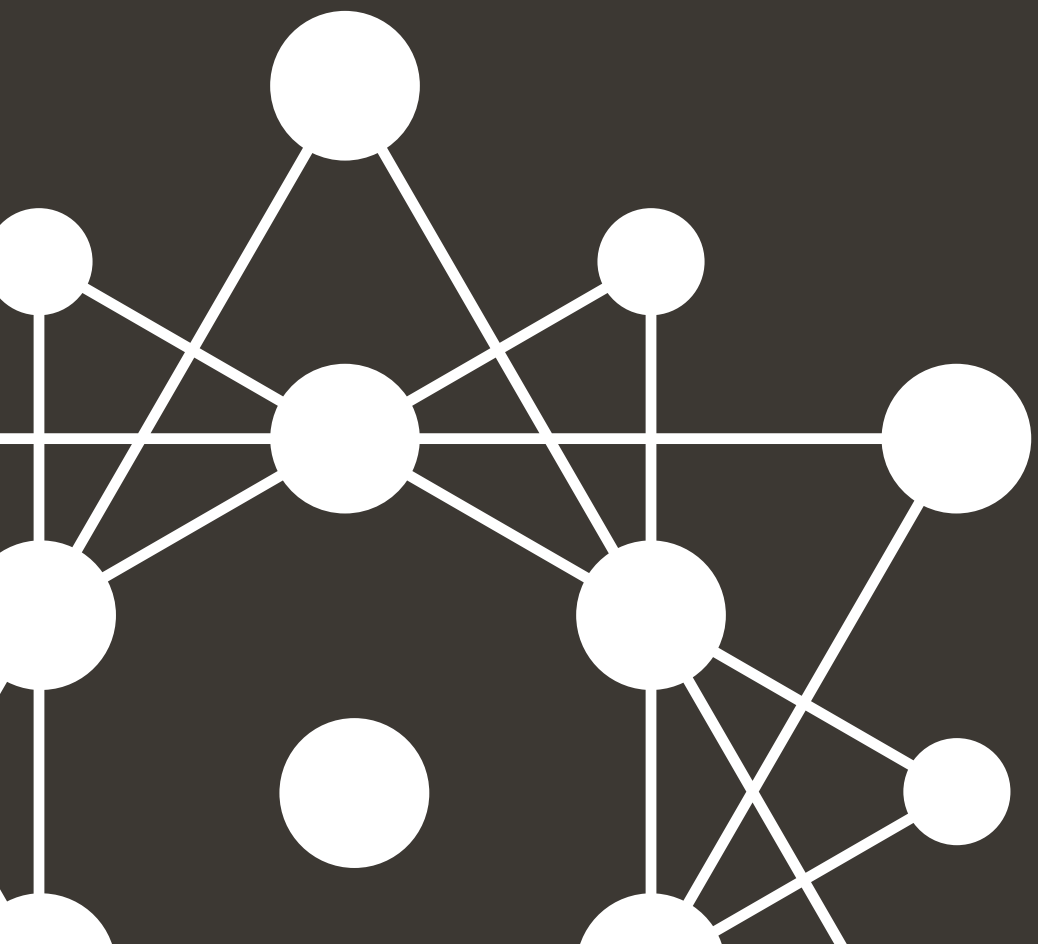
Tax Revenues: USTAR client companies reported the following sources of corporate income to which Utah taxes would apply:

- Follow-on investment that was then used to pay employee salaries and other product development and business expenses, and
- Sales of commercialized products or services, i.e., corporate revenue.

SRI used IMPLAN's data and software platform to estimate tax revenues based on reported wage income and corporate revenues of USTAR client companies and university licenses who responded to the survey and data collected from the U and USU on external funding, jobs and wages. IMPLAN estimates state and local taxes on corporate income, wage income, property and sales, as well as other miscellaneous taxes.

The inputs for modeling tax revenue came directly from the survey of USTAR client companies. SRI used the 2015 impacts for revenues and wages as inputs, as those would be the direct impacts that would generate tax revenue for the State of Utah.

The SRI report did not attempt to model total impacts (which includes indirect and induced impacts), only reporting direct impacts attributed to USTAR activities by current and former client companies.



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