

The Honorable Brian Sandoval  
 Office of the Governor  
 One Hundred One North Carson Street  
 Carson City, Nevada 89701

Mr. Richard Combs, Director  
 Legislative Counsel Bureau  
 401 South Carson Street  
 Carson City, Nevada 89701

Re: Nevada Knowledge Fund Annual Report 2018

Gentlemen:

NRS 231.1595 requires the Executive Director to report annually to the Governor and to the Director of Legislative Counsel Bureau on the progress of the Knowledge Fund. The attached report is for the period covering November 1, 2017 through October 31, 2018.

Since inception, the Knowledge Fund has supported and established a total of 12 projects within the Nevada System of Higher Education (NSHE). Of this total number, some projects have been completed with no new contracts issued. Project selection for the Knowledge Fund combines smaller university-industry collaboration efforts and larger centers that are implementing GOED's vision of *Applied Research Centers* at each of Nevada's universities and at the Desert Research Institute (DRI). These centers will conduct research and create intellectual property (IP) that will be used to develop new, relevant technologies to help companies grow their R&D base and enhance their growth through innovation. Applied Research Centers will assist companies to turn advanced technologies into production processes and commercial products by working collaboratively with such firms. The centers can be regarded as 'outsourced R&D departments' providing 'innovation on demand' services. This model is based on the 'Fraunhofer Institutes' in Germany and the 'Catapult' centers in the United Kingdom. Of the projects described below, the Nevada Center for Applied Research (NCAR) at the University of Nevada Reno (UNR) as well as the Applied Innovation Center for Advanced Analytics at the Desert Research Institute (DRI) can be categorized as Applied Research Centers. Other projects also conduct applied research center type work without constituting an actual center.

GOED has followed a strategic approach and rationale to allocate funding under this program. The rationale has been based on an approach termed *Innovation Based Economic Development* (IBED), sometimes also known as technology based economic development. This approach puts a university research infrastructure at the center of two interacting ecosystems: the *start-up economy ecosystem* powered by start-up firms and an *innovation economy ecosystem* driven by existing innovative growth companies. A dynamic regional innovation system requires efforts and initiatives to substantially enhance both ecosystems. Over the past three funding cycles, GOED has been selecting projects supported by the Knowledge Fund with the objective to strengthen the *innovation economy ecosystem*. Moreover, since inception, Knowledge Fund supported university-industry projects as well as Applied Research Centers have both been working with start-up companies and engage increasingly with entrepreneurs and/or entrepreneurship groups in their region. Thus, an entrepreneurial start-up culture has over time been *spilling over* to the universities and spur a 'change of

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culture' including an increased rate of development of commercializable university IP. Hence, for the fourth funding cycle the timing is appropriate for GOED to broaden its approach and in addition to continue supporting Applied Research Centers in their focus on the regional *innovation economy ecosystem* also increasingly direct efforts at the *start-up economy ecosystem*. To this effect, work has internally commenced for drafting a roadmap.

Sincerely,



Paul Anderson  
Executive Director

cc: Laura Freed, Executive Branch Budget Officer II  
Leannndra Copeland, Program Analyst



**Nevada Knowledge Fund Annual Report 2018**  
(for the period covering November 1, 2017 through October 31, 2018)

**Knowledge Fund supported projects – detailed progress descriptions**

**I. Nevada Institute of Personalized Medicine (UNLV)**

Project Inception: March 2014  
Total Funds Awarded (all years): \$3.25M  
Project Status: Current Project  
Project End Date: December 31, 2018

Approximately 1 in 20 people suffer from a genetic disorder by the age of 25 and approximately 1 in 10 overall, yet Nevada has almost no in-state infrastructure to diagnose and treat affected patients. This health disparity in our state negatively impacts the health and well-being of many Nevadans as well as our economy by the continued export of genetic health services and related revenues to other states. The Nevada Institute of Personalized Medicine (NIPM) and an affiliated enterprise will help regional healthcare partners utilize and deliver clinical genetics services and educate a clinical genetics workforce for Nevadans. The major long-term goal is to build a clinical genomics trial entity to provide services for Southern Nevadans and which will engage Nevada healthcare providers in personalized medicine.

The following updates on NIPM can be reported:

- NIPM became a biomedical center of excellence through a \$11.4M over five years award from the National Institute of Health (NIH). The award represents the first center of biomedical research excellence (COBRE) program led by UNLV. The NIPM COBRE is the first in the nation to focus exclusively on personalized medicine. The main goals of the grant are (i.) to advance the use of genomics and genetics in personalized medicine through cutting edge research discovery, (ii.) to build a center of excellence that fosters new investigator independence, and (iii.) to collaborate with key strategic partners. Projects forthcoming through the COBRE include (i.) developing new methods for comprehensive tissue-of-origin profiling for cancers of unknown sources, (ii.) diagnosing osteoporosis based on individual genetic makeup and environment; and (iii.) examining the role of microglia and immune system dysfunction in schizophrenia to help identify new genetic markers of the condition.
- To date, the team has won more than 10 competitive NIH grants totaling more than \$16M.
- The NIPM clinic has served over 600 patients resulting in many important re-diagnoses and is starting to fill an important health care gap for the people of Southern Nevada.
- NIPM launched DNA sequencing for its landmark clinical trials/contract with the Ruvo Center/Cleveland Clinic, which will sequence hundreds of Alzheimer's patients.
- Developed a collaboration in software analysis with the prestigious Hudson Alpha Institute and it's lead commercial venture Envision Genomics.
- Dr. Mira Han, NIPM's lead researcher in cancer genetics, received a \$574k award to study the effects of non-coding regions in the development of cancer. This represents the first grant in cancer genomics for NIPM.
- A total of five patent applications/families, based on three NIPM's developed innovations, remain in active prosecution.

- NIPM's clinical geneticist Dr. Mike Nasiak discovered a rare early-onset Huntington's Disease (HD) case in the Las Vegas area and deciphered the genetic disease linkage through the child's parents. This led to a second partnership with the Ruvo Center HD team and relevant pharma developers.
- NIPM has received a large donation of \$1.2M at the time of writing this report.

## **II. International Gaming Institute's Global Gaming Capital Initiative (UNLV)**

Project Inception: March 2014

Total Funds Awarded (all years): \$3.9M

Project Status: Current Project

Project End Date: June 30, 2019

The Global Gaming Capital Initiative evolved from the Knowledge Fund supported Center for Gaming Innovation (CGI). It seeks to reinforce Nevada's position as the world's thought leader in gaming and hospitality, which remain the largest contributors to Nevada's overall economy and of jobs for Nevadans. The acceleration of globalization and the rise of new technologies threaten the continued viability of Nevada's gaming-related economy, and focused investment in research and innovation is necessary to maintain Nevada's competitive advantage. The UNLV International Gaming Institute (IGI) has proposed a strategy that will: (1) Build upon UNLV's successful existing model to create innovative and commercially viable games that attract the next generation of gamblers through the Center for Gaming Innovation (CGI). Partner with 10 of Nevada's major operator and technology companies to field trial new tablegame innovations and develop technology partnerships to commercialize gaming innovations. (2) Build upon CGI's successful existing model to create innovative and commercially viable hospitality innovations that attract the next generation of tourists through the Hospitality Lab. Expand focus on commercialization strategies, alongside UNLV's Economic Development office, via new partnerships with incubators to generate successes in key GOED knowledge fund metrics (commercialization, intellectual property, and startups). (3) Work with GOED to build upon CGI's successful existing model to (a) create innovative approaches to e-sports technology, (b) integrate e-sports into the existing business and physical infrastructure in gaming/hospitality, and (c) generate research and commercialization contracts with companies in the local and global e-sports industry. (4) Serve governments around the world with regulatory/policy research, teaching, and advising. Deliver high-level research reports, advising services, and executive development programs to leading government and industry entities.

Major accomplishments for the reporting period include:

- Total numbers since inception of the respective projects for patents filed and granted have been impressive for both CGI and the Hospitality Lab: Since 2013, CGI filed 44 patents and have been granted nine. Since 2016, the Hospitality Lab has filed 12 patents.
- The third Hospitality Lab class was completed, and four projects have been identified by its industry partners for development and commercialization.
- The fifth Gaming Innovation Lab was completed with a class of 22 students from a diverse set of backgrounds. Six patent applications for the innovative content developed by the students were filed.
- CGI students debuted at the end-2017 G2E Global Gaming Expo, the "CES of Gaming" that draws about 26,000 attendees annually.



- The winning product of the 2016 gaming innovation class, Easy Jack, was approved for Nevada casinos in Q3, 2017. The student innovator formed a relationship with a distributor in Oklahoma and has achieved eight installs in multiple casinos in the region. Another student has launched field trials of his unique new table game concept, Casino Dominoes, in a Las Vegas casino.
- Nevada-based company Galaxy Gaming acquired four games and two licensed patents developed by CGI students. Galaxy Gaming is the second largest specialty table-game distributor in North America. It will showcase these new games at their booth at the 2018 G2E Global Gaming Expo in October.
- IGI was asked by Caesars Entertainment to launch their innovation week, in which presidents of each international property were requested to give an up-close and personal look at some of the latest UNLV gaming and hospitality innovations. In addition, students from the IGI's Hospitality Lab and E-Sports Lab classes created and demonstrated economically viable and sustainable business models for gaming, technology, food and beverage, entertainment, and guest experience.
- Japanese government officials and business leaders commissioned from IGI to guide their nation in launching Japan's first integrated resorts. Two reports were produced: The first one covered a socioeconomic analysis of the impacts of an integrated resort casino, with a particular emphasis on Japan's stated goals for the endeavor. The second examined how gaming regulation can help Japanese eliminate organized crime in casino management. This international leadership role reflects the Governor's vision that the IGI at UNLV serves as the global intellectual capital exporting Nevada ideas and IP to the rest of the world.
- In a ground-breaking new partnership IGI welcomed two employees from Netins, a Polish technology company that is expanding in Las Vegas. This is a direct result of the Governor's Trade mission to Poland last year. The two employees will be provided office space at IGI and will participate in both the Gaming Innovation class and the Hospitality/ E-sports Innovation class this fall semester.
- IGI's Young Executive Scholars Hospitality & Tourism Program (YES) convened for the second year. YES is a collaboration between IGI and Las Vegas nonprofit CORE, which is supported by The Rogers Foundation as well as Caesars Entertainment. YES takes advantage of UNLV IGI's gaming hospitality expertise to touch the lives of Las Vegas' under-resourced-youth, many of who are unaware of the leadership opportunities that can transform their future in Nevada. The initiative aims to grow a strong local talent-pipeline.

### **III. Nevada Center for Advanced Mobility (UNLV)**

Project Inception: April 2016

Total Funds Awarded (all years): \$210K

Project Status: Past Project

Project End Date: December 31, 2017

UNLV in collaboration with the Nevada Institute for Autonomous Systems, other NSHE institutions and the Governor's and UNLV's Offices of Economic Development established the Nevada Center for Advanced Mobility (NCAM) in early 2016 to serve as a catalyst for bringing together the government sector, industry, and research organizations to address modern transportation issues

For the reporting period, NCAM can highlight the following results:

- NCAM and Nexar announced a strategic partnership to create the first statewide vehicle-to-vehicle (V2V) network in the country. This unprecedented collaboration was designed to enhance safety on Nevada's roads and highways, spur economic development and job creation in the state, and introduce a series of innovative smart transportation systems that will optimize infrastructure management, regional planning and inform policy throughout Nevada.
- In late 2016, Nevada CAM conducted a global search for technology solutions to help address pedestrian safety on behalf of the Regional Transportation Commission of Southern Nevada (RTC). A byproduct of that search was the encounter of technology company WayCare. Under NCAM's guidance, the RTC and WayCare with its predictive analytics platform for smart cities, announced a first of its kind pilot program to help prevent traffic crashes and congestion.
- The RTC and WayCare are collaborating with Nevada Highway Patrol (NHP) and Nevada Department of Transportation (NDOT) to utilize WayCare's predictive insights to strategically deploy highway patrol and roadside service units. The technology enables local first responders and traffic management centers to more efficiently deploy resources and to patrol problem areas ultimately hoping in the prevention of traffic incidents.
- GOED, the Nevada Department of Transportation, the City of Las Vegas, the Regional Transportation Commission (Team Nevada), and NCAM worked with GENIVI (Jaguar Land Rover, Volvo, Harman, and Hortonworks) in a multi-phased 12-month pilot project that addresses pedestrian safety, increased traffic throughput and reduced traffic congestion across three to four key corridors in Southern Nevada.

#### **IV. Demand Responsive Rumble Strips for Advance and Safe Mobility (UNLV)**

Project Inception: April 2018

Total Funds Awarded (all years): \$150K

Project Status: Current Project

Project End Date: June 30, 2019

This project includes the redesign, prototyping and field testing of a Demand Responsive Transverse Rumble Strip (DRTRS) mechanism which becomes active (lowers) only when needed. This mechanism is to be installed on travel lanes upstream of locations with safety concerns. Making the rumble strips active only when required prevents drivers from becoming accustomed to the effects of the rumble strips while minimizing the noise as compared to permanent rumble strips. Hence, drivers' attention will be regained making them aware of the presence of pedestrians in the roadway. In addition, in the context of autonomous vehicles, the proposed mechanism provides redundancy so as to minimize the likelihood of a crash as a consequence of system failures and/or malfunction. In the context of connected vehicles, the proposed mechanism can be activated through communication with vehicles and pedestrians. UNLV has filed a non-provisional patent of the invention in partnership with the UNLV Office of Economic Development. Corresponding technical drawings and details have been provided to the United States Patent and Trademark Office.

Progress in the few months since inception includes:

- Won a National Science Foundation I-Corps award of \$50,000. The award comprises training from NSF and conduct customer discovery for the technology developed.



- Verizon provided \$30,000 to work on advanced mobility which included support for this project.
- Redesigned and improved the initial design that was completed and tested as part of the matching project sponsored by the U.S. and the Nevada Departments of Transportation. A prototype for the new design will be installed and tested on East Harmon Avenue within UNLV's campus in Las Vegas.
- Collection of day-long video data from the Harmon site to extract vehicle and pedestrian information. The data will let the project team to compare before and after scenario given traffic participants' response to the DRTRS.
- The UNLV Office of Economic Development has licensed the intellectual property from the project to Rebel Roadway Systems, LLC (RRS). The lead investigator is working with RRS to establish industry partnerships, public sector partnerships, research collaborations, and potential manufacturers to produce and sell the DRTRS.

## V. Fraunhofer IVI Collaboration (UNLV)

Project Inception: May 2018

Total Funds Awarded (all years): \$500K

Project Status: Current Project

Project End Date: December 31, 2022

Following the Governor-led trade mission to Germany in 2015 and a NSHE Delegation's visit to *Fraunhofer Institute for Transportation and Infrastructure Systems (IVI)*, Dresden in 2017, GOED has since been leading an initiative to build a transatlantic cooperation between Nevada's research institutions and IVI facilitated by an exchange program for researchers between Fraunhofer IVI and UNLV that is envisioned to be the first step towards the creation of a potential *Project Center in Autonomous Synchronized Mobility*. Fraunhofer IVI is the ideal partner for Nevada. It is member of the world- renowned Fraunhofer network of applied research institutions. In addition, the German federal government established six *digital test beds* for transportation. Dresden has been chosen as one of those six areas. Fraunhofer IVI will play a leading role to develop intelligent transport systems for autonomous or highly automated driving. During the first phase of the exchange, an Engineer from Fraunhofer IVI will visit UNLV to establish Nevada-based research in autonomous vehicles and increase research capacity in southern Nevada through UNLV. Correspondingly, an Engineer/post-doc will be sent from UNLV to Fraunhofer IVI to assist with existing projects which require computer vision expertise. Researchers participating in this exchange will be working within industry-driven applied research projects following the 'Fraunhofer model'. The technology areas are jointly selected by the IVI and UNLV teams and an overlap of research expertise is ensured to drive optimal outcomes.

Progress of the newest Knowledge Fund project includes:

- Jointly with Fraunhofer IVI selected a candidate who will take up the position of IVI engineer being sent to UNLV. The hiring process of a UNLV-post doc to be sent to Germany is still ongoing. The hiring process is proving extremely complex as the field of expertise is located at the boundary between applied research at an academic institution and the private sector. The search is therefore competing with private companies located in the Bay area.

- The hired IVI-engineer has started his work at UNLV in August for a duration of 11-months with a planned visa extension. The two-respective project leads from both institutions have coordinated and developed a scope of work to integrate R&D work in both locations.

## **VI. Nevada Center for Applied Research (UNR)**

incl. the Nevada Advanced Autonomous Systems Innovation Center

Nevada Center for Applied Research

Project Inception: October 2015

Total Funds Awarded (all years): \$4.7M

Project Status: Current Project

Project End Date: June 30, 2019

Nevada Advanced Autonomous Systems Innovation Center

Project Inception: March 2014

Total Funds Awarded (all years): \$3.5M

Project Status: Current Project

Project End Date: June 30, 2019

The Nevada Center for Applied Research (NCAR) is a stand-alone, fully functional applied research and development technology center that serves to enhance the global competitiveness of Nevada industry by leveraging the physical and intellectual assets of the University of Nevada, Reno (UNR). NCAR's mission is to stimulate regional innovation-based economic development (IBED) by aligning the needs of industry, startup companies, researchers and entrepreneurs with resources at UNR. This is achieved by providing industries with a central and public access point to utilize the broad range of technical services, intellectual capital, testing and research capabilities, advanced tools and methodologies available at NCAR's Shared Research Facilities that otherwise would be cost-prohibitive for startups and not cost-effective for established companies.

While leveraging all of UNR's physical and intellectual assets, NCAR is focusing on (i.) Robotics, (ii.) Life Sciences, and (iii.) Advanced Manufacturing.

NCAR has made the following progress in the reporting period:

- A continuously increasing number of UNR research faculty are now going through NCAR for their industry-sponsored projects.
- The High-Performance Computing Facility (HPC), seeded by the Knowledge Fund during NCAR's first round of funding, is being used as a supporting infrastructure for all programs.
- Currently, 15 affiliated companies are working on campus and about 44 companies and entities have performed one or more types of fee-for-service or facility use agreements through NCAR.
- The growth of the Bioscience Entrepreneurial Lab continues with the opening of a second facility with two companies already using the space.
- The Intelligent Mobility Initiative led by NCAR is expanding. To the founding stakeholders comprising Fraunhofer IVI (Dresden, Germany), RTC Washoe, Nevada DMV, Cities of Reno, Sparks, and Carson City as well as Proterra Inc., the following industrial partners were added: Switch, Dell EMC, Blynksy Inc., and Velodyne.
- The Intelligent Mobility Program is gaining national and international recognition with presentations at US Congress, the US Federal Transit Authority and at the Ministries of



Transport and Commerce of the Czech Republic. In addition, UNR was invited to partner in the European Union Horizon 2020 program as the only non-EU partner in a consortium of industry, agencies and universities from several EU countries and organized by the Central Europe Institute of Technology (CEITEC) in Brno, Czech Republic.

- The Intelligent Mobility Initiative is continuing to build out GOED's concept of a Living Lab in northern Nevada's metro areas with a real-world, urban test-bed for autonomous and connected vehicles and an intelligent traffic control system. Activities concentrate on the instrumentation of a mass-transit electric bus (the RTC's 'Sierra Spirit' route in Reno), an autonomous passenger vehicle, and intersections within the Living Lab area. A pilot deployed integrates roadside LiDAR technologies, dedicated-short-range-communication (DSRC) devices, a high-speed microwave/fiber network, a high-performance computing platform utilizing the HPC, and existing traffic infrastructure along N. Virginia St. segment from 4<sup>th</sup> to 15<sup>th</sup> St in Reno. Activities under the Living Lab concept are also continuing statewide with roadside LiDAR sensors to be installed at three intersections in the City of Henderson under a pilot with RTC South.
- NCAR and the Centre for Advanced Transportation Education and Research (CATER) were awarded by NDOT \$313k and RTC Washoe \$250k respectively for proposals dedicated to obtaining high-accuracy multimodal traffic trajectories with roadside LiDAR.
- The Autonomous Vehicle Testing Registry Application with DMV to start testing Intelligent Mobility initiative's hybrid Lincoln MKC on Nevada's roads has been completed. A partnership formed with the Regional Public Safety Training Center (RPSTC) will use the center's infrastructure to test the autonomous vehicle to a high level of public safety before targeting demonstration rides on Interstate 80 and suburban roads around Reno. Focus of the autonomous vehicle program in the reporting period has centered on research, systems engineering and partnerships with concentration on developing algorithms that endow autonomous vehicles with 'social intelligence' necessary to navigate in realistic traffic scenarios which humans can perform effortlessly.

## **VII. Mine Inspection Robotics (UNR)**

Project Inception: March 2018

Total Funds Awarded (all years): \$398K

Project Status: Current Project

Project End Date: December 31, 2019

The Mine Inspection Robotics project aims to develop the technologies, methods and systems, as well as a commercialization-ready integrated robotic solution that addresses the need for autonomous, reliable, and systematic robotic inspection of underground mines and for delivering volumetric scans of voids, as well as information for particular objects and entities of interest. A multitude of developments including those of GPS-denied visually-degraded navigation and autonomous planning and decision making will be specialized for the mine environment. An aerial robotic system tailored to the exact application needs is being developed, and aims to provide groundbreaking means to enhance productivity, improve safety, achieve rapid emergency response, and offer better protection of the environment. At the same time, exploitation of commercialization opportunities is within the scope of the project and is supported from the collaboration with AboveGeo, Barrick Gold Corporation, as well as an international Advisory & Support Board.

The project has made the following progress:



- The activities of the Mine Inspection Robotics Project allowed the expansion of research into the broader area of Subterranean Robotics. The result is the award of a highly competitive \$4.275 Million ‘CERBERUS’ (CollaborativE walking & flying RoBots for autonomous ExploRation in Underground Settings) grant from DARPA. The scope of the grant in the so-called *DARPA Subterranean Challenge* extends beyond supporting underground mining operations and relate to a variety of civilian and military operations in the subterranean world. UNR is leading a consortium of international partners that includes ETH Zurich, University of California, Berkeley, Sierra Nevada Corporation and Flyability.
- The team achieved a smooth collaboration with Barrick that has resulted in the ability to execute field tests in their mines at the desired rate. In fact, Barrick offers access at a frequency higher than the one initially requested which allows the team a more frequent and comprehensive testing. Up to this point, three field tests took place in Barrick’s Turquoise Ridge underground mine.
- The researchers have been working on the problems of autonomous localization and mapping as well as autonomous navigation and exploration inside the GPS-denied and often visually-degraded underground mine environment. They also started to identify some of the components and drivers that will need to be included in a proposed business for the commercialization phase of the project.

#### **VIII. Applied Innovation Center for Advanced Analytics at the Desert Research Institute (DRI)**

Project Inception: March 2014

Total Funds Awarded (all years): \$6M

Project Status: Current Project

Project End Date: June 30, 2019

The Applied Innovation Center at DRI (AIC) is an Applied Research Center following the Fraunhofer model and a ‘start-up’ in the data and analytics space. The AIC leverages the intellectual capital of more than 100 DRI faculty and 60 years of environmental science research to focus on four main areas of applied research: (i.) Climate, weather and energy nexus; (ii.) Internet of things and remote sensing; (iii.) Engineering and design, and; (iv.) Life Sciences and informatics. From these four core areas the AIC is able to: 1) Build platforms (hardware and software) for industry; 2) leverage these platforms for sponsored projects; 3) Create jobs; 4) write new and more competitive grants; and 5) build or help build high tech companies in NV. The AIC develops and incubates intellectual property by DRI scientists that meet the needs of industry relying on environmental expertise.

Within the last twelve months, the AIC has made the following progress:

- The Renown Institute for Health Innovation (IHI), a 50:50 partnership between Renown Health and DRI, has been expanding. The IHI is a not-for-profit start-up, tasked with solving challenging health problems using big data, clinical trials and public private partnerships. In the reporting period, the population health work has been broadened to include 50,000 northern Nevadans participants: The Healthy Nevada Project (phase two) commenced in mid-March partnering with Helix, a clinical sequencing company, which has allowed the IHI to develop clinically actionable treatment paths for participants and expanded partnering with VC funders and pharma companies. IHI is exploring long-term funding needs with these partners. Almost 20,000 participants have been recruited and sequenced. De-identified genetic data was transferred to the IHI for analysis and initial results for at risk participants were determined.



These participants will be contacted through Renown Health resources for explanation and treatment options.

- New funding of \$367k was booked for sponsored research projects, with additional sponsored projects likely to go forward in FY 2019.
- In Q3 2017, Predira Inc. was formed as the first spin out from Desert Research Corp. (DRC). DRC is DRI's for-profit C-corporation intended to incubate DRI generated IP. Advanced field testing in multiple fields at an agricultural company are in progress. Testing includes the development, build and programming of LoRaWan sensor arrays and LoRaWan base stations for monitoring and data collection for the *FieldScout* and *ForecastView* apps. Beta version software with improved user interface, dashboard and visualization requirements is now finished and being deployed to selected customers with active field testing. Meetings also progressed with a *ForecastView* demonstration visit with an ag company. Field testing of sensor effectiveness and data collection reliability is expected to be complete near the end of 2018.
- A second DRC spin out, Tu Biomics, was also formed in Q3 2017 as a for-profit C-Corp and the vehicle to incubate organic fungicides to improve crop and soil disease management for large scale farms. Tu Biomics staff is preparing for field trials in a strategic partner's fields in northern California. To support field trials, manufacturing of appropriate organic fungicides is being scaled up. Additionally, faculty are developing the biochemical characterization of these fungicides.
- In March, Tu Biomics, along with Predira, was one of 20 semi-finalist startups selected from over 200 applicants by Thrive, the Salinas Valley Ag Tech incubator fund, to pitch its business case to the fund's board. While neither made the finalist list, both received considerable interest from Thrive board members.
- Successful completion of a \$233k sponsored research project with a pharma company resulted in a well-received final report and a team-prepared research abstract, recently accepted for presentation at an upcoming conference. Additional development work was undertaken to provide two other pharma companies with specific preliminary data for 'proof of concept' purposes for significant sponsored research projects.

## **IX. WaterStart (DRI)**

Project Inception: April 2014

Total Funds Awarded (all years): \$3.7M

Project Status: Current Project

Project End Date: June 30, 2019

WaterStart is a cluster of global leaders in the implementation of water innovation and aims to make Nevada a global water innovation hub and portal for investment by leveraging the state's leadership and expertise in water. The WaterStart business model involves a joint venture between academic, public, and private sectors. Each partner brings critical resources to create a mechanism to accelerate the economic cycle through applied research. These resources will lead to technology commercialization that will bring high-value, shared services to a broad range of public and private sector clients as well as an advanced workforce with core technology skills and domain expertise to meet employers' needs and attract technology-focused companies to Nevada. At the same time, the WaterStart's efforts will enhance Nevada System of Higher Education's goal of strengthening public private partnerships to generate additional sources of nonfederal grants and contracts. By combining the domain expertise of the NSHE institutions, Southern Nevada Water Authority



(SNWA), and the Las Vegas Global Economic Alliance (LVGEA), WaterStart (1) acts as a portal for attracting, partnering with, and servicing national and international business in the water domain; (2) delivers high-value, shared services to public and private sector clients while building job skills and assisting DETR to grow Nevada's future workforce; (3) assists with commercializing and distributing the collective domain expertise in water sciences, technology, and management areas with NSHE and Water Utility Partners Southern Nevada Water Authority (SNWA), Truckee Meadows Water Authority (TMWA) etc.; (4) provides additional sources of grants and contracts to NSHE faculty members.

For the reporting period, the WaterStart has made the following progress:

- WaterStart closed deals with eight additional companies:
  - WaterStart has facilitated a project between WINT and the Atlantis Casino Resort Spa in Reno, NV for piloting the FlowLess technology and solution. WINT has agreed to establish a re-seller partnership in NV as well as opening a customer service support center based in Nevada upon selling additional units in the Mountain West region of the U.S. The Atlantis will become a design partner for testing and improving upon WINT's real-time beta. This project further supports the partnership between WaterStart and the Israeli Innovation Authority.
  - WaterStart facilitated a project between MetaWater and UNLV for the optimization of an online bromate sensor. After the initial testing by UNLV, SNWA will install, inspect, and commission the online bromate sensor in a robust industrial environment to further test and optimize the sensor. MetaWater will contribute additional funding to support two full-time employees in Nevada for a 24-month period. Phase 1 of the pilot (initiated in August 2017) has been completed. Facilitated by WaterStart, the final results were presented to SNWA and the Japanese METI.
  - WaterStart completed an agreement with microLan, a Dutch company that specializes in early warning systems for water quality monitoring. microLan will work alongside faculty at UNLV to perform the necessary development and testing of the BACTcontrol *E.coli* monitoring platform and hiring 2-4 people within the 2nd year of the project. microLan is also interested in establishing a local assembly shop and buying American parts to realize a U.S. facility.
  - Abyss Solutions, an Australian water assets inspections and management company, will be demonstrating their underwater remotely operated vehicle by inspecting SNWA's 3 intakes in Lake Mead for condition assessment and their potential infestation with quagga mussels. Abyss Solutions has secured two additional projects and interest from other large utilities targeted for WaterStart membership.
  - Apana, a Washington-based technology and services company, helping commercial and industrial businesses manage water using real-time data analytics for identifying and guiding resolutions of mechanical and operational water waste. WaterStart and Apana have agreed to collaborate in identifying commercial applications for their technology. The Apana technology was installed at the Bellagio and is currently collecting data, which is to be shared with SNWA to inform their conservation initiatives.
  - Klir, an Ireland-based company, provides a platform of cloud-based compliance software solutions that offer an easier and more effective way to manage regulatory compliance data so that water utilities can better quantify and mitigate risks. Klir submitted a proposal in Round 8 of Water Start's RFP process and has just recently initiated their pilot project with SNWA. They have begun establishing their U.S. office in Las Vegas with 2 employees.
  - Altum, a Finish company, has developed a technology to remove fouling from industrial equipment, including cooling towers, using focused power ultrasound. Altum has



incorporated in Nevada and will be creating a full-time presence in the state, housed at WaterStart.

- Cirrus, a Las Vegas-based company, focusing on reducing water evaporation in chillers. WaterStart contributed funding to support DRI faculty within the Environmental Engineering Lab to assess the viability of the Cirrus Ecowater technology at the Las Vegas Convention Center. The main objective of the study was to evaluate the water savings achieved by reducing scale forming potential in cooling tower water, a technology priority identified by MGM Resorts International and SNWA.
- WaterStart closed four new request-for-proposal (RFP) rounds: Rounds 8, 9, 10, 11. Round eight led to 34 proposals reviewed by representatives from TMWA, MGM, and SNWA. The round was the first RFP that was not disseminated by a third-party contractor. Follow up meeting with identified qualified leads led to three companies evaluated for meter data management solutions, three companies for potential projects with MGM Resorts International, and one being further evaluated by SNWA. Rounds nine and ten generated four promising leads, and round eleven an additional four.
- The One Drop Foundation awarded Channels for Water Innovation, WaterStart's supporting 501c3, a one-year grant of \$100,000 for the development of a web-based knowledge platform. This platform will serve as a tool for compiling and communicating WaterStart's work, specifically related to innovation priorities and results of pilot projects.
- WaterStart continued to conduct recruitment trips. Its Executive Director travelled to Israel to attend WATEC and the promoting the partnership between WaterStart and the Israeli Innovation Authority. WaterStart returned with 4 new technology leads. The second trip was to Finland as part of GOED's delegation to attend Slush, an international startup and investor event. This visit resulted in two new technology company leads and a verbal commitment from Tekes, Finland's funding agency for innovation, to jointly fund new projects.
- The Queensland Urban Utilities (QUU) joined WaterStart at the highest level of membership, which will bring additional funding through partner matching to support pilot projects. QUU is one of the largest water utilities in Australia, supplying drinking water, recycled water, and sewer services to over 1.4 million people. It is WaterStart's first international member.

## **X. NSHE – Industry Unmanned Autonomous Systems Collaboration Program**

Project inception: September 2014

Of the Collaboration program, the following project is still ongoing:

### **Project Prometheus (DRI)**

Total Funds Awarded (all years): \$491K

Project Status: Current Project

Project End Date: June 30, 2019

Prometheus stands for 'Partnership for Research to Open Markets for an Emerging Technology: Helping to Expand Unmanned Systems' in Nevada. The project's purposes include developing new technologies and applications as they relate to fire science research and fire management; assessing the commercial potential of fire-UAS applications and assisting Nevada companies in targeting relevant markets; building capacity and conducting outreach to promote fire-related UAS business for our Nevada partners in the field of fire science and fire management; and seeking opportunities to conduct demonstrations, operations, and relevant supporting research.



The project has made the following progress:

- Atmospheric-science sampling and analysis payload: A prototyped version of the project's atmospheric measurement and sampling payload experienced its first round of field tests during a deployment to the Tall Timbers Research Station in April 2018, where the U.S. Forest Service and Prescribed Fire Science Consortium's 2018 Spring Burn event was held. The payload functioned as designed, and several areas of refinement were identified. In June 2018, the project began additional development of the payload focusing on circuit optimization and miniaturization, and identification of more reliable and accurate sensors. Currently, calibration work on sensors is occurring in order to produce more accurate and dependable results.
- Thermal-infrared imaging of wildland fires: Limited opportunities to observe prescribed fires and the large number of additional mission objectives resulted in this objective receiving lower priority than emissions and biological sampling. In collaboration with the Nature Conservancy and U.S. Forest Service, the project has been invited to participate in a series of prescribed burns tentatively scheduled for October at the Sycan Marsh Preserve in southern Oregon. Research tasks will include collection of airborne thermal imagery.
- Miniaturized UAS-mounted bioassay: A rough prototype of this payload was concept-tested in April. Results of sampling trials completed with this payload are promising, and two microbiologists were added to the team to expedite development and testing.
- A collaboration established in the spring with the U.S. Environmental Protection Agency is showing signs of yielding benefits, and the project has received a solicitation to work together on measurements of static rocket motor testing on Department of Defense sites in spring and summer 2019.

## **XI. Cloud Seeding UAS Project (DRI)**

Project Inception: November 2015

Total Funds Awarded (all years): \$750K

Project Status: Past Project

Project End Date: June 30, 2018

DRI, in partnership with AviSight and Drone America, developed and tested UAS technologies for cloud seeding operations. This included creating forecasts and conducting flight planning for manned and unmanned aircraft, cloud seeding using manned and unmanned systems and ground generators as well as estimating effectiveness of UAS cloud seeding operations.

The goals of the project were four-fold: (1) development of new UAS technologies for cloud seeding operations while demonstrating Nevada's Public COA and commercial COA and 333 authority; (2) operation of UAS for cloud-seeding operations, both alone and in conjunction with ground-based generators and manned aircraft; (3) assessment of the effectiveness of unmanned cloud seeding platforms using newly-developed technology and tools; (4) assessment of the broader market potential and development of a commercialization process for UAS cloud seeding in other areas. Major accomplishments included (i.) longest commercial UAS flight in US airspace and DRI's first beyond-line-of-sight flight, (ii.) the first-ever flight test of burn-in-place cloud-seeding flares aboard the Drone America X-8 multi-rotor UAS, (iii.) first-ever flight test of burn-in-place flares aboard the Drone America Savant fixed-wing UAS, (iv.) first-ever flight test of ejectable flares aboard the DA Savant. In addition, DRI was permitted operations to 1200 feet altitude above ground level (AGL) through the FAA UAS Test Site Node status, which is a substantial advantage compared to other groups who are generally limited to 400'AGL.



Subcontracts to AviSight and Drone America ended June 30, 2017 and additional achievements include:

- The project team pursued a commercial opportunity to conduct cloud seeding for United Arab Emirates (UAE)'s Rain Enhancement Program. DRI also attended the International Conference on Aerospace and Aeronautical Engineering in Abu Dhabi to support the team's efforts to secure research and operational cloud-seeding contracts in the Middle East.
- Secured letter of collaboration with UAE-local company with ties to the crown prince of Abu Dhabi.
- In addition to the UAE prospect, the project team developed a relationship with NVEnergy that resulted in contracts to inspect power-line infrastructure in Nevada and beyond. AviSight continues to enjoy success from these efforts having recently received an award to conduct joint US-Israeli business R&D for infrastructure inspection.
- In the course of developing tools and platforms for UAS cloud seeding, DRI conducted a number of tests on the performance of UAS airframes under icing conditions. These tests revealed important structural deficiencies in conventional UAS airframes. As one outcome of the results, DRI has begun to seek collaborations to address the broader topic of UAS icing as a safety issue.
- Emergence of new opportunities: In September 2018, the FAA and related partners approached DRI to inquire about capabilities in the area of UAS icing research. Since this initial contact DRI has been invited to participate in a 2019 field campaign to improve aviation safety by conducting flights of manned and unmanned aircraft into icing clouds. This campaign will involve DRI as the lead UAS operator and UAS research partner, drawing on DRI's longtime meteorological strengths and capacity gained from projects such as Cloud Seeding. DRI has subsequently been approached by potential collaborators from Canada and Switzerland regarding work together on UAS icing and meteorology.

## **XII. Development of Unmanned Aircraft System for Agricultural Applications (DRI)**

Project Inception: April 2016

Total Funds Awarded (all years): \$152K

Project Status: Past Project

Project End Date: December 31, 2017

DRI, in collaboration with AboveGeo (formerly AboveNV), deployed the company's Unmanned Aircraft Systems (UAS) in support of agricultural and water management of crop fields owned by Winnemucca Farms, Inc. The project tested the applicability of UAS data to address large-scale, multi-crop agricultural needs, particularly related herbivory, salinity and water-related crop stress. Winnemucca Farms, Inc. is one of the largest Nevada farms and because they expressed interest in assessing UAS data products to improve farm management, all project efforts were focused on this farm (project location was the main farm of Winnemucca Farms' properties, north of Winnemucca, NV). The project collaborated with the Nevada Institute for Autonomous Systems (NIAS) to become a NIAS Secondary Node that allowed the use the NIAS blanket FAA Certificate of Authorization (COA).

The project's goal was UAS data acquisition to identify and map agricultural crop stress that will lead to improved water use while maintaining and/or improving crop yields. The primary project objectives included the following: (1) Formation of a partnership between the private sector and

DRI to help grow a UAS business already located in Nevada (i.e., AboveGeo), (2) Enhancement of DRI's and AboveGeo's UAS expertise leading to enhanced and national recognition. (3) Testing and refinement of platforms, sensors and data analysis for commercial and governmental environmental applications, specifically agricultural applications related to water efficiency and improved productivity.

The project accomplished the following:

- Multiple UAS flights were planned and completed during the 2016 and 2017 growing season at Winnemucca Farms. Throughout the two years of UAS image acquisition several cameras were evaluated and included.
- Testing of different commercially available software packages to determine the most effective software and processing steps to prepare image products from the UAS images collected, from both cost and benefit aspects. A standard set of image products was prepared for the project.
- A significant accomplishment of this project was the development of a web-based visualization tool that would be user-friendly and intuitive for farm personnel use. DRI developed the online tool using software available at the Institute, including DRI's suite of ESRI geographic information systems (GIS) products. The webpage interface was developed using Adobe Flex integrated with ESRI's ArcGIS Server version 10.5.1. A MicroSoft SQL Server 2012 database is used to store and host the UAS image products for Winnemucca Farms. Individual UAS image products can be viewed using drop down menus that allow farm personnel to select the image type or types they would like to view for respective fields and dates of acquisition. The website has capabilities that will allow the farm manager to zoom into high spatial resolution UAS images of each center pivot irrigation field. The website also provides data on the percent crop cover for each field based on the normalized difference vegetation index (NDVI) threshold or crop cover image. This data will allow the farm manager to estimate the value of lost crop yield by computing the value of the pounds or bushels of crop that would have been harvested from the non-crop acreage in each field and can help determine the cost – benefit ratio of enacting management decisions that require more resources to improve crop cover.
- DRI personnel provided training and technology transfer to AboveGeo on the following:
  - calibration and operation of FLIR thermal cameras;
  - how to establish ground-based calibration targets for acquisition of thermal images using UAS;
  - image processing techniques and algorithms;
  - information about the development of a web-based data visualization tool for UAS customers; and
  - a summary of lessons learned and best practices.
- AboveGeo personnel trained DRI faculty and provided the following technology transfer:
  - training on the flight operations and maintenance of a turn-key DJI Matrice system purchased by DRI from AboveGeo; and
  - flight operations lessons learned.