

OHIO FEDERAL RESEARCH NETWORK

Defense & Aerospace Workforce Development Initiative



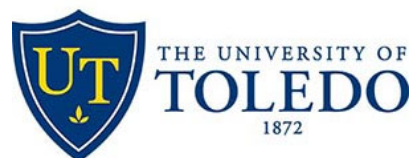
Ohio Federal Research Network

Driving Innovation Through Strategic Partnerships

2020 Annual Report to the
Ohio Department of Higher Education

30-Jun-20

CURRENTLY ENGAGED OHIO UNIVERSITIES IN OFRN



OFRN continues to work to engage all Ohio research universities in its activities

OHIO FEDERAL RESEARCH NETWORK

Defense & Aerospace Workforce Development Initiative

LETTER TO THE CHANCELLOR

Chancellor Randy Gardner
Ohio Department of Higher Education

June 30, 2020

It is with great pleasure that we submit the fifth Annual Report for the Defense/Aerospace Workforce Development Initiative originally funded through Ohio HB 64 of the 131st General Assembly. Referred to as the *Ohio Federal Research Network (OFRN)*, this remarkable initiative continues to represent our state's most innovative collaboration between Ohio's research universities, industry, and Ohio's key federal labs.

Driven by the requirements of the national labs, the OFRN investments are growing federal research spending in Ohio; advancing research initiatives aimed at emerging Air Force Research Laboratory, National Air and Space Intelligence Center, Naval Aerospace Medical unit, all located at Wright Patterson Air Force base and National Aeronautics and Space Administration (NASA) Glenn Research Centers requirements; enhancing university collaborations with Ohio-based small and medium size companies to engage them in innovation; creating new companies and retaining/growing jobs in Ohio for government and industry-related activities; and most importantly enhancing Ohio's economy.

To date, the OFRN has competitively allocated just over \$40 million over 4 rounds with 28 distinct research projects throughout the State to 12 different universities, 2 community colleges, 90 businesses, 8 spinout organizations as well as workforce development and commercialization activities. This has led to over \$193 million in follow-on funding from key federal and industry customers directly related to OFRN projects and sets up future program opportunities between OFRN affiliates and our federal partners to make Ohio a technology-based economic powerhouse. Currently, there is over \$350 million in new procurements pending with federal agencies as a result of OFRN business development requirements.

In December of 2019, OFRN awarded its fourth round of projects as a continuation of the third-round initiative called Sustaining Ohio's Aeronautical Readiness and Innovation in the Next Generation (SOARING). This effort is designed to expand Ohio's leadership in defense and commercial aerospace research, development, and sustainment of unmanned air systems (UASs), personal air vehicles (PAVs), and logistics delivery air vehicles (LADVs). SOARING projects leverage Ohio's unique aerospace assets to overcome critical research needs of OFRN's federal partners. These projects are most certainly advancing the State's aerospace industry, and as a result of the State's foresight to focus on PAVs and UAVs, Ohio was second only to California in the number of awards under the Air Force Agility Prime program focused on flying cars.

In closing, despite the challenges that the Covid-19 pandemic has created for all of us, the OFRN projects awarded late last year have continued to progress and remain on time and on budget. This is due, in no small part, to the remarkable efforts of our researchers, students, businesses and government partners, who remain committed to growing Ohio's innovation economy during these difficult times.

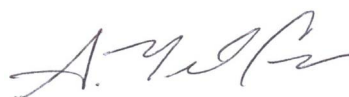
Finally, the key to OFRN success to date has been its remarkable collaboration with the Ohio Department of Higher Education, JobsOhio, the DoD and NASA partners, and the Governor's Office. These partnerships and their support of a requirements-based research model are what make OFRN unique and able to grow industry, state and federal R&D investments in Ohio.

We are truly driving innovation in Ohio through strategic partnerships!

Sincerely,



Dennis Andersh
Program Executive – OFRN
Wright State Applied Research Corporation



Dr. S. Michael Camp
Principal Investigator - OFRN
The Ohio State University

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OFRN's Mission

To meet or exceed research requirements of Ohio's federal laboratories while partnering with the commercial sector to create new technology products and expand federal contracting opportunities in areas such as national defense, space exploration, energy, healthcare, sensing and aeronautics.

OFRN's 5-Year Vision

Make Ohio the nexus for unmanned air systems (UASs), personal air vehicles (PAVs), and logistics delivery air vehicles (LDAVs) testing, integration, and manufacturing.

BACKGROUND

The Ohio Federal Military Jobs Commission (OFMJC) tasked Wright State University and The Ohio State University in November 2014 to frame a requirements-driven R&D initiative that would address emerging mission requirements for the US Air Force and National Aeronautics and Space Administration (NASA) in which Wright-Patterson Air Force Base (WPAFB) and NASA Glenn Research Center (NASA-GRC) play significant roles. The key goals were to (1) leverage the State of Ohio's R&D investment; (2) capitalize on federal and university research assets; (3) integrate Ohio firms and industrial partners into the proposed projects aligned with operational user needs; (4) better prepare and train universities and firms in Ohio to compete for federal funding; (5) facilitate the transition of government funded technology to commercial markets; (6) create the jobs, processes and firms of tomorrow in Ohio; and (7) to differentiate Ohio from other states relative to its commitment and support of our national defense and civil space missions.

The 2015 strategic planning effort resulted in the organization of Ohio's universities and community colleges around the future research priorities of WPAFB and NASA-GRC through the creation of the Ohio Federal Research Network (OFRN). The OFRN projects and activities were directly aligned with WPAFB and NASA-GRC strategic priorities, see Figure 1, and both organizations provided university researchers with insights into the requirements for each of the priority research areas. The OFRN investment is being utilized as seed funding and the catalyst for additional federal procurement and industry - sponsored research. The OFRN also provides an impetus for the state's leading research universities to frame a new requirements-focused/application-oriented set of projects and activities that will stimulate economic development and job creation here in Ohio.

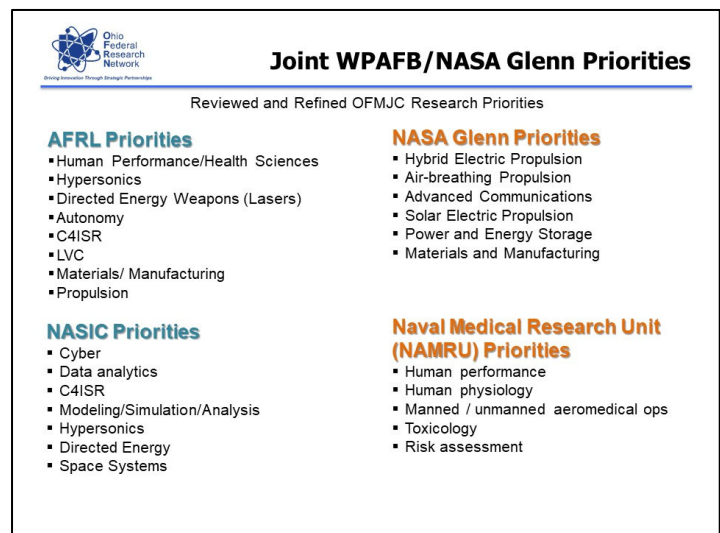


Figure 1 DoD/NASA Priorities

As a result of the above referenced strategic planning process in collaboration with the members of the OFMJC, the State supported the establishment of the OFRN to leverage federal, university, and commercial capabilities to support the future

of WPAFB and NASA-GRC, while retaining and creating new jobs within Ohio. On 10 December 2015, the Ohio Department of Higher Education contracted out the management of the Defense/Aerospace Workforce Development Initiative to the Wright State Applied Research Corporation (WSARC). OFRN has been and continues to be an active participant and supporter of both the Ohio Aerospace and Aviation Council (OAAC) and the state government supported Ohio Aerospace and Aviation Technology Council (OAATC).

There are currently 12 Ohio Research Universities, 2 community colleges, and 90 Ohio Industry Partners engaged in the OFRN research activities. Universities that were included as of June 2020 are: Case Western Reserve University (CWRU), University of Cincinnati (UC), University of Dayton (UD)/University of Dayton Research Institute (UDRI), University of Akron (UA), Ohio University (OU), University of Toledo (UT), Youngstown State University (YSU), the Air Force Institute of Technology (AFIT), The Ohio State University (OSU), Wright State University (WSU)/Wright State Research Institute (WSRI), Cleveland State University (CSU), and Miami University (MU). In response to OFRN’s fourth round of funding, Sustaining Ohio’s Aeronautical Readiness and Innovation in the Next Generation (SOARING), new engagement has occurred between OFRN and Columbus State Community College, Cuyahoga Community College, and Xavier University, . OFRN staff will continue to expand efforts to engage all Ohio Universities.

For in-depth background on the original strategic planning of OFRN see the Ohio Federal Military Jobs Commission Report to Governor John Kasich dated 31 December 2015: <http://ong.ohio.gov/OFMJC/011516-CommissionReport.pdf>

STRATEGIC INTENT OF THE OHIO FEDERAL RESEARCH NETWORK

The OFRN was established to:

- Expand Ohio’s research base of talent capabilities and investment to complement and support the research missions and priorities of the Air Force Research Lab (AFRL), the Naval Medical Research Unit – Dayton (NAMRU-D), National Air and Space Intelligence Center (NASIC), and the NASA-GRC.
- Align Ohio’s research universities and community colleges around the priority research initiatives of AFRL, NAMRU-D, NASIC and NASA-GRC that create external investment and business opportunities for Ohio.
- Establish a major focus on transitioning research advancements and technologies to operational domains and Ohio firms for both the federal government customer and commercial sector where relevant.
- Enhance the competitive posture of Ohio research universities for federal R&D funding.
- Make Ohio a leader in development and manufacturing support in Personal Air Vehicles (PAVs), Unmanned Aircraft Systems (UASs) & heavy-lift Logistics Delivery Air Vehicles (LDAVs)

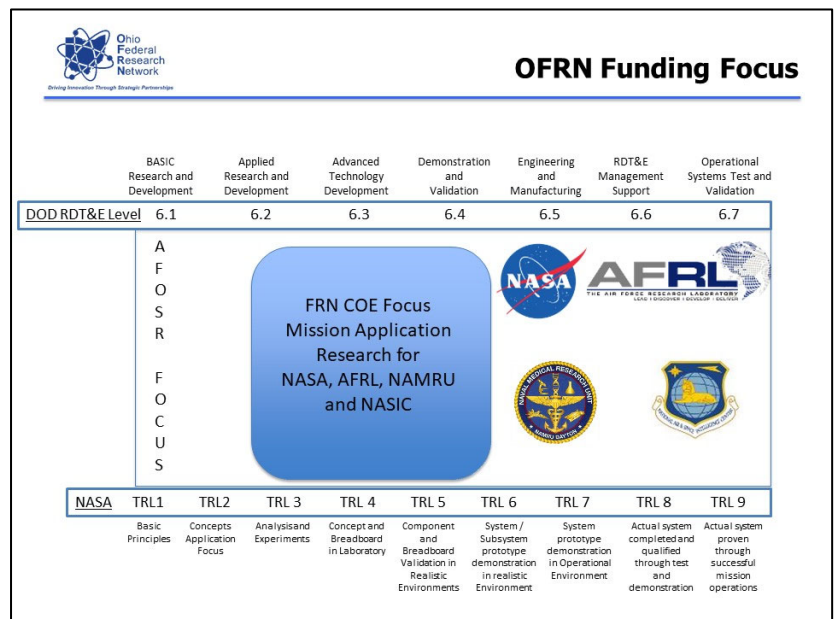


Figure 2 DoD/NASA TRL Levels

OFRN-funded projects are intended to be *applied* research, as opposed to *fundamental* research (see Figure 2)

ORGANIZATIONAL MANAGEMENT

The OFRN program is made up of six Centers of Excellence (COE), a Technical Review Council (TRC), an Executive Review Board (ERB), and is managed by the Wright State Research Institute (WSRI) on behalf of the Ohio Department of Higher Education (ODHE), see Figure 3. OFRN also has contracts in place with a number of consultants to assist with commercialization and workforce development. The precise members of the commercialization team evolve based on project and stakeholder needs.

OFRN Leadership

Prior to the awarding of the ODHE funds, Dennis Andersh, Executive Director of Wright State Research Institute (WSRI), and Martin Kress, Assistant Vice President for Research for The Ohio State University (OSU) were asked to take on the day-to-day leadership for framing the OFRN. The two leaders acted as the key interface to the federal labs and state offices, framed the charters, and helped recruit the members of the ERB and TRC. They also led the establishment of the six university COEs. Lead

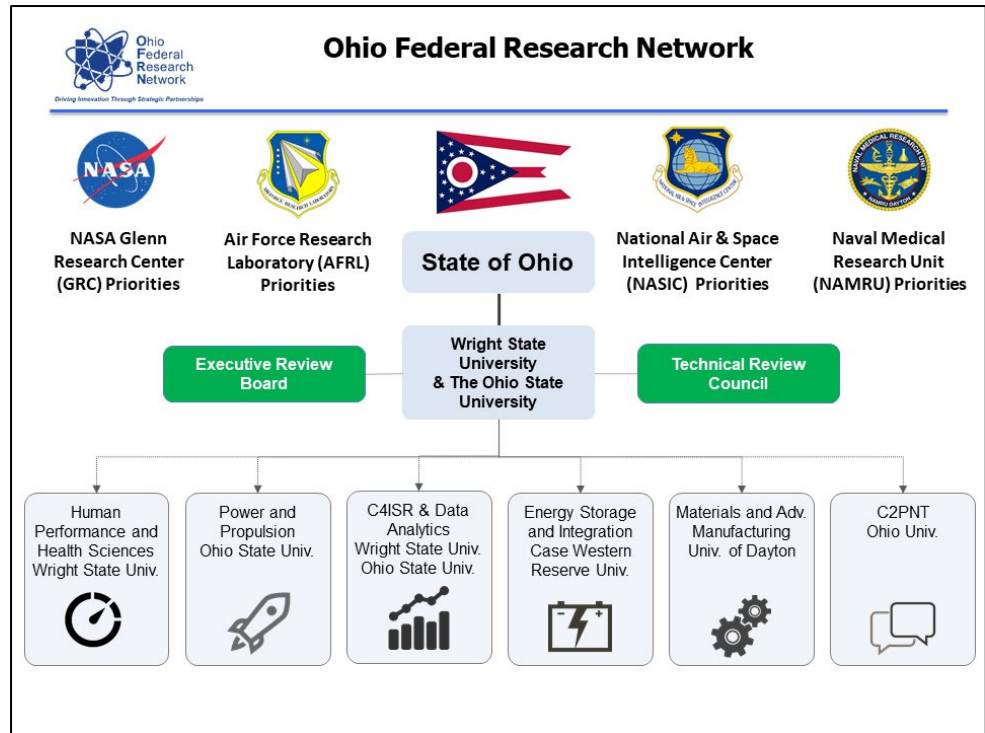


Figure 3 OFRN Organizational Chart

universities were selected based on the recognized strengths and core competencies within the State's university system and their prior professional experiences with AFRL and NASA-GRC. Each COE is directed to integrate other Ohio research universities into its activities and programs; and no proposal will be considered for OFRN funding consideration if it does not have multiple university partners participating in a "meaningful way."

As Mr. Andersh and Major General (retired) Mark Bartman who has assumed Mr. Kress's duties on behalf of OSU, continue to provide the day-to-day leadership for the OFRN, key to their success is the WSRI and OSU support staff and the support and engagement of critical state offices including ODHE, JobsOhio, Ohio Third Frontier, and the Ohio Department of Transportation (ODOT). The two leaders also continue their commitment to regularly provide briefings to the key partners, state officials and other interested groups across the state on the OFRN, its goals and objectives, and progress to date. This open and transparent briefing process is part of their commitment to build a partnership coalition that allows Ohio's research and industry talent to be shown in an effort to boost the State of Ohio's overall economic impact by bringing in more federal research dollars to the state. In October of 2019, Mr. Robert Tanner was selected to be the new OFRN Executive Director, after Paul Jackson's departure.

Wright State Applied Research Corporation (WSARC)

The Wright State Applied Research Corporation (WSARC) acts as the contracting, technical and program management agent for the OFRN. Specifically WSRI leads and oversees all procurement, contracting and financial reporting activities; supports the ERB and the TRC; supports the White Paper and Proposal Review processes; facilitates the ERB and TRC meetings and quarterly project reviews; is the funding agent for all projects; frames the technical review and project evaluation processes; keeps a repository of all deliverables of the OFRN; is the repository of federal lab requirements; and ensures that the OFRN remains fully compliant with state and federal policies, rules, regulations and accounting procedures.

Technical Review Council (TRC)

The TRC is responsible for comprehensive oversight of the portfolio of technologies that are used and developed by OFRN-funded projects. The TRC reviews all white papers and proposals; ranks them according to key criteria (established in RFPs), and then submits funding recommendations to the ERB.

Executive Review Board (ERB)

The ERB is responsible to oversee the development, funding, and performance of OFRN. The ERB provides ongoing oversight of the OFRN to support the research priorities of the federal installations and buildup Ohio’s capabilities in applied research, workforce development, and technology commercialization. The ERB reviews and can concur in or reject the recommendations of the TRC as to which projects will be funded under OFRN. To ensure the continued alignment of the OFRN within the original OFMJC goals and initiatives, the former chair of the OFMJC has a seat on the ERB.

Additionally, OFRN leadership leverages the ERB for strategic guidance regarding new initiatives and activities.

Figure 4 shows the membership of the ERB and TRC, and each has representation from Federal and State government, industry, and universities. Maj Gen Mark Bartman chairs the ERB and Dr. John Sankovic (President and CEO, Ohio Aerospace Institute) chaired the TRC.

Executive Review Board		Technical Review Council	
OSU Dean of Engineering	Dr. Dave Williams	UC Dept Head AEEEM, OAATC	Dr. Jay Kim
WSU President	Dr. Susan Edwards	KSU Director of Aeronautics,	Dr. Maureen McFarland
CSU President	Dr. Harlan M. Sands	Youngstown State University	Dr. Mike Hirpko
OU President	Dr. M. Duane Nellis	University of Dayton VPR	Dr. John Leland
UT President	Dr. Sharon L. Gaber	NASA Glenn	Mary Lobo
CWRU Dean of Engineering	Dr. Venkataramanan "Ragu" Balakrishnan	AFRL	Brian McJilton & Frank Albanese
OFMJC	Gary O'Connell	NASIC	John Hawkins
NASA Glenn Director	Dr. Marla Perez-Davis	NAMRU-D	Dr. Richard Arnold
AFRL	Mr. Jack Blackhurst	Ohio National Guard	Brig Gen James Camp
NASIC	Mr. Duane Harrison	Industry 1	Dr. T.S. Sudarshan
NAMRU-D	Dr. Richard Arnold	Industry 2	Dr. Suguna Rachakonda
Jobs Ohio	Glenn Richardson	Industry 3	Dr. Angie Bukley
Ohio National Guard	Maj Gen John Harris	OAI Chair	Dr. John Sankovic
Ohio Third Frontier	Karen Conrad	Ohio Third Frontier	Diane Chime
Industry 1	Ricky Peters	DriveOhio	Fred Judson
Industry 2	Salvatore Miraglia, Jr.	Business 1	Matthew Miller
Industry 3 Chair	Maj Gen (Ret.) Mark Bartman	Business 2	Jim Wheeler
Industry 3	James Haywood	Business 3	Jeffrey Banker
Industry 4	Dr. Michael Triplett	NAS Member	Dr. David Aspnes
		Former DHS	Craig Chambers

Figure 4 ERB and TRC Composition

Centers of Excellence (COEs)

The COEs are the collaborative research leads for the OFRN. Based on the OFRN leadership team’s assessment of customer requirements, each has been assigned a designated focus area. The COEs interact with all of the research universities to help frame and submit proposals for OFRN funding. COEs are also responsible for the program management of their project’s subcontractors, ensuring their statements of work are completed and milestones are met. ODHE funding is provided to the COEs on an annual basis, and they conduct a quarterly program review with the OFRN leadership team and support staff. This ensures that submission of deliverables and identification and mitigation of emerging risks to the projects.

In the first two rounds of OFRN funding, only a COE could submit white papers or proposals for OFRN consideration. In an effort to not artificially limit the field of opportunities, OFRN leadership allowed projects to be submitted to the SOARING initiative even if a project was not directly affiliated with a COE. This allowance was also necessary as SOARING projects could also be led by companies, an important pivot from previous rounds to better enable technology integration and commercialization. While the fourth round of funding will be deployed in a similar manner as SOARING, the COEs will be engaged as vital hubs of researcher activity providing a useful vehicle for training researchers to better pursue federal and corporate sponsored research dollars.

For the first two rounds of OFRN funding, the win rate is about 40% for proposals. The OFRN process is highly competitive and the quality of the proposals and the nature of the collaborations has increased with each call for proposals. Only 5 of 17 proposals submitted under SOARING were deemed fully fundable (and only 4 were ultimately funded during FY19), continuing OFRN’s history of being highly selective in its award decisions.



Human Performance and Health Sciences

HPHS – Wright State University/Wright State Research Institute

The research in this COE catalyzes government, academia, and industry collaboration to deliver high-impact solutions to the United States Air Force, United States Navy, NASIC, NAMRU-D, and NASA on human performance and health challenges. HPHS is led by Wright State University and is made up of six academic institutions spread across four projects.

HPHS Vision

Establish Ohio as a global leader in human performance and health science research, technology development, and commercialization



Ohio Center for Power and Propulsion

OCPP – The Ohio State University

This COE focuses to support NASA and AFRL's aerospace power and propulsion needs and reinforce Ohio's position as the world class leader in power and propulsion by leveraging existing expertise and developing economic growth through strong cooperation with Ohio's industrial institutions. OCPP is led by The Ohio State University and is made up of three academic institutions spread across five projects. Its mission is to tackle propulsion and power challenges through a federation of the best intellectual and economic resources, whether from academia, federal labs or from private industry in the state.

OCPP Vision

To assure Ohio's Continued Leadership in Power and Propulsion global markets, which is estimated to be \$50-\$100B over the next 20 years.



Materials and Advanced Manufacturing

M&M – University of Dayton/University of Dayton Research Institute

The projects conducted under this COE are targeted toward high priority government needs in materials and manufacturing which through a cooperative academic, industrial and government laboratory research approach; develop highly qualified college graduates, enabling Ohio industries and government laboratories to grow and excel through additional integrated R&D opportunities. M&M is led by the University of Dayton and is constructed of six academic institutions spread across four projects.

M&M Vision

Develop new jobs in high-value materials and manufacturing related disciplines within the State of Ohio by 2019 for the State Federal Laboratories and related industries in three key material areas: flexible electronics, advanced magnetic materials, and shape memory alloys



Partnership for Research in Energy Storage and Integration for Defense and Exploration of Space

PRESIDES – Case Western Reserve University

This COE aims to improve existing technologies and develop new technologies to better support NASA and AFRL's energy storage needs by leveraging existing expertise to strengthen Ohio's R&D collaborations and enable economic growth in the State. PRESIDES is led by Case Western Reserve University and is made up of seven academic institutions spread across three projects.

PRESIDES Vision

Establishing Ohio as a National Leader in Energy Storage and Integration for Defense and Space Exploration Priorities



Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance

C4ISR – The Ohio State University/Wright State University

This COE is focused on supporting the direct needs of NASA and AFRL in command and control (C2) and information domain oversight. The COE looks to define and document the next generation C4ISR concepts and command center abstractions through innovative approaches to C4ISR infrastructure and systems that enhance decision-making, sensor detection and classification, and communication efficiency and tolerance. C4ISR is co-led by The Ohio State University and Wright State University and is made up of four academic institutions spread across one project.

C4ISR Vision

To build a collaborative network of Ohio universities and industry partners that is nationally competitive in the research, development and commercialization of C4ISR technologies



Advanced Communications, Cyber, Positioning, Navigation and Timing

C2PNT – Ohio University

This COE's research is focused on addressing the electronic communications, cyber, positioning, navigation, and timing needs of the United States Air Force, United States Navy, NASIC, and NASA. C2PNT is led by Ohio University and is made up of four academic institutions spread across two projects. Its mission is to actively engage business and industry partners to promote new business ventures in the C2PNT realm.

C2PNT Vision

To create a true government, university and industry partnership focused on creating new and sustainable markets in the State of Ohio that can address the electronic communications, cyber, positioning, navigation, and timing needs of WPAFB and NASA-GRC

Ohio Federal Laboratories

The Ohio Federal Laboratories are a vital connection for OFRN funded projects and OFRN Principal Investigators. At the outset of the program, the project managers at the labs briefed hundreds of university researchers in special sessions held at NASA-GRC and Wright State University regarding their research priorities. OFRN leadership and staff continually connect

Ohio Federal Laboratories

- ❖ Air Force Research Laboratory (AFRL)
- ❖ Naval Medical Research Unit-Dayton (NAMRU-D)
- ❖ National Air and Space Intelligence Center (NASIC)
- ❖ National Aeronautics and Space Administration – Glenn Research Center (NASA-GRC)

with the labs to ensure the research priorities, which OFRN posts at www.ohiofrn.org, remain up-to-date and reflect both national and local interests. Beyond this, the labs also provide ongoing, direct access to OFRN and are actively engaged in the activities of the TRC and ERB. This engagement enables the TRC and ERB to fully understand how proposed projects align to the specific needs of the labs by active participation in TRC and ERB meetings and in the proposal review process. This interaction does not stop at the TRC/ERB level: there are numerous instances

of OFRN-funded PI's working with their federal counterparts to more deeply tackle the OFRN projects, the formation of new follow-on collaborations, and the labs investing their own capital and time into these efforts.

State Offices and Programs

Since the beginning, the OFMJC, Ohio Third Frontier, JobsOhio, ODoT, the Governor's Office, the Lt. Governor's Office, the Ohio Development Services Agency (ODSA), Legislators, the Adjunct General's Office, and the ODHE, have all been instrumental in the start-up and continued progress of this initiative. It has been a truly collaborative effort in ensuring this program is centrally placed within Ohio's State Government, Ohio's Federal Laboratories, Ohio's Leading Industry, and Ohio's Research Universities' strategic initiatives; thereby ensuring the success of the State's overall goals and objectives for the OFRN.

The Governor's Office and key State Legislators have closely monitored the implementation of the OFRN and have helped with the identification of ERB and TRC members. Regular briefings are provided to key leaders at the State level to keep them abreast of the program's progress and to gain their support for innovative initiatives such as a proposed Challenge Grant. The Governor's Chief of Staff serves as the key point of contact for the Governor's Office.

The Ohio Department of Higher Education (ODHE) has been the key interface for the OFRN leadership team at the State level. The funding for this statewide initiative is contained in the ODHE budget. Regular status reports are provided to the ODHE staff. ODHE also hosts meetings of OFRN's ERB and have arranged the briefings to the Chancellors' Research Officers Council.

The Ohio Third Frontier assists the OFRN by having an executive sit on the OFRN ERB and a Program Manager on the OFRN TRC. They have also assisted in the format of the TRC review meetings and bring a wealth of knowledge on what has and has not worked in their program to this initiative, thereby reducing the amount of time it has taken to get up and running and improving the project selection process.

JobsOhio also provides a key executive to the ERB and the TRC and has also been helpful in the framing and execution of the OFRN. A key outcome measure for the OFRN is jobs creation, and *JobsOhio* has provided assistance in to how best to estimate job creation and what criteria should be used by the OFRN for its proposal evaluation so it can best reflect potential results. *JobsOhio* and the OFRN have enjoyed an especially close relationship, working closely other Ohio agencies to promote Ohio's research network. Through the outreach efforts of *JobsOhio* and their promotion of the OFRN, Ohio's national profile within the UAS and Advanced Air Mobility industry has grown and is frequently cited by national companies as a reason for their interest in creating or growing their Ohio operations.

The Ohio Department of Transportation including the offices of Drive/Fly Ohio and the OFRN staff have worked extremely close in the development and networking of UAS strategies and industry opportunities. Whether engaging participants who are interested in using SkyVision, providing industry input to the FAA or leveraging new research for the advancement of Ohio's autonomous transportation systems, OFRN and ODoT are moving Ohio forward as a leader in UAS.

The Ohio Federal Military Jobs Commission supported OFRN through collaborative efforts with the other key focus areas of the Commission, in particular small business and workforce development. The former Chair of the Commission, Mr. Gary O'Connell, former Chief Scientist of NASIC, also sits on the ERB, as well as observes the TRC white paper and proposal reviews. He has provided significant input on how to better collaborate with the Federal Labs as well as with industry throughout Ohio and continues to keep the TRC focused on the end goal of bringing a significant increase to Ohio's economy.

The Ohio Adjutant General's Department has interfaced with the OFMJC and with the OFRN since their inception. OFRN leadership is currently working with TAG and other key federal organizations to execute OFRN's SOARING initiative. Former Adjutant General, Major General Mark Bartman, serves on the ERB. The current Adjutant General, Major General John Harris, has also been offered membership on the ERB.

THE OHIO FEDERAL RESEARCH NETWORK (OFRN) PROGRAM PORTFOLIO

As of 30 June 2020, the OFRN has funded 28 major projects through four highly competitive procurements. The funded projects will expand and strengthen university research opportunities across the state and boost the commercialization of developing technologies alongside industry partners which will better position Ohio for future federal initiatives.

In anticipation of the FY20-21 State Budget, in June 2019, OFRN announced its fourth request for proposals as part of the SOARING initiative. Project selection was finalized in December 2019. As with the original SOARING effort, OFRN staff sought to engage Ohio universities not currently active in the OFRN portfolio (and those with less than ideal levels of engagement). Specific effort was made to do a "road show" for the fourth round RFP in August and September of 2019 visiting eight universities and organizations throughout Ohio and included stops at smaller institutions, including Heidelberg University, Tiffin University, Bowling Green State University, Miami University, and Youngstown State University.

Strong Linkages and Collaboration across the State

The collaboration amongst university, industry and federal partners has increased dramatically across the state. The COEs involved in the OFRN are currently pursuing over \$200 million in joint proposals against federal R&D contracts. There has already been over \$100 million in proposals submitted that are currently in source selection, and since the inception of OFRN, universities across the state have won approximately \$193 million in new awards including: \$141 million in new awards from the Defense Advanced Research Projects Agency (DARPA), Office of Naval Research (ONR), Air Force Research Laboratory (AFRL), National Aeronautics and Space Administration (NASA), and Intelligence Advanced Research Projects Activity (IARPA), and National Science Foundation (NSF). Another \$50.7 million of corporate sponsored research has also been secured. This shows a dramatic return on the State's original investment in the OFRN program.

Key to the generation of this activity is a requirement that the proposals identify additional procurement opportunities they will pursue if funded by OFRN. In support of this requirement, OFRN provides the participating Ohio universities and

businesses with training for government pre-proposals and proposals. These trainings go well beyond the standard “here are the rules” slide decks one sees on the SBIR roadshow, hitting on grantsmanship and strategy.

Sustaining Ohio’s Aeronautical Readiness and Innovation in the Next Generation (SOARING) Initiative

Soon after the start of this past fiscal year, OFRN completed the source selection process for the SOARING Initiative (alternatively known as Round 4 or OFRN’s Fourth Funding Opportunity). With previous OFRN RFPs, potential projects were first required to submit a white paper. In Round 4, proposals rather than white papers were solicited to cause respondents to address specific technical criteria. A pitch day component was also added to the proposal process. This was to give the proposal teams experience in DoD styled pitch days as part of the proposal selection process.

A total of 31 proposals were submitted. The proposals were led by a mix of universities and businesses. At its first meeting on the Round 4 SOARING initiative, held October 29, 2019 in Columbus, the TRC evaluated and discussed each proposal. From this set of 31, the TRC identified 14 projects that warranted to proceed to pitch at pitch day. Based on the RFP’s aims and listed criteria for proposals, each submitted concept was evaluated by the TRC for alignment to federal research needs, project feasibility, potential economic impacts, budget & cost share, and team qualifications. The proposals that were not selected exhibited fundamental flaws or major misalignments with the Round 4 SOARING initiative. The TRC ultimately recommended funding for six of the proposals.

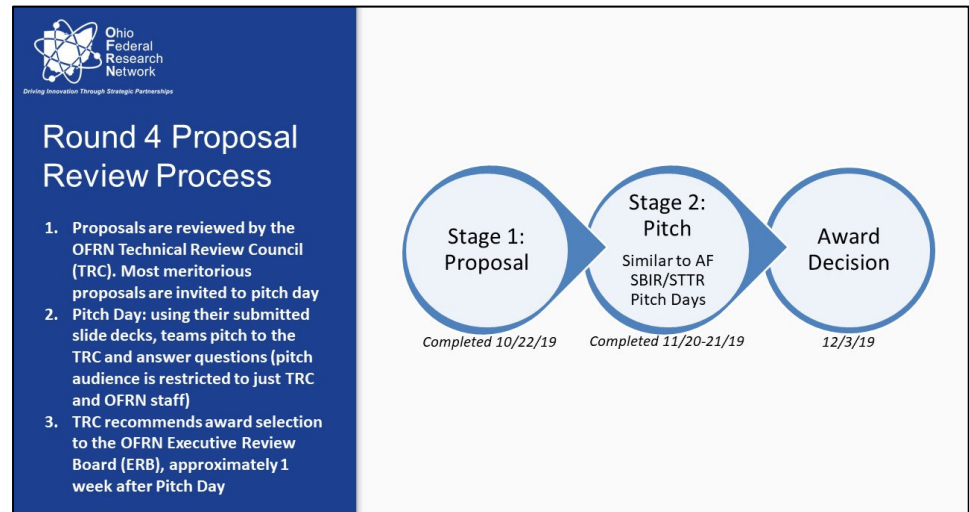


Figure 5 Round 4 Proposal Review Process

Considering one of the many aims of the OFRN is to lift up the competitiveness of the State’s research institutions for AFRL and similar funding opportunities, the TRC decided to utilize a categorization scheme similar to those used by DOD in proposal reviews, but with appropriate modification for the OFRN effort and process:

Category 1: Demonstrates technical merit and is consistent with OFRN goals. The offeror presents relevant experience and access to adequate resources. Risk is acceptable. The cost/price is reasonable and realistic. Proposals in Category 1 are recommended for acceptance (subject to availability of funds) and normally should only be displaced by other Category 1 proposals.

Category 2: Demonstrates technical merit and is consistent with OFRN goals. The offeror presents relevant experience and access to adequate resources; however, the project as presented *requires further development*. Risk of the project is generally viewed as acceptable. The cost/price is reasonable and realistic. Category 2 proposals are not recommended for acceptance as presented, but could be recommended as smaller, “seedling” concepts should OFRN secure additional funding (see Recommendation 3)

Category 3: Proposals in this category are not recommended for acceptance, as they exhibit one or more of the following characteristics: the offeror does not demonstrate sufficient technical merit, does not meet OFRN needs,

does not present adequate experience or resources, the risk level is unacceptable, or the cost/price is not reasonable or realistic.

The following table lists the six recommended proposals.

Category	Proposal #	Title (Lead Applicant)
1	405	CHIRP2C: Computer-Human Interaction for Rapid Program Analysis through Cognitive Collaboration (Riverside Research)
	417	Multi-purpose Mast/Aerial 360O radar/optical fused sensors for Perimeter Monitoring and Aerial Detect and Avoid (GhostWave, Inc.)
	421	Geometrically-Complex 3D Printed Antennas for UAVs (Youngstown Business Incubator (YBI))
	422	Resilient and Secure UAS Flight Control (Asymmetric Technologies)
	424	Interoperability, Resiliency, and Contingency Management for Ohio UAS Operations (CAL Analytics)
	428	A Hybrid Fuel Cell-Battery-Capacitor Power Source for UAS (Kent State University)

The six awarded proposals are summarized as follows:

405: CHIRP2C: Computer-Human Interaction for Rapid Program Analysis through Cognitive Collaboration (Riverside Research) CHIRP2C is an innovative, non-invasive multi-modal system that provides proactive, dynamic, intelligent collaboration between humans and AI agents to rapidly discover software vulnerabilities and accelerate the reverse engineering process and produce an active counter-UAS system.

417: Multi-purpose Mast/Aerial 360O radar/optical fused sensors for Perimeter Monitoring and Aerial Detect and Avoid (GhostWave, Inc.) Sensor Fusion of Stealthy Radars Immune from Jamming with Cameras for 360O cUAS Surveillance for FOBs.

421: Geometrically-Complex 3D Printed Antennas for UAVs (Youngstown Business Incubator (YBI)) In this work, lightweight, complex 3D printed antennas will be fabricated and implemented on UAV platform to address the communication requirements of the ADS-B protocol. Four printing processes will be explored in the context of three UAV structural features to implement and demonstrate a novel omnidirectional antenna in flight by the end of the period of performance.

422: Resilient and Secure UAS Flight Control (Asymmetric Technologies) Asymmetric's IronClad Secure Flight Controller with three resiliency/security enhancements: state-estimation controllers for fault-tolerant UAS control, directly integrated detect and avoid autonomy, and physically unclonable function modules for enhanced cybersecurity.

424: Interoperability, Resiliency, and Contingency Management for Ohio UAS Operations (CAL Analytics) Produce a UAS Interoperability Study describing how the various systems and use cases that Ohio is interested and investing in integrate and function together. Address a known gap through integration of a Contingency Management Platform (CMP) for improving health & integrity monitoring and situational awareness in the Ohio DOT UTM and SkyVision ecosystems.

428: A Hybrid Fuel Cell-Battery-Capacitor Power Source for UAS (Kent State University) The overall objective is to develop a lightweight high energy density (400 W-h/kg) on-board power source to enable UAS to have extended flight time and increased payload. The proposed power source is a hybrid power system that incorporates the complementary strengths of fuel cells, modern batteries and high-power density capacitors. A simulation of the hybrid power source will create a matrix to facilitate the selection of the appropriate fuel cell, battery and supercapacitor combinations for missions based on the

requirements of flight time and payload. Flight time of up to 12 hours will be demonstrated using a simulated power load in a laboratory. Upon completion of the 18-month project, a demonstration will be conducted using the hybrid power source to fly a VTOL UAV for 60 minutes

Technologies developed under SOARING will be demonstrated in simulated emergency scenarios in coordination with the Ohio National Guard. The selected OFRN teams will be focused on creating technologies to support in-field disaster response and their associated support or base flight systems. Demonstrations will be conducted using the Ohio/Indiana UAS Center in Springfield, OH, the Springfield Airport, and/or Calamityville in Fairborn, OH. The demo event is anticipated to occur in Fall 2020; however, the scope of the demos could change based on COVID-19 restrictions at that time.

COMMERCIALIZATION & INDUSTRY SPONSORED RESEARCH ACTIVITIES

Commercialization

Each OFRN-funded project has been designed to enable university research to solve a federal need while also enabling commercialization and economic impact in the State. In under four years, OFRN has attracted over \$193 million in new research awards, and OFRN teams are seeking over \$350 million more in the pipeline. OFRN's industry-led success rate exceeds that of any other Ohio university-led funding effort.

M&M: Materials and Advanced Manufacturing

High Performance Plastic Substrates for Flexible Electronics Project

- SABIC Venture Capital (Cambridge, MA) is finalizing an investment into an Ohio small business partner to the University of Toledo (UT) for next generation automotive polycarbonate and acrylic polymers technology. The OFRN has led this effort, including recruiting SABIC Ventures to open an Ohio office, post transaction, for future technology investment into Ohio companies. Currently SABIC Ventures has offices at MIT (Massachusetts Institute of Technology) but no presence in Ohio. This is the first SABIC Ventures investment into an Ohio small business.
- The Atlas Venture Group (AVG) (Manhattan, NY) Private Equity firm is investing over \$30M into the newly formed Toledo Solar Inc. Toledo Solar is the newest thin-film Photo Voltaic manufacturer in the United States, with an initial value estimated of \$100M and could create over 65 new manufacturing and engineering jobs in 2019.
- AK Steel (Dayton, OH) is now engaged on a commercial/University R&D project for incorporating Silicon encapsulated steel into a Solar PV panel. This effort, if successful, is being financed completely by Industry and will be tested at the University of Toledo (UT). Any IP that derives from this research will be jointly owned by Toledo Solar Inc, AK Steel, and UT.
- Orbital Research Inc. (Cleveland, OH) has licensed polymer IP from the University of Akron (UA) and is prototyping Virtual Reality (VR) based headsets that are derived from OFRN and AFRL based cockpit hardware for a major Japanese mobile device manufacturer.

Adaptive Bio-Inspired Aerospace Structures Actuated by Shape Memory Alloys Project

- IP created at the University of Toledo (UT) and The Ohio State University (OSU) has been licensed by two new startups- **Regenfix LLC, and Thermomorph LLC.**
 - Thermomorph LLC has recently been approved for FDA clinical trials for their newly created pulmonary thrombosis removal device technology.
 - New technology for the 3D printing of Nitinol for medical implants has allowed Regenfix to engage in a Letter of Intent for investment and clinical trial support from **Norman Nobel (Cleveland, OH)**- a global leader in medical implant manufacturing.
 - Regenfix LLC has received a commitment for \$5M of equity investment capital from a Michigan-based Venture Capital group.
 - **Atlas Materials LLC** has been formed in 2019 in partnership with the University of Toledo to commercialize the manufacturing of NiTi powders for additive manufacturing of Nitinol based implants.

High Temperature Soft Magnetic Materials Project

- Technology created at Case Western Reserve University (CWRU) has resulted in the formation of a Cleveland-based startup **Fenix Magnetism LLC** to address a \$20B annual global market. Fenix has been Venture Capital financed by Silicon Valley-based Inner Product Partners LLC; a Venture Capital group formed by former DARPA leadership.
- **Case Western Reserve University (CWRU)** has created an Ohio based commercial spin out Thermotech LLC that is based upon thermally conductive graphene additive based polymers.

Laser Clad Welding Project

- Next generation Laser Clad Welding technology developed by **Lincoln Electric (Cleveland, OH)** and Case Western Reserve University (CWRU) has been fully licensed and commercialized by Lincoln Electric Inc. **Lincoln Electric** has committed over \$5M in R&D and commercialization efforts thus far into this project.

HPHS: Human Performance and Health Sciences

Regional Live Virtual Constructive Assistant Project (RLVC)

- Technology created at Wright State University (WSU) built on the Amazon Alexa platform has resulted in a Public/Private partnership between Michigan-based **Rubix Technologies LLC, WSU and CareSource Inc.**
- In 2019, WSU and Rubix Technologies LLC hope to announce the joint formation of a Dayton-based startup to sell a Software as a Service (SaaS) Data Analytics and Alexa skill development company that specializes in home health care for CareSource's Medicaid clients. Currently engaged in talks with Amazon Alexa Venture Fund for an initial investment and strategic partnership for the new Dayton startup.

Advanced Cognitive and Physical Sweat Bio Sensing Project

- Created at the University of Cincinnati (UC), this technology seeks analytes present in sweat through a novel wearable sensor system. Core components are patented and licensed to a venture-backed start up in Cincinnati, **Eccrine Systems LLC**, who with the OFRN UC PI has successfully achieved follow-on funding from the Air Force Research Laboratory and other sources in excess of \$4.5 million with more than \$2 million additional funding pending. Eccrine is expected to achieve market entry in early 2019.
- A new spin out company, Amplify Sciences, has been founded to further commercialize other technologies developed as a direct result of this project. In early 2019, Amplify pitched to Y-Combinator and is pursuing SBIR/STTR opportunities.
- Continued work with AFRL on next generation biosensing technology. We are working with Steve Kim and Saber Hussain at AFRL, have submitted on paper for publication, and have a 2nd one in progress with them.

Motion Sickness Interaction with Spine Disorders Project (MOSSD)

- Spine disorders leading to back pain is a common ailment in the population at-large. Back problems are of particular interest to military aviators as they can be the cause of lost pilot airtime as well as spatial disorientation leading to disastrous ends. This project implements a device and database developed at the Ohio State University (OSU) and licensed to start-up **SpineDynX LLC** to examine the link between spine disorders and motion sickness. The strong partnership between the OSU PI and the team at the Naval Medical Research Unit at Wright-Patterson Air Force Base (WPAFB) has led to joint proposals to further development. Application of the lumbar motion monitor (LMM) used in the research is providing reference data and validation of the technology necessary for partner SpineDynX LLC to commercialize a clinical version of the device.
- Work continues with two different software development companies (Switchbox and Priority Design) to build a commercially usable device platform that extends the ideas behind the OFRN technology.
- We have been able to secure an STTR award, an SBIR award and two NIH awards based upon the connections developed under this process. These effort total nearly \$4M.
- We have been awarded an NSF I/UCRC award as well as a couple of other smaller DoD awards

Sliding-Scale Autonomy through Physiological Rhythm Evaluation Project (SAPHYRE)

- The technology developed, derived from pilot flight systems data and analysis provided by the United States Air Force, has been commercialized by Dayton-based **Perduco Inc.** Additionally, Perduco has created 3D visual

analytics systems and real time haptic feedback instruments that are being transitioned to various areas at the DoD and the commercial sector.

C2PNT: Advanced Communications, Cyber, Positioning, Navigation and Timing

Test and Evaluation of Autonomous Systems Project (TEAS)

- **Galois, a Portland Oregon-based company has opened an office in Dayton, Ohio** to commercialize technology created at Wright State University (WSU) and the Air Force Research Laboratory (AFRL). Galois has recently created a new Ohio-based spin out, **Tangram Flex**, to take this core research beyond the DoD markets. Tangram Flex has already had a major success: in December 2018, the company successfully raised \$4.5M in out-of-state seed funding.
- The secure software development methods that Galois developed are still going strong. They spun off Tangram Flex based on the work done under TEAS. I don't have insights into what Tangram Flex is currently doing, but they are based in Dayton and they appear to have hired a lot of people.

Intelligent Channel Sensing, Secure, Cross-Layer Communication Project

- Ohio based company created in 2018, Wish Technologies. Currently working through institutional channels to transfer the spectrum analysis aspect of this project into the new company for further development, licensing and production.
- This project combines multiple technology innovations in spectrum analysis and communication, security and encryption, cognitive radio and machine learning to provide secure and persistent communication on land, air and space systems, which has several commercial applications where communication is congested such as cellular systems, or where spectrum analysis and interference mitigation is critical such as space to ground data transmission.
- Invention disclosures are in process with the lead organization, Wright State University, and connections made with Ohio companies for commercialization of key project components, as well as industry partner in satellite communication in Westlake, Ohio, **Comsat Architects, Inc.**

GPS Denied Environments

- This project has created an Augmented Reality (AR)-based flight training system.
- The project utilizes "Intelligent" Data Analytics to determine critical pilot performance from hand and eye movements.
- A private flight training company (NDA restricts release of company name) based in Ohio has partnered with Ohio University and Wright State Research Institute to develop the technology.

OCPP: Ohio Center for Power and Propulsion

Power Components and Electronics Project

- IP has been created at the Ohio State University (OSU) for two new power electronic devices:
 - Next generation Power Converters
 - Next generation Electric Motors
- These components are currently being evaluated in prototype by GE Aviation and **Honda** for potential 'bench testing' for next generation the aviation and automotive industries, respectively.
- \$10M/ year for 5 years (total \$50M) in additional funding has been introduced to the OSU OCPP COE by NASA in partnership with **GE Aviation** for continued research.
- Won a Department of Energy phase 1 STTR with industry partner **Asymmetric Technologies, LLC** on new brushless motor designs. These designs have already garnered interest from **Ford Motor Co.** for use in hybrid vehicles
- Added new industry partner, **Safran S.A.**, regarding the electric motor design portion of the OFRN project.

Advanced Turbine Cooling Project

- IP created at The Ohio State University (OSU) for advanced sensors and turbine blade design has been licensed to Honeywell Inc., a major supplier of turbine blades for the aviation and natural gas turbine blade industries.
- As a direct result of the OFRN project, **Pratt & Whitney** recently entered into a substantial partnership with OSU's Gas Turbine Laboratory to establish the Pratt & Whitney Center of Excellence. This new Center of Excellence will allow Pratt & Whitney to partner with OSU's best minds in order to help solve industry-wide problems and advance Ohio's standing as a leader in jet engine technologies.

- There have also been new commercialization opportunities in the form of continuing industry research grants to pay for information that will feed into their proprietary design systems. The \$9.5M Pratt & Whitney Center of Excellence for Blade Tip Rubs remains a major part of our work efforts. In addition, Honeywell has put in \$235k at OSU for 2020 to support the ongoing research related to the OFRN experiment. They have also continued funding work at AFIT at a lower level.
- There has been ongoing technology development on two fronts. In regard to the experiment funded by OFRN and Honeywell, we are using the extensive data set developed as part of OFRN to help validate new advanced modeling techniques proposed by Honeywell and OSU. This work is still in progress but is promising. Additionally, a primary focus of the OFRN project was the development of a method for taking infrared images of rotating blades. That technology has gone on to form a key part of our new collaboration with Pratt & Whitney, and we have continued to develop the camera timing and image processing tools to work even better for the new project.

PRESIDES: Partnership for Research in Energy Storage and Integration for Defense and Exploration of Space High Energy/Power, Long Cycle Life, Thermally Safe Lithium Sulfur (Li-S) Battery Project

- The Li-S battery project at the University of Dayton Research Institute (UDRI) has resulted in three issued patents with several more currently under process.
- Several of the current patents for a solid-state electrolyte have been licensed for over \$2M to a Global top 2 smartphone and device company.
- Xerion Battery, from Illinois, has relocated to Dayton, OH and is in the process of prototyping with UDRI a next generation solid state Li-S battery that will produce energy with little environmental or thermal runaway liabilities.
- Filled patent (J. Kumar, Y. Wang and L. Estevez, Solid-state lithium sulfur batteries and methods of making, U.S. Provisional Patent Application Serial No. 62/825,361(2019) work on Solid state Lithium – sulfur battery. We are also developing novel structural battery based on solid-state lithium battery.

High Energy Density Li-Ion Battery Based on Advanced Silicon Anodes Project

- Silicon anodes would greatly increase the energy density of batteries enabling longer life in all application; however, there are issues with the rapid degradation of silicon in charge\re-charge cycles. A novel binder developed by University of Akron (UA) research is being employed, along with industry partner pH Matter LLC in Columbus, Ohio, to overcome the technical issues in the use of silicon anodes.
- Provisional patent filing by UA led to technology option to pH Matter and the creation of new start-up, Akron PolyEnergy, Inc. The OFRN team on this project has successfully won additional follow-on funding, together and separately, more than \$1.6 million from NASA, NSF, DoE, and Rev1 Ventures.
- Through OFRN connections, pH Matter has pulled a North East Ohio ESP collaborator, The Tech Belt Energy Innovation Center, into a DOE EERE proposal for reversible fuel cell technology. That project is valued at more than \$1.2 million for Ohio-based organizations.

Multi-Functional, Structural Energy Storage Project

- Working with the Akron-based industry partner, Event38, the Case Western team developed a replacement wing for a small UAV with embedded energy storage capabilities. The test flights at the Springfield test field proved significant increases in endurance/range and loiter time. The team is now jointly pursuing Small Business Technology Transfer funding to establish a fieldable replacement wing for a UAV in the DOD inventory.

C4ISR: Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance Human Centered Big Data Project (HCBD)

- New software methods for ‘de-black-boxing’ algorithms inherent to AI learning methods created at Wright State University (WSU) and The Ohio State University (OSU) are currently under Invention Disclosure and IP review at WSU. **A spin out company, Kairos Research, has been formed to commercialize these algorithms.**
- Current industry partner **Paxata Inc**, a San Francisco-based software company has recently opened an office in Columbus, Ohio in partnership with In-Q-Tel as a partner. Paxata is currently reviewing the technology for potential deployment into the Health Care Clinical Trial Analytics markets for simulated drug trials.
- Wright State University researchers on the HCBD team have formed a thriving collaborative relationship with Kairos Research, LLC. Their collaborative research activities have led to numerous federal grant proposals and at least one major federal contract win.

- Based on relationships and expertise developed under the HCBP program, Wright State researchers on the HCBP team have formed a collaborative partnership with Tenet3 corporation. WSU researchers are providing technical capabilities and research in support of Tenet3 in the area of natural language processing.

Training

In addition to providing commercialization support services, OFRN also engaged consultants (Burr Zimmerman of UVG, Ltd, Chris Mathers of Leveragent, and Michael Camp of OSU) to provide grantsmanship, pitch, and customer discovery training to companies and researchers tied to OFRN's projects, COEs, and Round 4 proposers. This pilot effort was in the form of a Proposers day on September 26, 2019, and one-on-one pitch training sessions for the selected proposals

The Proposers Day started with a presentation by OFRN with background and information on the Round 4 RFP. This was followed by a seminar from UVG, Ltd on grantsmanship and proposal training. The seminar covered training on the general proposal tips as well as the OFRN Round 4 RFP proposal components including the Technical Volume, Cost Volume, and supplemental Volumes including the Pitch Deck. Michael Camp facilitated a session on Customer Discovery with the objectives of: develop an understanding of how to gather the data and insights needed to construct a compelling narrative that differentiates your proposal; be able to clearly demonstrate (with evidence) how your technology solves a significant problem and creates sustained value for the target customer(s); and understand how to use the discovery process to identify, qualify and secure partners and sponsors (with funding) for whom your platform aligns with their emerging missions and research focus areas.

The fourteen selected proposal teams participated in a pitch training seminar on November 5, 2019 facilitated by Leveragent. This consisted of a half day group session to prepare the teams for the November 20-21, 2019 Pitch Day for the finalists. All teams were represented at the session. Participants received recommendations on how to create a winning OFRN pitch presentation and pitch delivery. Topics included: quad charts; SWOT charts; creating your story; and the components of a compelling, compact presentation. This session was followed by two one-on-one sessions for each proposal team to prepare for Pitch Day. In session one, teams received feedback on their presentation. Teams incorporated the feedback received in session one for a follow up session two to fine tune the presentation for Pitch Day.

FINANCES - OFRN PROGRAM FUNDS ALLOCATION/EXPENDITURES

Total State Operation Funding for the OFRN programs for defense, aerospace, workforce development and federal defense emerging mission is \$41.8 million for FY 16 through 20. This consists of four line items in the State Budget: (1) \$20 million designated for WSARC, (2) \$5 million designated for OSU, (3) \$6.9 million designated for OSU, and (4) \$9.9 million also designated for OSU. \$25 million was allocated to the OFRN program for research projects executed by the COEs, for commercialization and workforce development activities of Lorain County Community College and Cleveland State University, legacy aerospace development projects, special projects, consultants, administration, and training. \$6.9 million is designated for the Round 3 SOARING programs. \$9.9 million is designated for the Round 4 SOARING programs. A breakdown of the funding is displayed in Figure 5.

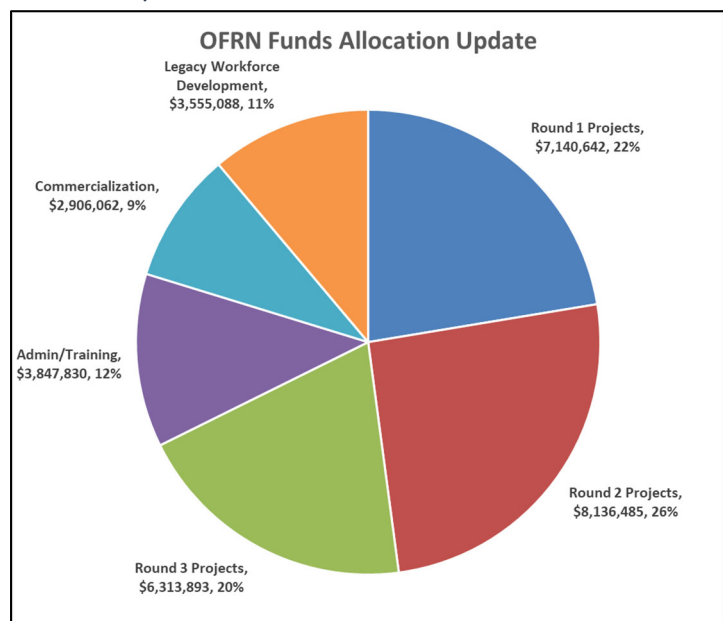


Figure 5 OFRN Allocated Funds

Operations/Administrative Costs of the OFRN.

Consistent with the legislative intent, The Ohio State University and Wright State Research Institute have subcontracted to allocate the \$5 million from ODHE to support COE activities, \$6.9M to support the Round 3 SOARING program, and \$9.9M to support the Round 4 SOARING program. Figure 6 shows the funding allocation and expenses as of 30 June 2020 across all projects and funding rounds.

ODHE-WSARC (OFRN) MOU Section 369.455 of Amended House Bill 64 of the 131st General Assembly, Defense/Aerospace Workforce Development Initiative									
Budget Categories	Round 1 Projects	Round 2 Projects	Round 3 Projects	Admin/Training	Commercialization	Legacy Workforce Development	Total Budget	Total Expensed	Balance
PRESIDES COE - Case Western Reserve	\$1,633,806						\$1,633,806	-\$1,633,806	\$0
OCPP COE - The Ohio State University	\$2,005,537	\$1,739,609					\$3,745,145	-\$3,745,145	\$0
M&M COE - University of Dayton	\$2,007,377	\$1,017,061					\$3,024,438	-\$3,024,438	\$0
HPHS COE - Wright State University	\$1,493,922						\$1,493,922	-\$1,493,922	\$0
C4ISR COE - Wright State University		\$1,200,000					\$1,200,000	-\$1,149,841	\$50,159
C2PNT COE - Ohio University		\$20,118					\$20,118	-\$20,118	\$0
C&WD Team - Cleveland State University					\$1,108,000		\$1,108,000	-\$1,108,000	\$0
C&WD Team - Lorain County Community College					\$974,884		\$974,884	-\$974,884	\$0
OFRN Legacy Workforce Development Programs						\$3,555,088	\$3,555,088	-\$3,555,088	\$0
OFRN Administration				\$2,757,517	\$487,082		\$3,244,599	-\$2,863,682	\$380,918
Subtotal	\$7,140,642	\$3,976,787	\$0	\$2,757,517	\$2,569,966	\$3,555,088	\$20,000,000	-\$19,568,923	\$431,077

ODHE-OSU (OFRN) MOU Section 369.473 of Amended House Bill 64 of the 131st General Assembly, Emerging Missions and Job Growth Opportunities									
Budget Categories	Round 1 Projects	Round 2 Projects	Round 3 Projects	Admin/Training	Commercialization	Legacy Workforce Development	Total Budget	Total Expensed	Balance
C2PNT COE - Ohio University		\$2,087,478					\$2,087,478	-\$2,087,478	\$0
HPHS COE - Wright State University		\$2,072,220					\$2,072,220	-\$2,072,220	\$0
OFRN CONSULTANTS				\$43,019	\$180,317		\$223,337	-\$223,337	\$0
OFRN ADMIN G&A				\$40,255			\$40,255	-\$40,255	\$0
OSU PROJECTS & ADMIN				\$576,710			\$576,710	-\$576,710	\$0
Subtotal	\$0	\$4,159,698	\$0	\$659,984	\$180,317	\$0	\$5,000,000	-\$5,000,000	\$0

ODHE-OSU (OFRN) MOU Section 381.440 of Amended Substitute House Bill 49 of the 132nd General Assembly, Emerging Missions and Job Growth Opportunities									
Budget Categories	Round 1 Projects	Round 2 Projects	Round 3 Projects	Admin/Training	Commercialization	Legacy Workforce Development	Total Budget	Total Expensed	Balance
PERSISTENT SURVEILLANCE SYSTEMS			\$1,998,349				\$1,998,349	-\$1,363,733	\$634,615
GHOST WAVE			\$1,344,597				\$1,344,597	-\$621,042	\$723,555
UNIVERSITY OF CINCINNATI			\$968,947				\$968,947	-\$147,016	\$821,931
OFRN CONSULTANTS				\$58,207	\$155,779		\$213,986	-\$135,018	\$78,968
WSARC UNALLOCATED				\$13,049			\$13,049	\$0	\$13,049
OSU PROJECTS & ADMIN			\$2,002,000	\$359,072			\$2,361,072	-\$576,710	\$1,784,362
Subtotal	\$0	\$0	\$6,313,893	\$430,329	\$155,779	\$0	\$6,900,000	-\$2,843,520	\$4,056,480

Grand Total	\$7,140,642	\$8,136,485	\$6,313,893	\$3,847,830	\$2,906,062	\$3,555,088	\$31,900,000	-\$27,412,443	\$4,487,557
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Figure 6 OFRN COE Allocation | Funded | Expensed

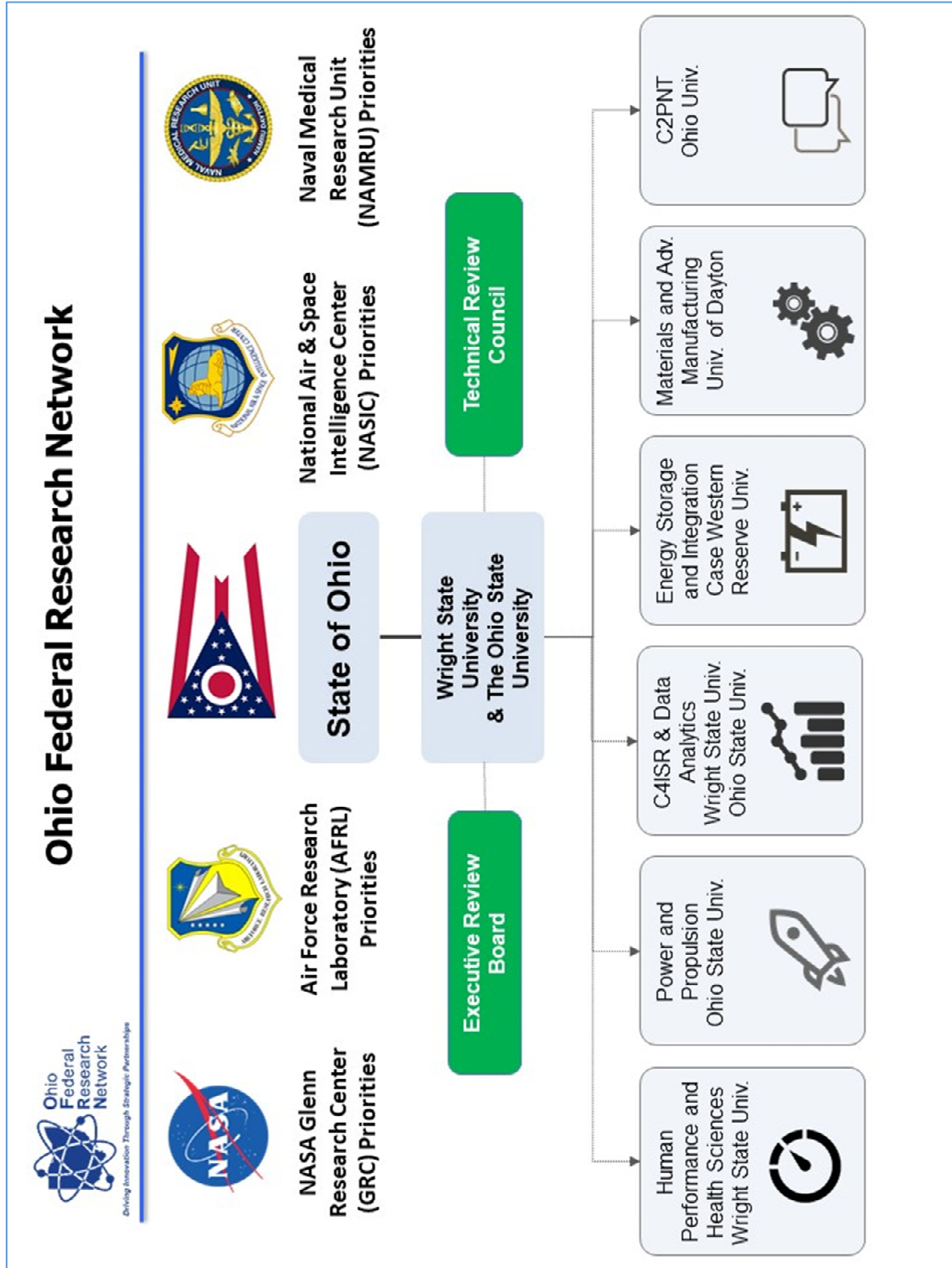
NEXT STEPS

Going forward, OFRN will continue to:

- Work to secure additional funds to enable funding of all recommended SOARING proposals
- Expand Ohio technology commercialization opportunities
- Leverage the seed funding provided by the State of Ohio to expand the OFRN federal R&D portfolio and to integrate key technical assets across the state
- Work actively with OFRN's federal partners Statewide to address pressing requirements and to pursue new funding sources
- Use OFRN's projects and activities to train the next generation of systems engineers and thinkers to meet emerging government and industry workforce needs
- Continue to use competitive Challenge Problems to address the emerging industry and military requirements
- Continue OFRN's collaborative research activities with the State's R&D universities and businesses using project technologies to address national challenges
- Enhance OFRN's efforts to brand the State of Ohio as a key enabler of emerging systems and technologies -- the source of innovative systems solutions

During the next year, OFRN leadership and staff intend to continue to engage with industry, academia and all levels of government throughout the state, to promote future Opportunity Announcements and to continue to build multi-disciplined teams that further Ohio's national leadership in research, development, testing and manufacturing. The OFRN team also plans to continue student participation and engagement through active learning opportunities created by future projects. Today, the OFRN is recognized by a growing list of supporters and participants as a statewide resource and builder of strategic partnerships that is delivering economic impact and workforce development for the State.

APPENDIX 1 – OFRN PROJECT OVERVIEW





WPAFB / GRC Mission Applications Driven Centers of Excellence (COEs)

Projected Growth over 5 years: 2,500 new jobs for Ohioans
\$350 million in new federal research contracts to Ohio based universities and companies

Application Domains	Human Performance and Health Sciences	Power and Propulsion	Materials and Manufacturing	Energy Storage/Integration	Command, Control, Communications Computing Intelligence & Surveillance (C4ISR)	Advanced Communications Precision Navigation and Timing (PNT)
<ul style="list-style-type: none"> Aerospace Systems <ul style="list-style-type: none"> Manned Remotely Piloted Hyperersonic Space Systems <ul style="list-style-type: none"> Manned Unmanned Cyber Systems <ul style="list-style-type: none"> IT Weapon Systems Modeling/Simulation/Analysis Commercialization & Technology Transition Small / Med Business Growth Connections to Business Workforce Development <ul style="list-style-type: none"> STEM Skilled Unskilled <p>Primary Support: All Universities to specifically include UC, UD, KSU, Miami, BGSU, Central WSU, Stark State, Clark, UA, UT, CSU, Lorain, Case, Sinclair, OU, OSU</p>	<ul style="list-style-type: none"> Autonomy LVC Training Neuroscience Aerospace Physiology /Toxicology Biosensors / Biomarkers Human Machine Teaming RPA Operations <p>Existing AHEAD</p> <p>Lead: WSU Primary Support: UC, UT, OSU, Case, UD, KSU, CSU, Sinclair, Lorain, Clark, Jobs Created: 575 Contracts Awarded: \$167M Private Sector Investment: \$150M Project 25% Y/Y Growth</p>	<ul style="list-style-type: none"> Hybrid Electric Power and Propulsion Solar Electric Power and Propulsion Advanced Turbine Engines Energy / Fuels Energy Storage / Retrieval On-board Power Systems <p>Lead: OSU Primary Support: UC, UD, UA, UT, CSU, Lorain Potential Jobs : 400 Potential Contracts: \$100M Potential Private Sector Investment: \$50M</p>	<ul style="list-style-type: none"> Nanomaterials Sustainability Additive Manufacturing Ceramics Composites Materials for Adverse Conditions Flexible Electronics <p>Lead: UD Primary Support: YSU, OSU, UA, Case, UC, UT, CSU, KSU, Lorain, Sinclair, Clark, Central Potential Jobs : 600 Potential Contracts: \$150M Potential Private Sector Investment: \$75M</p>	<ul style="list-style-type: none"> Batteries Supercapacitors Green Technologies Rapid charge/ discharge-cycling Micro-devices <p>Lead: Case Primary Support: UT, OSU, UD, UC, CSU, Lorain Potential Jobs : 200 Potential Contracts: \$50M Potential Private Sector Investment: \$10M</p>	<ul style="list-style-type: none"> Human-Centered ISR Data Analytics Data Compression / Analytics Processing Exploitations and Dissemination Infrared (IR), Electro-optical (EO), Laser, RF, Hyperspectral, Acoustic, & Radar Sensors Space Situational Awareness Electronics Warfare (EW) <p>Lead: WSU/OSU Primary Support: UD, OU, BGSU, Case, UT, UC, Miami, Sinclair Potential Jobs: 600 Potential Contracts: \$150M Potential Private Sector Investment: \$75M</p>	<ul style="list-style-type: none"> Directed Energy Offensive and Defensive EW Novel Payloads Avionics Next Gen Global Positioning Systems (GPS) Space Communications Tactical Communications RF Spectrum Management FCC Advanced Algorithms Digital Systems <p>Lead: OU Primary Support: WSU, OSU, KSU, UD, Miami, Lorain Potential Jobs : 300 Potential Contracts: \$75M Potential Private Sector Investment: \$25M</p>

ROUND 1 TECHNICAL AWARDEES

Awardee	COE	Award Amount	Cost Share	Partners
Case Western Reserve University	The Partnership for Research in Energy Storage (PRESIDES) Center of Excellence	\$1.6 million: (\$800k in year 1; \$800k in year 2)	\$750,000 University Partners: \$640,282 Small Business: \$39,718 Large Business: \$70,000	University Partners: Ohio State University, University of Akron, University of Toledo, University of Dayton Industry Partners: Small Business: pHMatter LLC, CRG Inc, UES Inc., CAR Technologies LLC, Large Business: Lubrizol Advanced Materials, Inc., GrafTech International Holdings Inc.; Americarb
University of Dayton	The Materials and Manufacturing (M&M) Center of Excellence	\$2 million: (\$1MM in year 1; \$1MM in year 2)	\$1,694,531 University Partners: \$1,648,531 Small Business: \$46,000 Large Business: \$0	University Partners: University of Akron, Case Western Reserve University, Ohio State University, University of Cincinnati, University of Toledo, Ohio University, Youngstown State University Industry Partners: Small Business: Akron Polymer Systems, Lucintech Inc., Orbital Research Inc., Hana Microdisplay Technologies Inc., Norman Noble Inc., Electrodyne Large Business: GE Aviation, Lincoln Electric, Eaton
Ohio State University	The Ohio Center for Power and Propulsion (OCP) Center of Excellence	\$2 million: (\$750k in year 1; \$750k in Year 2; \$500k in year 3)	\$1,633,514 University Partners: \$1,633,514 Large Business: Phase 2 Possible \$995,000 from GE Aviation	University Partners: University of Akron, University of Dayton Industry Partners: Small Business: Orbital Research, Inc., Large Business: Emerson Network Power, Meggitt-USA Inc., Parker Hannifin Corporation, GE Aviation
Wright State University	The Human Performance and Health Science (HPHS) Center of Excellence	\$1.5 million: (\$745k in year 1; \$755k in year 2)	\$854,536 University Partners: \$704,795 Small Business: \$149,741 Large Business: \$0	University Partners: University of Cincinnati, University of Toledo, AFIT, Case Western Reserve University Industry Partners: Small Business: The Perduco Group, Advanced TeleSensors Large Business: University of Toledo Medical Center, Dayton Children's Hospital, Crown Equipment, University Hospitals Case Medical Center, University of Cincinnati Medical Center, Premier Health, Red Bull

ROUND 2 TECHNICAL AWARDEES

Awardee	COE	Award Amount	Cost Share	Partners
Ohio State University and Wright State University	The Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) Center of Excellence	\$1,200,000 (Yr1: \$585,034 Yr2: \$614,966)	\$693,117 University Partners: \$559,117 Small Business: \$134,000 Large Business: \$0	COE Partners: HPHS COE University Partners: Ohio University, Case Western Reserve University Industry Partners: Small Business: Tenet3, Perduco, DesignKnowledge, Illumination Works, DelphicDB, Columbus Collaboratory, Amperand, MatchTx Large Business: Hewlett Packard, Lexis Nexis, Ipsos, Nuance
Ohio University	The Advanced Communications, Positioning, Navigation and Timing (C2PNT) Center of Excellence	\$2,100,002	\$2,176,046 University Partners: \$726,046 Small Business: \$1,325,000 Contingent \$4,200,000 Large Business: \$0 Federal Partner Contingent: \$1,250,000	COE Partners: HPHS COE University Partners: Wright State University, Air Force Institute of Technology Industry Partners: Small Business: Galois, Inc., Comsat Architects, GIRD Large Business: None
University of Dayton	The Materials and Manufacturing (M&M) Center of Excellence	\$1,097,197 (Yr1: \$570,433 Yr2: \$526,764)	\$1,413,139 University Partners: \$1,353,139 Small Business: \$40,000 Large Business: \$20,000	University Partners: Case Western Reserve University, Ohio University, University of Cincinnati, Wright State University, Youngstown State University Industry Partners: Small Business: NONA Composites, Cincinnati Inc. Large Business: Orbital ATK, GE Aerospace
Ohio State University	The Ohio Center for Power and Propulsion (OCPP) Center of Excellence	\$1,999,838 (Yr1: \$872,120 Yr2: \$1,127,715)	\$2,614,219 University Partners: \$1,614,219 Small Business: \$0 Large Business: \$1,000,000	University Partners: University of Dayton, Case Western Reserve University, University of Cincinnati, The Ohio State University, Air Force Institute of Technology Industry Partners: Small Business: Innovative Scientific Solutions, Inc. Large Business: Honeywell, Battelle

ROUND 3 TECHNICAL AWARDEES

Awardee	Project	Award Amount	Cost Share	Partners
The Ohio State University	Brushless Doubly-fed Machine and Drive System for Aviation Application	\$2,100,000 OSU: \$996,000 UD: \$100,000 Safran: \$906,000	\$2,230,000 University Partners: \$1,675,000 Small Business: \$1,094,000 Large Business: \$0	University Partners: Ohio State University, University of Dayton Industry Partners: Small Business: Safran Large Business: none
GhostWave	UAS Detect and Avoid Sensor Fusion of Stealthy Radars and Vision	\$1,345,000 OSU: \$73,000 OU: \$158,000 GhostWave: \$266,000 Converge Tech: \$250,000 Dr. Walton: \$28,000 Event38: \$14,000 IS4S: \$306,000 Lockheed Martin: \$250,000	\$1,257,000 University Partners: \$199,000 Small Business: \$558,000 Large Business: \$500,000	University Partners: Ohio State University, Ohio University Industry Partners: Small Business: GhostWave, Converge Technologies, Event38, IS4S Large Business: Lockheed Martin
University of Cincinnati	Regional Unmanned Traffic Management System (RUTMS)	\$969,000 UC: \$587,000 Sinclair: \$200,000 Demeter: \$92,000 Simlat: \$90,000	\$1,009,000 University Partners: \$725,000 Small Business: \$285,000 Large Business: \$0	University Partners: University of Cincinnati, Sinclair College Industry Partners: Small Business: Demeter, Simlat Large Business: none
Persistent Surveillance Systems	Autonomous/Remote Piloted Cirrus SR22 for a Long Duration Aerial Surveillance Platform and Remote Pilot Assisted Personal Air Vehicle	\$1,987,000 OU: \$150,000 WSU: \$150,000 PSS: \$478,840 Autonodyne: \$691,431 MacAir: \$417,029 MacNaughtan Dev: \$61,309 Bosma: \$49,790	\$5,482,825 University Partners: \$285,213 Small Business: \$5,197,611 Large Business: \$0	University Partners: Ohio University, Wright State University Industry Partners: Small Business: Persistent Surveillance Systems, Autonodyne, MacAir Aviation, MacNaughtan Development, Bosma Tech. Large Business: none

ROUND 4 TECHNICAL AWARDEES

Awardee	Project	Award Amount	Cost Share	Partners
Riverside Research	CHIRP2C: Computer-Human Interaction for Rapid Program Analysis through Cognitive Collaboration	\$1,176,717 Riverside Research: \$600,021 Unmanned Science Inc.: \$576,696	\$\$1,268,958 University Partners: \$226,817 Small Business: \$1,042,141 Large Business: \$0	University Partners: University of Cincinnati, University of Dayton Industry Partners: Small Business: Riverside Research, Unmanned Science, Inc. (USI) Large Business: none
GhostWave, Inc.	Multi-purpose Mast/Aerial 3600 radar/optical fused sensors for Perimeter Monitoring and Aerial Detect and Avoid	\$1,262,622 GhostWave: \$619,265 AFIT: \$15,000 OSU: \$58,000 Sinclair: \$25,000 Converge: \$457,861 StreamDSP: \$87,496	\$1,300,000 University Partners: \$139,000 Small Business: \$1,161,000 Large Business: \$0	University Partners: AFIT, Ohio State University, Sinclair Community College Industry Partners: Small Business: GhostWave, Converge Technologies, StreamDSP Large Business: none
Youngstown Business Incubator (YBI)	Geometrically-Complex 3D Printed Antennas for UAVs	\$972,877 YBI: \$174,067 YSU: \$384,889 KSU: \$99,000 Event38: \$134,930 UTC: \$179,991	\$434,229 University Partners: \$314,000 Small Business: \$120,229 Large Business: \$0	University Partners: Kent State University, Youngstown State University Industry Partners: Small Business: Youngstown Business Incubator, Event38, Universal Technology Corp. Large Business: none
Asymmetric Technologies	Resilient and Secure UAS Flight Control	\$1,450,069 Asymmetric: \$893,977.63 OSU: \$302,816 OU: \$203,275.36 Lockheed Martin: \$50,000	\$1,582,292 University Partners: \$230,014 Small Business: 1,352,278 Large Business: \$0	University Partners: Ohio State University, Ohio University Industry Partners: Small Business: Asymmetric Large Business: Lockheed Martin
CAL Analytics	Interoperability, Resiliency, and Contingency Management for Ohio UAS Operations	\$1,399,882 Cal Analytics: \$518,668 KSU: \$140,000 OSU: \$139,777 Resilienx: \$305,848 Kongsberg: \$205,715 TruWeather: \$89,874	\$1,176,798 University Partners: \$163,376 Small Business: \$1,013,623 Large Business: \$0	University Partners: Kent State University, Ohio State University Industry Partners: Small Business: Cal Analytics, Resilienx, Kongsberg Geospatial, TruWeather Solutions Large Business: none
Kent State University	A Hybrid Fuel Cell–Battery–Capacitor Power Source for UAS	\$1,214,201.61 KSU: \$518,975 CWRU: \$145,747 UD: \$194,962 WSU: \$159,679 Event38: \$194,839	\$1,011,776 University Partners: \$816,776 Small Business: \$195,000 Large Business: \$0	University Partners: Kent State University, Case Western Reserve University, University of Dayton, Wright State University Industry Partners: Small Business: Event38 Large Business: none

ROUND 1, ROUND 2, ROUND 3, and ROUND 4 FOLLOW ON FUNDING

COE	PI/University	Funding Agency	BAA/Program	Value
C2PNT	Wu / WSU / ICS	NSF	CRII	175,000
C2PNT	Wu / WSU / ICS	NSF	CRII	175,000
C2PNT	Wu / WSU / ICS	NIST	FirstNet	1,800,000
C2PNT	Wu / WSU / ICS	AFRL	IDATE	25,000
C2PNT	Wu / WSU / ICS	NSF	EAGER	125,000
C2PNT	Wu / WSU / ICS	USAF	SBIR	150,000
C2PNT	Wu / WSU / ICS	NSF	DRL	1,955,190
C2PNT	Wu / WSU / ICS	AFRL		33,000
C2PNT	Wu / WSU / ICS	AFRL		62,500
C2PNT	Gross / WSU / TEAS	DARPA	Case TA4	2,400,000
C2PNT	Gross / WSU / TEAS	DARPA	Case TA3	4,700,000
C2PNT	Gross / WSU / TEAS	DARPA	CASE TA5	4,900,000
C2PNT	Gross / WSU / TEAS	AFRL	RQQA V&V	148,000
C2PNT	Gross / WSU / TEAS	AFRL	RQQA V&V	230,000
C2PNT	Gross / WSU / TEAS	AFRL/RHCI	HIVE	3,000,000
C2PNT	Gross / WSU / TEAS	Air Force	SBIR	750,000
C2PNT	Gross / WSU / TEAS	DARPA	(Galois)	2,700,000
C2PNT	Gross / WSU / TEAS	AFRL	RQQA V&V	420,000
C4ISR	Raymer / WSU / HCBD	IARPA	Hybrid Forecasting Competition Program	2,100,000
C4ISR	Raymer / WSU / HCBD	DARPA	Ground Truth Program	3,700,000
C4ISR	Raymer / WSU / HCBD	DoD	Enginility - Reactionary Assistance Support for Container	30,000
C4ISR	Raymer / WSU / HCBD	DARPA	Agile Teams Program	950,000
C4ISR	Raymer / WSU / HCBD	AFOSR	Towards Undifferentiated Cognitive Agents	450,000
C4ISR	Raymer / WSU / HCBD	Raytheon-BBN/IARPA	Forecasting Counterfactuals in Uncontrolled Settings	1,920,000
C4ISR	Raymer / WSU / HCBD	Army	SBIR Phase I	40,000
HPSH	Reiter / WSARC / RLVC		SBIR PH I PMAA Aptima - WON	20,000
HPSH	Reiter / WSARC / RLVC	AFSOC	AFSOC ACTOR- WON	1,800,000
HPSH	Reiter / WSARC / RLVC		Norell/WSARC - CRAMMIT	110,000
HPSH	Reiter / WSARC / RLVC	AFRL/RV	Norell/WSARC - TENET 3 Phase II	220,000
HPSH	Reiter / WSARC / RLVC	N/A	SBIR-TCCC	10,000

COE	PI/University	Funding Agency	BAA/Program	Value
HPHS	Reiter / WSARC / RLVC	N/A	SBIR-CLEAR	60,000
HPHS	Reiter / WSARC / RLVC	AFRL	Tech Warrior	2,600,000
HPHS	Reiter / WSARC / RLVC	N/A	SBIR-ECCCHO	225,000
HPHS	Reiter / WSARC / SAPHYRE	AFRL	Recently awarded SAVANT - WON	75,000
HPHS	Reiter / WSARC / SAPHYRE	AFRL	Deployable Technologies	350,000
HPHS	Reiter / WSARC / SAPHYRE	AFRL	Mission-Directed Learning Environment	3,500,000
HPHS	Reiter / WSARC / SAPHYRE	AFRL/RH	Norell/WSARC - HMT TO4	6,700,000
HPHS	Reiter / WSARC / SAPHYRE	DARPA	Goal-driven Agile Teams and Environments (GATE) - WON	1,000,000
HPHS	Reiter / WSARC / SAPHYRE	SOCOM	Teamwork analysis in Diads of Analyst-Machine - WON	45,000
HPHS	Reiter / WSARC / SAPHYRE	DARPA	Norell/WSARC - LEAP	8,600,000
HPHS	Heikenfeld / UC / ACSB	DOD	SBIR	150,000
HPHS	Heikenfeld / UC / ACSB	Air Force Research Laboratory (DOD - USAF - AFMC)	Physiological Marker Sensing Materials and Devices	38,000
HPHS	Heikenfeld / UC / ACSB	AFRL (DOD - USAF - AFMC)	Objective Pilot State Assessment through Sweat Biomarkers	423,000
HPHS	Heikenfeld / UC / ACSB	CincyTEch/ODSA and UC 2019 Funds	LFA Concentrator Phase 2	175,000
HPHS	Heikenfeld / UC / ACSB	Eccrine Systems	ISF Sensing Discover Project	39,000
HPHS	Heikenfeld / UC / ACSB	CincyTEch/ODSA and UC 2019 Funds	LFA Concentrator Phase (UC Accelerator Phase I)	40,000
HPHS	Heikenfeld / UC / ACSB	Y Combinator	Amplify Investment	150,000
HPHS	Heikenfeld / UC / ACSB	DOD	SBIR Phase II - Eccrine	150,000
HPHS	Marras / OSU / MOSSD	DHA	STTR, Phase 1	150,000
HPHS	Marras / OSU / MOSSD	Ohio Occupational Safety and Health Research Program		250,000
HPHS	Marras / OSU / MOSSD	NSF	NSF 17-516	310,000

COE	PI/University	Funding Agency	BAA/Program	Value
MM	Vogt / UA / Flex Electronics	DOE/Sandia	DuraMAT / Composite adhesives for PV- Prime - UA - WON	180,000
MM	Vogt / UA / Flex Electronics	FlexTech Alliance	FlexTech Alliance / Power pack for electronic print devices- Prime – ITN Energy Systems (\$170K to Lucintech)- WON	500,000
MM	Vogt / UA / Flex Electronics	AFRL	AFRL funding on PV development (UT lead) - WON	1,870,000
MM	Vogt / UA / Flex Electronics	AFRL	University Cooperative Agreement - UT lead - WON	2,600,000
MM	Vogt / UA / Flex Electronics	ODOT	Energy Harvesting Flexible Piezoelectric Elements - WON	40,000
MM	Vogt / UA / Flex Electronics	UTC, Dayton	Flexible Hybrid electronics Technology Review - WON	40,000
MM	Vogt / UA / Flex Electronics	Ohio U	Innovative flexible electronics for intelligent monitoring - WON	50,000
MM	Vogt / UA / Flex Electronics	AFRL	TRUST in Flexible Electronics	4,000,000
MM	Vogt / UA / Flex Electronics	Air Force Research Laboratory	Lightweight Flexible Solar Cells	4,669,907
MM	Vogt / UA / Flex Electronics	Ohio University, Innovation Strategy Planning Grant	Non-invasive Continuous Wearable Glucose Sensor	20,000
MM	Vogt / UA / Flex Electronics	NSF	NSF / low cost manufacture of tandem PV- Prime - UT	300,000
MM	Vogt / UA / Flex Electronics	ONR	solar cell degradation	450,000
MM	Elahinia / UT / Shape Memory Alloys	UT Rocket Fuel	Organ repositioner: Enhancing the Safety of Radiation Therapy in Treating Pelvic Tumors - Won	50,000
MM	Elahinia / UT / Shape Memory Alloys	UT Rocket Fuel	Aerospace additive manufactured actuators	50,000
MM	Elahinia / UT / Shape Memory Alloys	NSF	SBIR Phase I Quick Flow Blood Clot Removal Device	225,000
MM	Elahinia / UT / Shape Memory Alloys	NSF	SBIR Phase II Quick Flow Blood Clot Removal Device	750,000
MM	Elahinia / UT / Shape Memory Alloys	NASA	Pilot study in preparation for a large grant submission to NASA - WON	35,000
MM	Elahinia / UT / Shape Memory Alloys	TVSF	TVSF	150,000
MM	Willard / CWRU / Hi Temp Mag Mat	NSF	DMREF	1,600,000
MM	Willard / CWRU / Hi Temp Mag Mat	DARPA	Ultra High Performance Fe16N2	300,000

COE	PI/University	Funding Agency	BAA/Program	Value
MM	Willard / CWRU / Hi Temp Mag Mat	OH/DAGSI	AFRL (Spintronics work)	155,000
MM	Willard / CWRU / Hi Temp Mag Mat	DOE SBIR/STTR	Nano-Laminate Soft Magnetics for Powder Conversion	50,000
MM	Willard / CWRU / Hi Temp Mag Mat	EERE	Advanced Manufacturing	800,000
MM	Willard / CWRU / Hi Temp Mag Mat	NSF	CMMI	350,000
MM	Szaruga / UDRI / LCM	DoE - IACMI	Injection Overmolding of Continious Carbon Fiber Preforms	500,000
MM	Szaruga / UDRI / LCM	DoE	Hybrid Additively Manufactured Tooling for Large Composite Aero Structures	520,000
MM	Szaruga / UDRI / LCM	AFRL	Air Force SBIR - NextGen (AM tooling)	40,000
MM	Szaruga / UDRI / LCM	AFRL	Reusable Hypersonic Vehicle Study	35,000
MM	Szaruga / UDRI / LCM	AFRL	LCAAT WiSDM (TFP and AM tooling)	1,150,000
MM	Szaruga / UDRI / LCM		Automotive Sub-tier (TFP)	49,941
MM	Szaruga / UDRI / LCM	Sutomotive OEM	Automotive OEM (TFP)	125,000
MM	Szaruga / UDRI / LCM	AFRL		300,000
MM	Szaruga / UDRI / LCM	DoE - IACMI	Scale-Up of Next Gen Nano-Enhanced Composite Materials	620,000
MM	Szaruga / UDRI / LCM	IACMI/Lockheed	Aligned Fiber for High Performance, Rapid Cycle Time Processing (Part of larger IACMI program w/Lockheed. Objective: Low cost fiber preforms for military aircraft components)	710,000
OCP		DOE	STTR	150,000
OCP	Zhang / OSU / Hybrid/Turboelectric Propulsion	DoE	STTR	80,000
OCP	Zhang / OSU / Hybrid/Turboelectric Propulsion	NASA	ULI	10,000,000
OCP	Zhang / OSU / Hybrid/Turboelectric Propulsion	SAFRAN	contract	105,000

COE	PI/University	Funding Agency	BAA/Program	Value
OCP	Zhang / OSU / Hybrid/Turboelectric Propulsion	GE/State of Ohio	Education of Engineers and Students	2,500,000
OCP	Zhang / OSU / Hybrid/Turboelectric Propulsion	DOE/Power America	Develop SiC Inverter Driver for Switched Reluctance Motor	240,000
OCP	Zhang / OSU / Hybrid/Turboelectric Propulsion	DOE	STTR Phase I Variable flux machine and drive for hybrid electric vehicles	150,000
OCP	Wang / OSU / Control Architecture	Navy	n/a	2,300,000
OCP	Wang / OSU / Control Architecture	NSF	Cybersecurity proposal related to control of power systems	500,000
OCP	Wang / OSU / Control Architecture	AFRL	Power, Thermal and Control Technologies and Experimental Research	7,300,000
OCP	Wang / OSU / Control Architecture	Future Motors	Inverter Drive and Power Architecture system for Electric Bike	69,000
OCP	Wang / OSU / Control Architecture	GE EPIScenter	Real-time modeling and simulation for commercial aircraft	175,000
OCP	Wang / OSU / Control Architecture	AEP	Cybersecurity testbed of power systems	250,000
OCP	Wang / OSU / Control Architecture	Exacter Inc	Advanced Grid Infrastructure	120,000
OCP	Mathison / OSU / ATC	Honeywell	HPTIC-II	261,000
OCP	Mathison / OSU / ATC	Pratt and Whitney	Blade Tip Rub Center of Excellence	8,581,000
OCP	Mathison / OSU / ATC	Honeywell	Continuation of experiment	110,000
PRESIDES	Zhu / UA / Li-ion Battery	PNNL/DOE		420,000
PRESIDES	Zhu / UA / Li-ion Battery	DOD - NAVY	SBIR Phase I	150,000
PRESIDES	Zhu / UA / Li-ion Battery	Rev	Funding for pouch cell fabrication equipments	100,000
PRESIDES	Zhu / UA / Li-ion Battery	DOE	SBIR	480,000
PRESIDES	Zhu / UA / Li-ion Battery	NSF	CBET	300,000
PRESIDES	Zhu / UA / Li-ion Battery	NASA	HOT Program	75,000
PRESIDES	Zhu / UA / Li-ion Battery	Spark	Spark	100,000





COE	PI/University	Funding Agency	BAA/Program	Value
PRESIDES	Zhu / UA / Li-ion Battery	DOE	DOE EERE SBIR Phase II High Energy Density Lithium	1,000,000
PRESIDES	Zhu / UA / Li-ion Battery	NASA	"High Energy, Long Cycle Life, and Extreme Temperature Lithium-Sulfur Battery for Venus mission" (UDRI and UA team)	600,000
PRESIDES	Kumar / UD / Li-S Battery	NASA	Integrated high temperature battery and micro-controller with active cooling for Venus and Mars applications	600,000
PRESIDES	Kumar / UD / Li-S Battery	US Army SBIR Ph 1 & II	2018-0124	1,150,000
PRESIDES	Kumar / UD / Li-S Battery	NASA	HOTTech 80NSSC17K0762	633,363
PRESIDES	Kumar / UD / Li-S Battery	FAA	DTFAC-16-C-00045	600,000
PRESIDES	Kumar / UD / Li-S Battery	Army	Developing Li-S battery, including new carbon materials for S-cathode	1,000,000
PRESIDES	Kumar / UD / Li-S Battery	NSF (SBIR Ph I)	NSF17-545	250,000
PRESIDES	Kumar / UD / Li-S Battery	NASA SBIR ph 1 & II	NNX17CC08C	900,000
PRESIDES	Prakash / CWRU / Multifunction Structural Energy Storage	DAGSI	DAGSI Fellowship	65,000
PRESIDES	Prakash / CWRU / Multifunction Structural Energy Storage	AFRL	AFRL-RQ -- CWRU Educational Partnership Agreement (EPA) on Structural Batteries (2017-2021) - Facilitate educational and research collaboration in structural batteries between AFRL & CWRU	600,000
PRESIDES	Prakash / CWRU / Multifunction Structural Energy Storage	NASA	OSGC VTOL aircraft (student competition)	3,000
PRESIDES	Prakash / CWRU / Multifunction Structural Energy Storage	AFRL	AFRL 2017 SFFP (Summer faculty fellowship) Led to new collaborations (co-advising graduate students) on the development of structural battery (CWRU+AFRL-RQ)	35,000


COE	PI/University	Funding Agency	BAA/Program	Value
PRESIDES	Prakash / CWRU / Multifunction Structural Energy Storage	AFRL	AFRL 2018 SFFP (Summer faculty fellowship) Led to new collaborations (co-advising graduate students) on the development of structural battery (CWRU+AFRL-RQ)	33,000
PRESIDES	Prakash / CWRU / Multifunction Structural Energy Storage	AFRL	AFRL 2019 SFFP	32,000
PRESIDES	Prakash / CWRU / Multifunction Structural Energy Storage	DAGSI	DAGSI Fellowship	65,000
PRESIDES	Prakash / CWRU / Multifunction Structural Energy Storage	NASA	NASA ULI	530,000
	PSS - Autonomous Cirrus SR22	AFRL / Leidos	Flight Test Support	45,000
	PSS - Autonomous Cirrus SR22	THEIA Group	Aircraft Integration Services	200,000
	PSS - Autonomous Cirrus SR22	AFRL Leidos	RTD2 contract Team Member	25,000,000
	KEYW		ACT3 Autonomy Research Center	3,000,000
	UDRI		ACT3 Autonomy Research Center	3,500,000
	STR		ACT3 Autonomy Research Center	2,500,000
	WSRI		ACT3 Autonomy Research Center	500,000
	Mile2		ACT3 Autonomy Research Center	3,500,000
	WSRI		ACT3 Autonomy Research Center	4,000,000
	Event38		Phase II	867,926
	GhostWave - UAS Detect Avoid	Army xTech Search	SBIR Competition	10,000
	PSS - Autonomous Cirrus SR22	US SOUTHCOM	Operational Evaluation of Wide Area Surveillance for Counter Drug Maritime Support	10,200,000
	PSS - Autonomous Cirrus SR22	Baltimore Police Department Law Enforcement Support	Community Support Program support of People of Baltimore	4,000,000
	PSS - Autonomous Cirrus SR22	MSTI	Extended Tether Operations Demonstration	100,000
	PSS - Autonomous Cirrus SR22	AFRL Leidos	Air Force Marathon Support	125,000
	PSS - Autonomous Cirrus SR22	MTSI REAS	Flight Dev and Test	19,000

COE	PI/University	Funding Agency	BAA/Program	Value
	PSS - Autonomous Cirrus SR22	US SOUTHCOM	WAAS Demo Successfully demonstrated System	43,000
	GhostWave - UAS Detect Avoid	Army xTech Search	SBIR Competition	120,000
	GhostWave - UAS Detect Avoid	AFWERX	SBIR Competition - 1st round	50,000
	GhostWave - UAS Detect Avoid	AFWERX	STTR Competition - 2nd round	25,000
	OSU - Brushless Doubly-fed Marhine	Boeing	Independent speed variable frequency generator for 787	140,000
	UC - RUTMS	Sinclair LVC exercises		10,000
	Asymmetric - UAS Flight Control	USAF/USSOCOM	SBIR phase 2	2,250,000
	Asymmetric - UAS Flight Control	USAF/USSOCOM	Payload Integration Work	200,000
	Kent State Univ - Hybrid Fuel Cell Battery	AFRL Leidos	Jet-fuel desulfurization	25,000
	CAL Analytics	FAA	FAA BAA contract related to the CMP	1,912,000
OCP	Mathison / OSU / ATC	Honeywell	support ongoing research related to OFRN experiment (post project end)	250,000
OCP	Mathison / OSU / ATC	Pratt and Whitney	Blade Tip Rub Center of Excellence	1,000,000
HPS	Marras / OSU / MOSSD	Misc	STTR, SBIR, and 2 NIH awards	4,000,000

APPENDIX 2 – OFRN PROJECT DETAIL

Round 1 Projects Awarded

		<h3>Improving Health Care through Realistic Live Virtual Constructive (LVC) Training</h3>	
<p>Problem</p> <ul style="list-style-type: none"> 24.3% of 4596 battlefield deaths were deemed potentially survivable (PS)¹. Strategies to mitigate hemorrhage and optimize airway management are needed to reduce the number PS deaths.¹ 		<p>Approach</p> <ul style="list-style-type: none"> Integrate the cadaveric training with LVC training to improve medic readiness and reduce PS deaths. 	
<p>New Insights New Cadaveric Training Protocol</p> <ul style="list-style-type: none"> Capable of simulating realistic battlefield injuries as well as physiological response to injuries.  <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-left: auto; margin-right: auto;"> <p>Cadaveric training of PJs at NCMR in April 2018</p> </div>		<p>Budget, Schedules, Deliverables, & Risks Continue development of LVC "Dynamic Cadaver" models and usage:</p> <ul style="list-style-type: none"> "Dynamic Cadaver" models: improve cost effective controls, procedure approaches, availability of additional techniques, and education learning tools. Development of a Rapid Sequence Intubation synthetic mentor for improved airway management. Development of metrics and measures to improve performance, competence, and confidence of emergency procedures. <p>Reference: ¹ Eastridge, BJ et al. "Death on the battlefield (2001-2011): Implications for the future of combat casualty care", J Trauma Acute Care Surg Volume 73, 2012</p>	
<p>LVC Training Platform</p> <ul style="list-style-type: none"> Developing an Alexa-based platform for step by step training of methods to address different battlefield injuries. 			

		<h3>SAPHYRE Quad Chart</h3>	
<p>Technical Concept & Approach</p> <p>Problem: One-size fits all design of HMI systems and augmentation strategies is not optimized for individual variability, experience, trust in the system, and proficiency.</p> <p>Challenge: Current industry methods for augmenting human machine teaming are focused on reducing workload independent of the operator state. The challenge is to model workload as a function of physiological indicators to enable augmentation solutions when operators become task saturated.</p>		<p>Project Requirement, Federal Alignment, Sponsoring Organization (s)</p> <p>Federal Needs:</p> <ul style="list-style-type: none"> Augmentation of human performance <ul style="list-style-type: none"> Heart Rate Variability methodology (AFRL/RH). Performance Augmentation of Human Machine Teaming <ul style="list-style-type: none"> Individualized performance assessment in HMT environments (AFRL/RH), cognition and performance simulations (AFRL/RH) <p>Approach:</p> <ul style="list-style-type: none"> Current industry methods for augmenting human machine teaming are focused on reducing workload independent of the operator state. Our approach incorporates the individual unique qualities, platform, and environmental states into the sliding scale autonomous workload. 	
<p>Team & Economic Impact For State of Ohio</p> <ul style="list-style-type: none"> Ali K. Reiter, PhD Wright State University Vijay Devabhaktuni, PhD University of Toledo Kevin Xu, PhD University of Toledo Jeff Weir, PhD AFIT Robert Meyer, AFIT Thomas Pestak, The Perduco Group Carly Rau, The Perduco Group This research will generate an estimated 55 jobs including jobs with team members and aviation and automotive industry partners within the state of Ohio. Impact on multiple commercial areas including the automotive sector for in-vehicle dynamic adjustments (Advanced Telo Sensors, Inc.), aviation industries as well as sports and gaming. 		<p>Budget, Schedules, Deliverables, & Risks</p> <ul style="list-style-type: none"> Period of Performance: 24mos Milestones: IRB Approval (November 2016), System Design & Build Complete (October 2016), Completion of Testing & Analysis (January 2018) Deliverables: <ul style="list-style-type: none"> Fiscal and programmatic reports necessary for WSARC to meet its quarterly reporting requirements to the State. <ul style="list-style-type: none"> Site visits. Periodic meetings. Risk: Time to complete collection with new experimental design and development of algorithm in compressed schedule. 	



Ohio Center for Power & Propulsion – Hybrid/Turboelectric Propulsion

Technical Concept & Approach



Design and verify a 300-kW and 2-MW electric drive system for hybrid turbo/electric propulsion.

Challenges: high power density and high efficiency of the electric machine and power electronic converter.

Project Requirement, Federal Alignment, Sponsoring Organization (s)


- **Federal Stakeholder: NASA. Goals in NASA's hybrid-turboelectric propulsion technology roadmap:**
 - Power density 14 kW/kg for machine and 25 kW/kg for power converter.
 - Efficiency 99% for both machine and power converter.
- **Potential impact on federal stakeholder mission:**
 - Innovations: slotless stator, caved rotor, hybrid switch, and 3-level T-type neutral point clamp converter.
 - Benefits for federal customers: 1) understand risks solutions to achieve the power density/efficiency requirements; 2) identify the technology gaps between research and commercialization of large electrified aircraft.

Team & Economic Impact For State of Ohio

- **PI:** Julia Zhang, Ph.D., Ohio State University (OSU)
- **Teams:** OSU and University of Akron (UA)
- **Potential economic development impact for the State of Ohio:**
 - Create more jobs in the fields of electrified aircraft and advanced power semiconductor devices.
 - Additional research: NASA University Leadership Initiative (\$10 M for 5 years), GE/State of Ohio (\$2.5 M for 5 years), DoE vehicle program (\$2 M for 3 years), NASA brushless doubly-fed machine program (\$2 M for 3 years).
- **Commercial impact industry/sector/business partners:**
 - Aerospace, automotive, heavy-duty vehicle industry.
 - GE Aviation, NASA, AFRL, Boeing, Ford, GM, etc.
 - SAFRAN, SMART Microsystems.

Budget, Schedules, Deliverables, & Risks

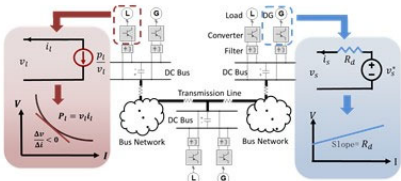
- **Period of performance:** 36 months.
- **Major milestones:**
 - Converter: tested the 3-phase 300-kW converter under full load using a 100-kW permanent magnet machine.
 - Machine: rotor failure analysis finished, rotor redesigned, sent for manufacturing.
 - Drive system: converter integrate with an alternative motor.
- **Deliverables:** 300-kW machine prototype, 300-kW power converter prototype, loss and weight estimation, 2-MW design.
- **Key technical risks:** delay in motor manufacturing, high speed operation stability.



OCPP COE - Control Architecture for Intelligent Aviation Electric Power Systems

Technical Concept & Approach

- Develop algorithms for energy optimization
- Control against instability induced from Constant Power load



Project Requirement, Federal Alignment, Sponsoring Organization (s)

Federal stakeholders and their formal requirement.

- NASA: Reduce Co2 emission with more electric aircraft
- Air force: increase system reliability and energy efficiency of aircraft power system

Potential impact on federal stakeholder mission.

- Significantly improving system energy performance by minimizing costly downtime, repair, and maintenances.
- Improving flight survivability in missions
- Saving cost of mission fuels

Research Novelties

- Hierarchical control and energy optimization over multi-time scales. Migrating reliability monitoring methods from microgrids

Team & Economic Impact For State of Ohio

Team
 OSU: JK Wang (PI), Jin Wang, Mehesh Illindala, Wei Zhang
 UDRI: Bang-Hung Tsao
 RIT: Luis Herrera UA: Seungdoeg Choi

Intellectual Merits


- Contribution to fundamental science (constrained minimal energy control in a Differential Algebraic system is still an open question)
- Extension to other electric platforms (ships, microgrids in battle field, and domestic microgrids)

Economic Impacts

- Sustaining funding and employment opportunities
- Further education of undergraduate student has been done through VentureWell funded class
- Commercialization of idea through Ohio ICorps Program in 2018

Budget, Schedules, Deliverables, & Risks


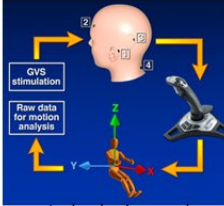
Period of Performance: 24 months



M&M COE - High Performance Plastic Substrates for Flexible Electronics

Technical Concept & Approach

Develop high performance polymer substrates/films tailored for flexible electronics






Use new materials and processes to develop improved performance/lower cost flexible electronics

Project Requirement, Federal Alignment, Sponsoring Organization (s)

AFRL requirements (NextFlex):

1. material stable at temperatures >400C would be desirable. Even 350C would be beneficial for some other specific electronics manufacturing processes.
2. Uniform film thickness, very low roughness, and low defect density are highly desirable - as is low moisture uptake. Cost is important
3. higher dielectric constant that allows increased inductive coupling might be important for RF or non-contact communications through film or lower dielectric constant to minimize cross-talk on long conductor runs may be of benefit

Alignment with potential for decreased mass of electronics / improved antennas for communication / robust electronics

Team & Economic Impact For State of Ohio

Project Team: B. Vogt (UA), M. Heben (UT), S. Kaya (OU), A. Compaan (Lucintech), F. Lisy (Orbital)


Economic impact: Enabling technology for 2 small businesses
Lucintech has identified market for flexible devices
Orbital has potential for millions of units if manufacturing and comfort issues with dry electrodes are overcome

Add-on funding obtained (> \$9MM in funds to Ohio organizations):
 \$4.6MM (to UT) from AF on PV
 \$4MM (\$1.7MM to UA) from AFRL on trust in flexible electronics
 \$0.5MM (\$0.17MM to Lucintech) power pack for flex through FlexTech Alliance
 Additional \$0.93MM to UT and UA on related work

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Budget, Schedules, Deliverables, & Risks

- Period of Performance: 7/12/16 -1/31/18
- Milestones:
 - Methodology to generate substrate protrusions for
 - High temperature, high dielectric constant polymer for printable electronics
 - Printed passive and PV testbeds developed
- Deliverables:
 - High temperature plastic substrate with > 350 C processibility
 - PV on plastic with >12 % PCE
 - Substrates for dry electrodes for vestibular stimulation with performance similar to current technology with lower discomfort for wearer.




M&M COE – Adaptive Bio-Inspired Aerospace Structures Actuated by Shape Memory Alloys

Technical Concept & Approach

Additive manufacturing of high torque rotary actuators

Faster actuation

Lower cost of manufacturing



Team & Economic Impact For State of Ohio

- **PI:** Mohammad Elahinia, University of Toledo
- Team members: University of Toledo, OSU, CWRU
- Estimate 20 jobs; ~\$20M potential from creation of the Global Center for Shape Memory Materials & Structures
- Various fundamental and applied funding opportunities at NASA, AFRL, US DOE, NSF, and DARPA
- **Industry Partners:** GE Aviation, Lincoln Electric, and Norman Noble

Project Requirement, Federal Alignment, Sponsoring Organization (s)

- NASA Glenn Research Center (High Temperature & Smart Alloys Branch)
 - 2015 NASA Technology Roadmaps TA 12: Materials, Structures, Mechanical Systems, and Manufacturing.
- Shape-morphing materials for a variety of applications, i.e., control surfaces, deployable reentry vehicles, expandable habitats, and deformable mirrors


Team & Economic Impact For State of Ohio

Budget, Schedules, Deliverables, & Risks

- Period of Performance: [24 months]
- **Milestones**
 - Identification of NASA desired composition for HTSMAs
 - Characterization of the structure of the HTSMAs using high-resolution TEM
- **Deliverables**
 - Alloy development for High Temperature SMAs by adding different amounts of ternary elements
 - Create functional shape memory and superelastic NiTiHF
- **Risks:**
 - Thermodynamic stability of ternary additions to Ni-Ti
 - Embrittling

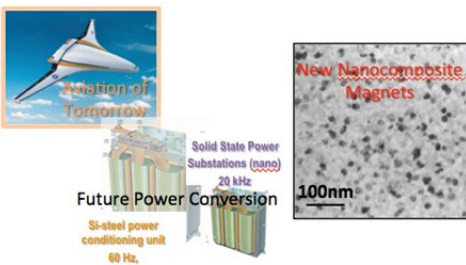
Appendix 2 – OFRN Project Detail

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M&M COE - High Temperature Magnetic Materials

Technical Concept & Approach



Project Requirement, Federal Alignment, Sponsoring Organization (s)

- Federal stakeholders**
 - Bowman/Noebe, NASA GRC
 - Turgut/Horwath, AFL
- Potential impact on federal stakeholder mission**
 - New high performance magnetic materials for power applications at elevated temperatures becoming increasingly important
 - Materials aligned with proposed future aeronautical propulsion and power needs
 - Needs align well with the goals of this project

Team & Economic Impact For State of Ohio

- Team**
 - Willard (PI), Case Western Reserve University
 - Heben (co-PI), University of Toledo
 - Shi (co-PI), University of Cincinnati
 - Solomon (co-PI), Youngstown State University
- Economic Impact**
 - (2016) NSF DMRP – CWRU (lead) \$1.6M/4 yrs. Computation design of nanocomposite magnets
 - (2016) DARPA – CWRU (sub) \$150k/1 yr. Process development of rare earth free permanent magnets (with Fenix Magnetics (lead))
 - (2016) Fenix Magnetics (start up company) Commercialize rare earth free permanent magnets 3 Ohio employees, based in Rocky River, OH

Budget, Schedules, Deliverables, & Risks

Period of Performance: 24 months


Milestones:

- ✓ Fabrication of the alloy into melt spun ribbons with nanocrystalline structure
- ✓ Production of particulate samples from melt spun ribbons
- Thick film fabrication of nanocomposite magnets
- Additively manufactured parts from particulate nanocomposites

Technical Risks:

- Experiencing a ribbon production bottleneck

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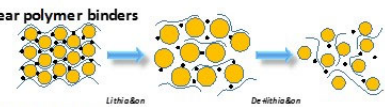


PRESIDES COE - High Energy Density Li-ion Battery Based on Advanced Si Anodes

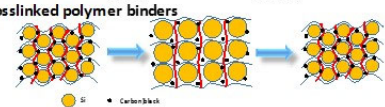
Technical Concept & Approach

Silicon-based anode, crosslinked polymer binders mitigate volumetric expansion problems

linear polymer binders



crosslinked polymer binders



● Si ● Carbon Black

Project Requirement, Federal Alignment, Sponsoring Organization (s)

- Federal Stakeholders: NASA and AFRL
- Potential impact on federal stakeholder mission:
 - Space and aeronautics missions require rechargeable batteries with high specific energy. Current batteries have limited energy density and are relatively heavy.
 - Li-ion batteries and silicon anodes can potentially offer a light-weight, high energy density solution
 - Benefits would include

Team & Economic Impact For State of Ohio

PI: Yu Zhu, UA
NASA: James Wu
AFRL: Michael Rottmayer, Joseph Fellner
University partners: S. Chuang (UA), M. Canova (OSU), M. Heben (UT)
Industry partners: P. Matter (pH Matter LLC), K. Dudek (CAR Technologies), M. Graham (Akron Polymer Systems)

Potential economic impact (in 2 years):

- Jobs: 4+
- Follow-on funding: \$300K+ via fed agencies

Budget, Schedules, Deliverables, & Risks

Period of performance: 24 months

Q2: Silicon anode and polymer binder ready for test


Q4: Half cell demonstration

Q6: Full cell demonstration

Q8: Long cycle testing

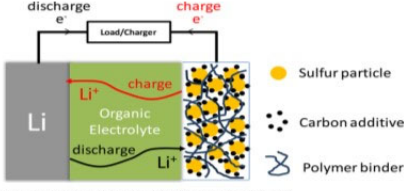
Key deliverable: Li-ion Si anode full cell with 1000 mAh/g.

Key risk: N/A



PRESIDES COE – High Energy/Power, Long Cycle Life, Thermally Safe, Li-S Battery

Technical Concept & Approach



Potential: Li-S is well suited for high energy density
Challenges: Poor cycle life, high self-discharge, and limited temperature range
Our solution: Lithium protection, hybrid electrolyte, improved S-cathode

Project Requirement, Federal Alignment, Sponsoring Organization (s)

NASA + AFRL: Rechargeable batteries; high energy density; > 300 Wh/kg; lightweight; > 100 cycles (AFRL), > 200 cycles (NASA).
Current batteries: LIBs < 220 Wh/kg; unsafe
Our approach: Solid electrolytes improve safety and cycleability

NASA: Power source for EVA suits, load-leveling and electrical power on solar-powered missions, orbital missions, landers/rovers.
AFRL: Power worn systems, UAVs, surveillance.

Benefits: Many research funding from government agencies and industries are expected. We were awarded NASA SBIR Phase I and II, and an Army SBIR Phase I on solid-state Li-S battery.

Team & Economic Impact For State of Ohio

PI: Jitendra Kumar (University of Dayton)
NASA: D. M. Hernandez-Lugo
AFRL: S. Rodrigues

UD: P. Bhattacharya, N. Vallo, Z. Jiang, G. Subramanyam (UD)
CWRU: R. Akolkar, L. Dai, D. Jauhari, L. Qie, A. Maraschky, C. Hu

Industry partners: B. Henslee (CRG), A. Rai (UES), John Busbee (Xerion)

Potential economic impact (in 2 years):


- Jobs: 3+
- Follow-on funding: \$1M+ via fed agencies

Commercial impact (in 2 years):

- Established collaborations with Eagle Picher, Xerion and pHMatter

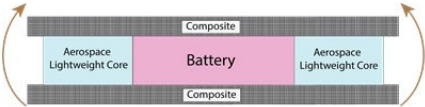
Budget, Schedules, Deliverables, & Risks

- **Period of Performance:** [24 months]
- **Milestones:**
 - Increased LSB cycle life > 3x using solid electrolyte separator
 - Increased cycleability of Li anode > 10x
 - Validated use of thin Li in full LSBs
- **Deliverables:** high energy density, durable and safe Li-S battery prototype
- **Key technical risks:** S cathode not up to the required capacity



PRESIDES COE – High Performance Multifunctional Structural Energy Storage

Technical Concept & Approach



Create high-performance multifunctional structural energy storage systems. Establish multifunctional design rules and performance guidelines for their integration.
Challenges: Manufacturing compatibility; Electrochemical performance of embedded cells; Structural integrity of structural battery; Thermal management.

Project Requirement, Federal Alignment, Sponsoring Organization (s)

NASA + AFRL: multifunctional load-bearing structures with energy storage functionality; potential weight & volume savings; Increase flight endurance and payload capacity; specific energy density >300 Wh/kg; long-life >100 cycles; & safe.
AFRL: Small and micro UAVs; self-powered load-bearing structures; autonomous sensor networks & surveillance
NASA: Structural energy storage for electric propulsion; cross-cutting programs on light-weighting and reduced onboard power for space & aero-vehicles; extra-vehicular suits; power load-leveling for solar powered missions.

Team & Economic Impact For State of Ohio

PI: Vikas Prakash (CWRU)
NASA: J. M. Pereira, Patricia Loyselle
AFRL: M. Rottmayer, J. Baur, T. Howell


University partners: Bo Li (CWRU); Bang-Hung Tsao (UDRI)
Industry partners: Jim Green (CSA America), Jeff Taylor (Event 38 Unmanned Systems).

Economic impact: (in 2 years): Jobs: 2+; Follow-on federal funding: \$300K/year
Commercial Impact (sectors): Aerospace; Automotive; Energy; Consumer Electronics; Health

Budget, Schedules, Deliverables, & Risks

Period of performance: 24 months
Key Milestones: Q1: Target applications, candidate structural materials and commercial batteries identified.
Q5: Multifunctional design of structure-battery.
Q7: Prototype and Validation
Q8: Multifunctional design rules, performance guidelines & industry standards established.
Key deliverable: Structure-battery modules: sandwich structures, I-beams etc. Focus—sUAS, more-electric air-vehicles
Key risk: None

Round 2 Projects Awarded

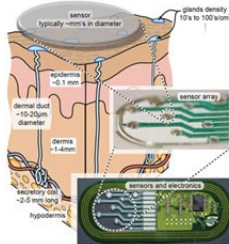


HPHS COE – Advanced Cognitive and Physical Sweat Biosensing

Technical Concept & Approach

Sweat sensing of chemical analytes will allow non-invasive continuous sweat monitoring.

Approach:
Identify Analyte
Create Sensor
Integrate Sensor
Commercialize Application



Project Requirement, Federal Alignment, Sponsoring Organization (s)

- **AFRL** – Craig Murdock / NAMRU-D – Karen Mumy– *Provide continuous access to chemical biomarker information coming from the body.*
- There are no existing approaches or similar alternatives.
- Compared to other 'sweat sensing' patches in development, our approach and IP directly addresses challenges we have identified, challenges which are not yet known by the public.
- This technology will allow the DOD to monitor warfighter cognitive and physical performance, recovery, and also for the 1st time quantify in real-time internal toxin exposure.

Team & Economic Impact For State of Ohio

Team


- Jason Heikenfeld (UC) – global leader in sweat biosensing
- Brent Cameron (Toledo) – electrochemical biosensor expert.
- William Kraemer (Ohio State) – global leader, physical perf.

• **Economic impact** is 103 jobs in 5 years, \$5.34M in follow-on-funding, and >\$30M in private/industry investment in commercialization.

• **Target markets include:** military personnel, mental health, consumer goods, workforce safety, elite athletics, health and wellness. Total aggregate market easily could be \$B's/yr.

Budget, Schedules, Deliverables, & Risks

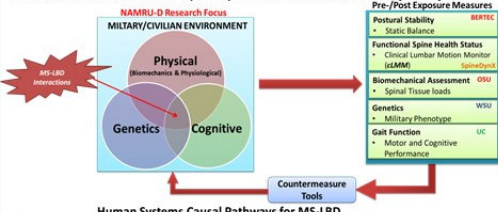
- **Period of Performance:** 24 months.
- **Milestones:**
 - (1) Clinically downselect analytes (vasopressin, adrenal, creatine kinase, neuropeptides, cortisol, etc.)
 - (2) Robust electrochemical sensors for analytes.
 - (3) Sweat sensing patch integration and pilot manufacturing.
 - (4) Clinical validation of sweat sensing patches.
- **Major technical risks** include blood-sweat correlations and limit-of-detection for electrochemical sensing modalities.



HPHS COE – Motion Sickness interactions with Spine Disorders (MOSSD)

Technical Concept & Approach

Challenge: Understand motion sickness (MS) causal mechanisms and its influence on susceptibility to low back disorders (LBDs)



Human Systems Causal Pathways for MS-LBD

NAMRU-D – Naval Medical Research Unit – Dayton OSU – Ohio State University UC – University of Cincinnati WSU – Wright State University
 SpineDyna – Industry Sponsor BERTEC – Industry Sponsor

Project Requirement, Federal Alignment, Sponsoring Organization (s)

- **NAMRU-D:** LCDR Dustin Huber, dustin.huber@us.af.mil
- **Requirements:** Understand MS-LBD causal mechanisms and develop quantitative tools to evaluate Countermeasure efficacy against MS and LBDs.
- **NAMRU-D Mission Impacts**
 - Current MS desensitization training is marginally effective and requires refresher training.
 - Our approach integrates genetics, postural stability, spine loading and kinematics (**cLMM**) before and after MS exposure to combat MS and LBDs.
 - Supporting Human Systems Integration including personnel health, protection, performance, and training.

Team & Economic Impact For State of Ohio

MOSSD Team


- The Ohio State University: William Marras, Ph.D. (PI)
- University of Cincinnati: Amit Bhattacharya, Ph.D.
- Wright State University: Tim Brodenck/All Reiter PhD

• **Economic Impact**

- Leverage the cLMM as a spine health service and expand to broader markets
- Jobs: 55 - 68
- Additional Research: BAA
 - PA-AFRL-AFOSR-2016-0001: ~\$47,000,000
 - BAA-AFRL-RQKHC-2016-0009: ~\$40,000,000
 - BAA-AFRL-AFOSR-2016-0004: \$25,000,000
- IP: Yes
- HealthCare, Military (NAMRU-D, AFRL)
- **Industry Partners:** SpineDyna LLC (Columbus, OH), Bertec Corporation (Columbus, OH)

Budget, Schedules, Deliverables, & Risks

- **Period of Performance:** 24 [months]
- **Milestones:**
 - NOTC data acquisition with human testing
 - Data Integration
- **Deliverables**
 - MS-LBD susceptibility report
 - Spine Health testing service
- **Key technical risks:** KRAKEN availability, test subject recruitment

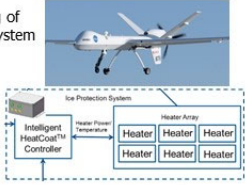
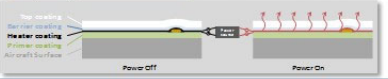


OCPP COE – UAV Icing Protection

Technical Concept & Approach

Design, implementation and testing of MQ-9 engine inlet Ice Protection System

WBS	Task Description
1.0	Project Management
2.0	Requirements
3.0	Inlet Test Article Development
4.0	HeatCoat Analysis & Design
5.0	System Integration
6.0	IRT Testing
7.0	Reporting

Project Requirement, Federal Alignment, Sponsoring Organization (s)

The Air Force Life Cycle Management Center (AFLCMC) requires a retrofitable anti-icing technology and certification approach for medium altitude unmanned aircraft systems (UAS). Battelle's HeatCoat Ice Protection System (IPS) is an innovative electro-thermal anti-icing and de-icing system based on carbon nanotube (CNT) heaters. It will enable UASs to operate in icing conditions without adding excessive weight and without requiring the expense of structural redesign of aircraft components. Tests to date on a large UAS wing and inlet sections have demonstrated that HeatCoat™ provides excellent ice protection for UASs when operated in icing conditions per Federal Air Regulation (FAR) 25, Appendix C, for flight into known icing conditions (FIKI).

Team & Economic Impact For State of Ohio

Team: OSU: Jim Gregory (PI) ; Battelle: Randy Johnson; UDRI: Brian Czapor; CWRU: Vikas Prakash; NASA Glenn: Icing Research Tunnel (IRT)

- OSU: Principal Investigator and ice accretion analysis
- Battelle: Requirements, tailor the HeatCoat design, fabricate the HeatCoat kit, support development of the test article, integration
- CWRU: Thermal analysis of HeatCoat to aid in system performance tailoring
- UDRI: Lead development and fabrication of the test stand for use in the NASA IRT, test latest AFRL coating stackup with HeatCoat
- NASA Glenn: Testing performed at Icing Research Tunnel (IRT)

New job creation is estimated to begin in FY 18 and ranges from 23 total jobs for 50 ship sets to 80 jobs for 200 ship sets. Total production for MQ-9 UAS is estimated to be 300 sets.

Commercialization Partner: Battelle Memorial Institute


Budget, Schedules, Deliverables, & Risks

Period of Performance: 24 months

Deliverables: Report showing results of icing wind tunnel testing on MQ-9 surrogate engine inlet structure

Risks: Cost is the biggest risk: cost of development of model support stand, and cost of wind tunnel time. Risk is decreasing as we make technical progress.


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OCPP COE - Advanced Turbine Cooling

Technical Concept & Approach

Jet engines of the future will require better understanding of film cooling and losses caused by air leaking over the tips of turbine blades. New designs must balance efficiency improvements against higher thermal loads that can damage components.




Project Requirement, Federal Alignment, Sponsoring Organization (s)

- Key federal stakeholders: Dr. John Clark in the Turbine Engine Division of the Air Force Research Laboratory, Dr. Ken Suder in the NASA Turbomachinery and Turboelectric Branch
- Benefits to federal customers:
 - High-fidelity data sets for exploring turbine blade tip leakage flows and heat transfer
 - Advanced development tools including well validated computational models and novel experimental techniques
 - New understanding feeding into industrial design cycle to produce more efficient engines

Team & Economic Impact For State of Ohio


- PI: Randall Mathison (OSU)
- Team members include: The Ohio State University, University of Cincinnati, Air Force Institute of Technology, Honeywell Aerospace, Innovative Scientific Solutions Incorporated
- Results could impact other industry members including GE Aviation, Teledyne Turbines (Toledo), Siemens Energy (Mt. Vernon), and suppliers around the state
- Methods and results developed will improve competitiveness for future funding opportunities including follow on to NASA's Small Core Engine initiative, Air Force development programs, and further industry investment



Budget, Schedules, Deliverables, & Risks

Period of Performance: 24 months


Month	Method Development	Computational Modeling	Stationary Experiment	Rotating Experiment
1-6	Contract Issue	Develop model using existing data	Update Hardware	Hardware Modifications
7-12	Contract Issue	Comparison to stationary expt.	Surface and Flow field data	Experiment Assembly
13-18	Rig Updates, PSP testing	Detailed validation, create rotating model	Investigate revised geometries	Experiment Execution
19-24	Compare cooling	Comparison to rotating experiment		Data Analysis




M&M COE – Low Cost Manufacturing for Limited Production Composite Structures

Technical Concept & Approach


OBJECTIVE: Reduce the fabrication time and cost of composite structures by 25% to meet AF Low Cost Attributable Aircraft Technology goals.



Additively Manufactured Tools



Advanced Composite Manufacturing



Design Tools

Project Requirement, Federal Alignment, Sponsoring Organization (s)

AFRL: affordable composite mfg, processing science, additive manufacturing and multifunctional structures.

NASA: composite materials systems and advanced manufacturing techniques to tailor component properties for hybrid electric power systems

Cost/Risk Model for Composites: impact design with initial manufacturing risk modeling/assessment

Low Cost Composite Tools: time to market; tools produced < 2 weeks at 75% the cost of machined metal tools

Low Cost Composite Preforms: reduced fabrication time and associated costs; increased toughness


Team & Economic Impact For State of Ohio

- PI: Steve Szaruga (UDRI)
- UDRI: lead, Case Western Reserve University, University of Cincinnati, Ohio University, Wright State University, Youngstown State University
- Manufacturing has the greatest impact upon the State's economy with a GDP of nearly \$100B (JobsOhio). New lightweight composite materials and 3D printing/additive manufacturing are two of the game changers where Ohio is leading the way (JobsOhio)
- Industrial Partners:
 - NONA Composites
 - Orbital-ATK
 - General Electric Aerospace

Budget, Schedules, Deliverables, & Risks

- **Period of Performance:** 24 months
- **Milestones:**
 - Cost/Risk model verification and validation
 - Demo small scale tools using low CTE designs/mats
 - Mechanical characterization of woven composites
- **Deliverables:**
 - 1. Cost/Risk Model
 - 2. LCAAT tool demo
 - 3. Woven composite component demo

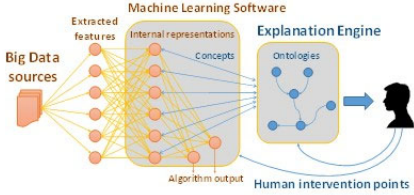
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C4ISR w/HPHS COEs – Human-Centered Big Data (HCB)

Technical Concept & Approach

(1) Improve discovery and hypothesis generation from Big Data. (2) Increase *transparency and trustworthiness* of analytic algorithms to maximize human-in-the-loop analytic performance



Project Requirement, Federal Alignment, Sponsoring Organization (s)

- **NASIC/AF requirement:** Advanced techniques & technologies for Big Data analysis.
- **Current limitations:** Discovering *relevant* information in Big Data is challenging. Analytic algorithms (e.g., *deep neural networks*) are helpful but are "black boxes" lacking transparency.
- **Our solution:** Develop active learning algorithms for enabling iterative search and information down-select. Leverage semantic ontologies to generate *human-understandable explanations* of an algorithm's internal representations & outputs. **Impact:** Optimal integration of human & machine intelligence will greatly improve accuracy & reliability of analytic products.
- **Sponsors:** NASIC/GXKA (M. Brown), AFRL/RH (M. Talbert).


Team & Economic Impact For State of Ohio

- **PI:** Michael Raymer, Wright State Univ. & Brad Minnery, WSRI
- **Team members:** WSRI/WSU, Ohio State, Case Western. Industry partners: Heureka Software; Perduco Group, Ipsos, Hewlett Packard, DesignKnowledge, LexisNexis, Nuance, Illumination Works, Tenet3, Broadline Capital, Columbus Collaboratory, Amperand, MatchTx
- **>\$12M in potential new R&D funding:** IARPA, DARPA, NSF, DoD Labs
- **Est. 40 new jobs** (established industries & start-ups)
- **Broad potential impact extends to non-DoD industries.** Health care analytics; business analytics (marketing, finance, demand forecasting), infrastructure management (energy grid), and geopolitical analysis (election forecasting, risk assessment)

Budget, Schedules, Deliverables, & Risks

- **Period of Performance:** 24 months
- **Milestones:** 1) Demo active learning in interactive search; 2) Demo proof-of-concept explainable machine learning; 3) Demo interactive visualization for knowledge discovery concept
- **Deliverables:** 1) Active learning algorithms for human-in-the-loop information search and down-select; 2) Algorithms for explainable machine learning; 3) Concepts and algorithms for interactive visualization in knowledge discovery

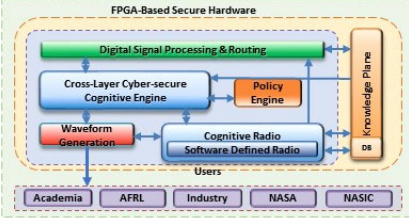
Rev 06-18



C2PNT COE – Intelligent Channel Sensing Based Secure Cross Layer Cognitive Networking for Resilient Space Communication

Technical Concept & Approach

- "Cyber secure" high capacity resilient OAV & space communication network
- "Cognitive communication" for adapting rapidly to changing environments
- "Cognitive radio" hardware and software integrated in a unique framework
- "System level" technological solution to airborne & space communication



Project Requirement, Federal Alignment, Sponsoring Organization (s)

- AFRL:** Technologies for mission assurance in contested and denied environments against threats to EM spectrum, & network-enabled spectrum warfare
 - POC: Michael Nowak (michael.nowak@wpafb.af.mil)
- NASA:** Space-based spectrum sharing, assured access to spectrum, cognitive technologies
 - POC: Elias Naffah (elias.t.naffah@nasa.gov)
- NASIC:** Detection/mitigation of malicious-code/malware in satellite hardware and software; trusted satellite-cockpit communication.
 - POC: Chad Arnold (chad.arnold.4@us.af.mil)
- NRL:** Application of intelligent channel sensing in underwater channel.
 - POC: Zhiqiang Liu (zhiqiang.liu@nrl.navy.mil)


Team & Economic Impact For State of Ohio

- University Partners**
 - Wright State University: Dr. Zhiqiang Wu
 - University of Toledo: Dr. Ahmad Javaid and Dr. Vijay Devabhaktuni
 - Ohio University: Dr. Harsha Chenji and Dr. James Stewart
 - Air Force Institute of Technology: Dr. Robert Mills, Dr. Scott Graham
- Industry**
 - Comsat Architects: Dr. Kul Bhasin
 - GIRD Systems Inc.: David Maldonado
- Job Creation Plan**
 - Ohio jobs through Comsat & GIRD federal dollars on CR&SDR (40 in 5 years)
 - Training specialized workforce across OH (produce 65 graduates in 2 years)
 - Trained workforce hiring by AFRL/NASA/NASIC & Contractors (80 in 5 years)
- Commercialization and IP**
 - Team holds a wide range of existing IP including publications, SBIR data rights, proprietary technologies, and trade secrets.
 - Team is at the frontier of the proposed technological areas, confirmed by publications, GIRD' multiple SBIR contracts, and Comsat's NASA contract.

Budget, Schedules, Deliverables, & Risks

- Period of Performance: 24 months
- Significant Milestones**
 - Cognitive networking algorithms designed to enable spectrum sensing, interference mitigation, and high data-rate communications
 - Machine learning enabled cross-layer cybersecurity algorithms/models designed and implemented for optimal information security
 - "FPGA based secure hardware" for multi-level secure code compilation
 - Proposed algorithms and technologies implemented & validated using nationally strategic federal testbeds, i.e. AFRL's DYSE and NASA's ScaN
 - Integration into the Interplanetary Overlay Network software codebase
 - New Collaborations, New IP, New Jobs, New Talents, New Technologies

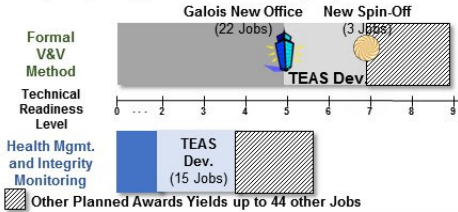
Rev 09-18



C2PNT w/HPHS COEs – Test & Evaluation of Autonomous Systems (TEAS)

Technical Concept & Approach

- TEAS** – Autonomy test, evaluation, verification, and validation process and tool improvements creating technical capability to support Air Force autonomy requirements



Project Requirement, Federal Alignment, Sponsoring Organization (s)

- AFRL/DoD Req: Develop and Execute TEV&V capability for Autonomy Security and Safety; System-of-Systems resiliency inclusive of human-machine teaming
- Project is aligned to OSD T&E of Autonomous Systems
 - Test Infrastructure and Personnel
 - Safety/Cyber Security for Autonomous Systems
 - Testing of Human System Teaming
 - Health Monitoring and Integrity Management
- Achieves capability development of sequential testing and supports security/safety analysis for autonomous systems
- Sponsors: AFRL/RQ – Dr. Derek Kingston, AFRL/RH – Greg Feitshans

Team & Economic Impact For State of Ohio


- PI: David Gross, Wright State University
- Team Members: Wright State University, Ohio University, AFIT, Galois, Ohio FRN HPHS & C2PNT COEs
- Potential Economic Development Impact
 - \$51M+ in identified Research opportunities from AFRL, DARPA, Army and industry
 - Galois – Open Dayton Office
 - \$1.325M Cash Committed Cost Share
 - \$4.2M Contingent Investment to grow business based on commercial demand
 - Spin-out business from IP maturation planned within three years
 - 84 New Jobs: Galois (25), OU (8), WSU (7), AFRL/ Industry (44)

Budget, Schedules, Deliverables, & Risks

- Period of Performance:** 24 months
- Milestones:** 1) Analysis of UxAS Software 2) GPS Denied Scenarios; 3) Refactored Code Decision; 4) Health Monitoring and Integrity Mgmt interface for autonomy; 5) Testing of Human-System Teaming/Resilience Research Report
- Deliverables:** Analysis Document; Software V&V Report; Software, Flight Test Reports, Final Report including Operator Trust Verification Analysis
- Key Risk:** Limited ability to use M&S; Complexity of autonomy TEV&V

Rev 09-18

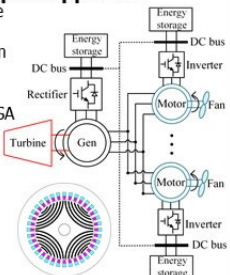
Round 3 Projects Awarded



The Ohio State University: Brushless Doubly-fed Machine and Drive Systems for Aviation Application

Technical Concept & Approach

- Design, develop and demonstrate a brushless doubly-fed machine based hybrid electric drive system for more electric aircraft.
- Application for VTOL, UAS, PAV, LDV propulsion for AFRL and NASA applications.
- Only portion of power through converter: 30-40% reduction in system weight; reduced losses/thermal load.
- 50% reduction in system cost
- Safer shutdown under fault conditions.



Team & Economic Impact For State of Ohio


- PI:** Julia Zhang, OSU
- Team**
 - The Ohio State University
 - SAFRAN
 - UDRI
- Economic Impact** — short term technology development at universities and in multiple manufacturing facilities—SAFRAN, ZIN Technologies, Fredon, Accurate Metal, Warren Screw, Boeing.
- Long term potential production activities: 80-100 people

Project Requirement, Federal Alignment, Sponsoring Organization (s)

- Demonstrate new innovative design in a 150 to 300 kw size
 - Sponsoring organizations
 - NASA Glenn: Ray Beach/Cheryl Bowman
 - AFRL: John Nairus
- Potential impact on federal stakeholder mission:
 - Helps NASA and AFRL achieve key goals in electrified aircraft technology.
 - Weight, cost, and manufacturing complexity reduction
 - Safer system under fault conditions


Budget, Schedules, Deliverables, & Risks

- Period of Performance: 18 months
- Milestones:**
 - Power system and motor/gen design complete by month 3.
 - Manufacturing complete by month 11
 - Demonstration complete by month 18
- Deliverable:** 150/300kw brushless doubly-fed machine and drive systems
- Risks**
 - Magnetic performance of new machines are lower than expected
 - Time delay caused by long lead time of some parts



GhostWave/Dean Zody – Detect and Avoid Sensor Fusion

Technical Concept & Approach



AOI#14 Detect and Avoid

- Sensor Fusion of Optical and Radar
- Immune from Interference of other UAV
- Light weight
- Low power
- Onboard. Closed Loop System
- Future BVLOS Requirement

Project Requirement, Federal Alignment, Sponsoring Organization (s)

- AFRL and Air National Guard both are asking for Detect(UAS Sense) and Avoid Systems
- Current systems are vision based and do not perform well in Degraded Visual Environments.(DVE)
- This System
 - Includes radars that provide more information than optical solutions and perform well in DVE.
 - This approach uses the best of optical and radar by sensor fusion.
 - The customer will have a Detect and Avoid System that performs in DVE and is immune from jamming, interference and is drone swarm friendly.


Team & Economic Impact For State of Ohio

- PI:** Dean Zody, GhostWave
- Team Members:** The Ohio State University, Ohio University, Lockheed Martin, GhostWave, Event 38 and IS4S
- With awarding this project, IS4S will begin open offices in Ohio for two new engineers and GhostWave will hire an engineer.
- Post Project
 - Begin commercialization of the solution and expanding to fixed wing and larger UAVs.
 - Adding up to 20 engineering and manufacturing jobs by 2020
- In addition to engineering, electronic manufacturing in Ohio will also increase for the radar sensors that are part of the solution.
- Department of Defense is looking into UAV Survivability which could use this technology in a larger project
- The commercial impact** includes providing Sense and Avoid systems for agriculture, real estate, and hobbyist. Potential business partners include DJI, Parrot and others.

Budget, Schedules, Deliverables, & Risks

- Period of Performance:** 18 months
- Milestones:**

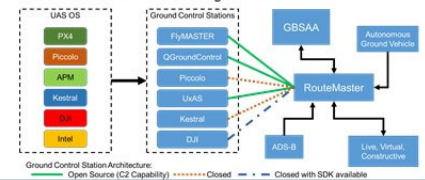
Design Radar System	Sensor Fusion of Camera / Radar
Integrate with UAS	Demonstration at Calamityville
- Deliverables:**
 - Multi-rotor copter that passes Calamityville test,
 - Sensor Fusion Detect and Avoid System,
 - Radar Prioritization Algorithms.
- Key technical risks** include having processing power on board to perform tasks and developing fusion algorithms. (there will be more processing power by intro)



University of Cincinnati – Regional Unmanned Traffic Management System (RUTMS)

Technical Concept & Approach

- Objectives: Partial Universal Translator of sUAS to communicate with Springfield GBSAA and/or Piccolo Autopilot, Creation of Regional Unmanned Traffic Management System
- Challenges: Closed Architecture of many sUAS prevents true Universal Translator from being created



Ground Control Station Architecture
● Open Source (C2 Capability) ● Closed ● Closed with SDK available

Project Requirement, Federal Alignment, Sponsoring Organization (s)


- AFRL:** POC: David Casbeer (david.casbeer@us.af.mil), Team Lead, UAV Cooperative & Intelligent Control, Control Science Center of Excellence, AFRL Aerospace Systems Directorate
- Potential Impact on Federal Stakeholders:
 - Current operations are limited in handling multiple kinds of autopilots
 - The proposed effort will enable mission planning for multiple UAS and an enhanced collision avoidance system.
 - Enable operations in a GPS denied and urban canyons

Team & Economic Impact For State of Ohio

- University Partners
 - University of Cincinnati: Kelly Cohen (PI), Manish Kumar, Raj Sharma, Jiaqi Ma, Justin Ouwerkerk, Bryan Brown
 - Sinclair Community College: Jeff Miller, Andrew Shepherd, Todd Simpson, Ryan Palm, Casey Dearth
- Industry Partners
 - Demeter UAVs: Terry Hofecker
 - Simlat Ltd.: Roy Peshin
- UAS services could create 56+ jobs in OH, 98+ by 2024
- Research projects have the potential to generate new, commercially relevant products and/or IP, in both localization and RUTMS
 - Commercial strategies will applied as necessary to emerging IP or patentable products

Budget, Schedules, Deliverables, & Risks


- Period of Performance:** [18 months]
- Milestones:**
 - Demonstrate the translator and associated software for visualization, mission planning, and localization.
 - Test integration of software with multiple autopilots
 - Testing and demonstrations using disaster response/emergency management scenarios
- Risks:**
 - Developing Translator given the "closed" autopilots



Persistent Surveillance - Autonomous/Remote Piloted Cirrus SR22 Aerial Surveillance Platform and Personnel Air Vehicle "Air Uber" System

Technical Concept & Approach

Autonomous SR22 Camera Positions



What: Conversion of FAA Certified 4-passenger Cirrus SR22 aircraft into fully autonomous air vehicle

- Quick Install Kit for remote pilot support & UAS operations based on certified Avionics/Autopilots.
- Multi-INT, modular payloads for ISR / emergency mgt

Why: Multiple Commercial and DoD markets/missions

- Baseline air vehicle for "Uber Air"; Autonomous Surveillance for DoD/first-responder missions

Challenges: System certification for NAS operations

Project Requirement, Federal Alignment, Sponsoring Organization (s)

- AFRL Sensors & Aircraft Systems–Sensor Flight Test Support
- NASA Glen Command and Control – UAS NAS integration
- Ohio National Guard – Multi-INT, swappable mission pods
- Impact on federal stakeholder mission
 - Current Federal Limitation:** Current autonomous air vehicles lack the payload capacity and endurance required by major sensors in development and require millions to integrate/test
 - Benefits for Federal Customers:** Provides an affordable and flexible Ohio alternative for flight testing of sensors and systems.
 - Cost effective platform to test sensors, radars, ELINT, communication, see & avoid systems in reconfigurable pod
 - New approach – Commercial product/service based, established, large commercial market


Team & Economic Impact For State of Ohio

- PI:** Ross McNutt (Persistent Surveillance Systems)
- Members:** Results Driven: Industry, Academia, DoD team
 - Persistent Surveillance Systems Survylsds Beavercreek OH
 - Ohio University – COE C2NPT Integrity and Safety
 - Wright State University – CS Detect Image processing
 - AFRL RYMD, RQQD, NASA Glenn Command and Control (C2)
 - Cirrus/Avidyne Commercial Aviation upgrades & mods
 - MacAir Aviation AC Mods and flt testing Xenia Ohio
 - Autonodyne / Avidyne Adv Avionics to open office OH
 - MacNaughtan Dev – Immersive Sims Beavercreek OH
 - Bosma Technologies Dayton–Air-to-Air Refuel – Dayton
- Potential economic development impact:**
 - 50-100 jobs, \$5.4 M in matching funds and effort
 - \$35M in identified potential Gov programs
 - \$42M in potential aircraft upgrades and support service

Budget, Schedules, Deliverables, & Risks

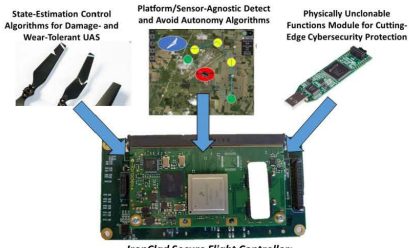
- Period of Performance:** 18 Months
- Milestones:**
 - Demo of remote pilot support for extended surveillance
 - Military Exercise Support with multiple mission pods
 - Demonstration of remote pilot support for civil pilots
 - "Air Uber" demonstration for Uber executives
- Deliverables:** – Certifiable Remote Pilot Assisted and Autonomous SR22 with pilot support service
 - AC Quick mod kit for conversion of the 5,500 SR22s
 - Multiple mission pods, Air to Air refueling system
- Key risks:** End-to-End integration; FAA approvals

Round 4 Projects Awarded



Asymmetric Technologies – Resilient and Secure UAS Flight Control

Technical Concept & Approach



IronClad Secure Flight Controller:
Proven, Cybersecure, Open-Architecture, Platform-Agnostic UAS Flight Controller

Project Requirement, Federal Alignment, Sponsoring Organization (s)

- Federal Partner: **Air Force Research Laboratory**
- AOIs addressed:
 - **#2:** Field Swappable Aircraft Variants,
 - **#7:** Onboard Protocols for Non-Traditional Systems,
 - **#8:** Computational Efficiencies and Onboard Heat Management,
 - **#13:** Detect and Avoid
 - **#14:** Security Assurance, Encryption, and Testing
- Provides AFRL and other federal/commercial UAS developers an **American-made, common, cybersecure, platform-agnostic and resilient flight control capability**
- Current UAS FCs lack integrated detect and avoid capability, cybersecurity, damage/wear-tolerance, and/or are proprietary and expensive


Team & Economic Impact For State of Ohio

- **Asymmetric Technologies:** Service-Disabled, Veteran-Owned Small Business in Columbus and developer of IronClad **Ohio State Aerospace and Physics:** for UAS control and advanced cybersecurity expertise
- **Ohio University:** for detect and avoid autonomy algorithms
- **Lockheed Martin Rotary and Mission Systems:** Condor fixed-wing platform developed for AFRL and integration and commercialization support
- **State of Ohio Economic Impacts:**
 - Engineering jobs in UAS and payload integration, advanced embedded electronics manufacturing and testing positions,
 - Multiple Ohio-based UAS providers interested in integrating IronClad into their platforms (Theiss, SelectTech, Event38)

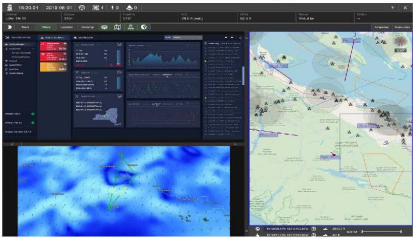
Budget, Schedules, Deliverables, & Risks

- **Requested Budget Total:** 2020: \$967k, 2021: \$483k, Total Requested : \$1,450k
- **Cost Share:** \$1,352K
- **Period of Performance:** 18 months
- **Milestones:** **M1:** System Requirements/Acceptance by AFRL, **M2:** Controllers/ DAA/PUF Modules Operating on IronClad, **M3:** Flight Test Readiness Review/Acceptance by AFRL, **M4:** Final Ground/Flight Demonstrations.
- **Deliverables:** **D1:** Quarterly Technical/Cost Status Reports, **D2:** System Requirements Document, **D3:** Updated IronClad SFC Boards, **D4:** State Estimation Controller Algorithms; **D5:** OpenUxAS Software Modified for IronClad Use; **D6:** PUF Module Integrated with IronClad, **D7:** Detailed Flight Demo Test Plan; **D10:** Final Report
- **Technical Risks:** Real-time, fault-tolerant control systems don't work as planned with existing open-source FC software implementations
GBDAA/ADS-B may not sense other aircraft during demonstration
Required encryption processes cause excess latency in telemetry data streams

Interoperability, Resiliency, and Contingency Management for Ohio UAS Operations



Technical Concept & Approach



- UAS Interoperability Study
- Contingency Management Platform (CMP) Integration

Project Requirement, Federal Alignment, Sponsoring Organization(s)

Federal Stakeholders: AFRL, NASA, OANG, ODOT

- ✓ Enable enhanced situational awareness and contingency operations for SkyVision (AFRL, OANG) and ODOT UTM systems
- ✓ Develop communication requirements (CONOPS) for BVLOS operations and transitions between UTM / ATM
- ✓ Provides artifacts (CONOPS, Safety) for obtaining BVLOS waivers and COA's (AFRL, NASA, OANG, ODOT)
- ✓ Process and tool set for rapid development and evaluation of innovative UAS operations (AFRL, ODOT, OARNG, NAMRU-D)

Team & Economic Impact For State of Ohio

Team Members: CAL Analytics, Kongsberg Geospatial, TruWeather Solutions, The Ohio State University, Kent State University, ResilienX

Economic Impacts:

- Increased capability and operationalization of SkyVision and ODOT UTM systems
- CONOPS for Ohio UAS operations highlighting interoperability between various UAS operations and UTM / ATM
- Enables R&D for new large-scale markets, such as PAV transportation and logistics (package delivery by UAS)
- 5-8 Jobs at Project End; 15-20 Jobs by 2022

Follow on Funding:

- \$20+M by 2022

Budget, Schedules, Deliverables, & Risks

Requested Budget Total: \$1,500,000

Year 1: \$900,000 **Year 2:** \$600,000

Period of Performance: 18 Months

Milestones:

- CONOPS Delivery / M&S Evaluation (8 months)
- CMP Integration (10 months)
- Demonstration at SkyVision and ODOT UTM (17 months)


Deliverables:

- UAS Interoperability Study
- (2) Integrated Contingency Management Platforms (CMP) – SkyVision and ODOT UTM

Technical Risks:




- Getting vendor interface requirements for CMP integration

5/18/2020
21



GhostWave Inc. – Multi-purpose Mast/Aerial 360° radar/camera fused sensors for Perimeter Monitoring and Aerial Detect and Avoid

Technical Concept & Approach

Saudi Refinery attack Sept 2019

- Camera Stealthy Low-Cost Radar Sensor Fusion
- 360° Detection Low Altitude UAS in all directions
- 360° Detect and Avoid for VTOL

Project Requirement, Federal Alignment, Sponsoring Organization (s)


- AFRL Focus on Detection
- Army Detection (xTechSearch)
- Air Force – Detection (AFWERX)
- Ohio Guard – FOB Monitoring
- Impact is Warfighter Air Space Situational Awareness
 - Current practice is not looking at low altitudes and is not 360°
 - Sensor Fusion of 360° radar and 360° camera.
 - A sensor solution that can be incorporated into existing DoD C2 Systems (security)
- Alignment with OFRN AOI 3, 13 and 16

Team & Economic Impact For State of Ohio

- Dean Zody, John Bair, Kevin Barry, Dr. Peter Collins, Dr. Wladimiro Villarroel, Dr. Michael Jirjis, Dr. Andrew Shepherd
- Economic Impact
 - 10 jobs, \$1.5M in Cash Cost Share by end of project
 - 20 jobs and \$5M Incremental funding by 2023
- commercial impact
 - Currently no available sensors for FOB and event security systems industry/sector/business partners
 - Integration into Prime Contractor C2 Systems
- Currently pursuing significant Federally Funded follow on research projects in Ohio using RF Noise architecture.
 - Army Phase I SBIR
 - xTechSearch Challenge Phase 4

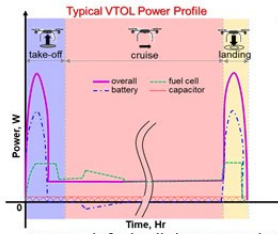
Budget, Schedules, Deliverables, & Risks

- Requested Budget Total: \$1.5M (note total project \$3M with Costs Matching)
 - GhostWave \$1200K
 - Converge Tech \$1180K
 - Lockheed Martin \$350K
 - General Dynamics \$50K
 - AFIT\$70K
 - OSU \$100K
 - Sinclair College \$50K
 - Total \$3.0M
- Year 1: [\$1.0M], Year 2:[\$500K] (OFRN Portion).
- Follow On High Probability Funding Year 1: [\$1.0M], Year 2:[\$500K]
- Period of Performance: 18 months
- Milestones: [up to 4] 1. Finalize HW SW Design 2. First Article Testing Solution 3. Four Beta units developed 4. Three production ready units delivered.



Kent State University (PI: Dr. Yanhai Du)
A Hybrid Fuel Cell–Battery–Capacitor Power Source for UAS

Technical Concept & Approach



- *The Problem:* onboard power limitations (weight and power capacity) are the bottle necks of UAVs to meet the billion dollars’ market need for extended flight time and payload.

Approach: fuel cell, battery and capacitor hybridization.
 Goal: energy density 400 W-h/kg for a 12-hours flight time.

Project Requirement, Federal Alignment, Sponsoring Organization (s)


- *Federal stakeholders:* AFRL, NASA, ARL
- *Potential impact on federal stakeholder mission*
 - AFRL is focused on development of advanced electric and hybrid electric power systems to increase range/ endurance and onboard payload power, enables more reliable architectures, and supports quiet operation.
 - NASA’s Strategic Thrust 6: Assured Autonomy for Aviation Transformation. The proposed work aligns very well with NASA-GRCs interest in hybrid electric power systems.
 - Proposed power supply system with a very high specific energy will enable the development of lightweight and long-endurance UASs for various federal customers.

Team & Economic Impact For State of Ohio

- *Team:*
 Kent State University (lead party): Yanhai Du (PI), David Stringer, Rui Liu; Wright State University: Hamed Attariani; University of Dayton: Dong Cao; Case Western Reserve University: Lei Zhu; Event 38: Jeff Taylor.
- *Potential Economic and Development Impacts*
 - Further strengthening Ohio’s position in aerospace energy, fuel cells (top 5 in the nation) and energy storage research.
 - PI Dr. Du previously awarded by DARPA, US Army and NASA for portable fuel cell power source development.
 - Creating 15 new jobs related to manufacturing and R&D.
 - UAS/UAV companies benefit from the integrated high energy density power system to meet customers needs.

Budget, Schedules, Deliverables, & Risks

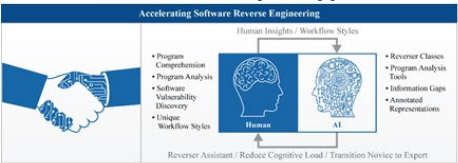
- Requested Budget Total: \$1,244,418
 - Year 1: \$949,988, Year 2: \$294,430
- Period of Performance: 18 months, starting on Jan 1, 2020
- Major Milestones
 - Hybrid power system initial design completed.
 - Components are determined and acquired.
 - Integrated power sources and functionality tests.
 - Flight demonstration conducted; TRL 6 upon completion.
- Main Deliverables
 - Power source, performance and modeling data;
 - Demos: 400 W-h/kg for 12-hr simulation and 1-hr flight.
- Key technical risks
 - Deviations in power requirements; reliability of the hybrid power system.



Riverside Research – Computer-Human Interaction for Rapid Program Analysis through Cognitive Collaboration (CHIRP2C)

Technical Concept & Approach

Accelerating Software Reverse Engineering



CHIRP2C is a novel and revolutionary cognitive system that provides proactive, dynamic, intelligent collaboration between humans and artificial intelligence (AI) agents to discover software vulnerabilities rapidly.

Project Requirement, Federal Alignment, Sponsoring Organization (s)


- Sponsor:** NASIC FME, AFRL RYD, NAMRU-D
- Requirement:** Tools to decompose software binary, identify critical functionality, and perform vulnerability analysis.
- IMPACT:** CHIRP2C reduces time for analysis. Enables rapid understanding of the inner workings of the software program and greater insight into the overall system.
 - Currently, highly skilled reversers needed, time/labor intensive process
 - CHIRP2C captures key techniques and insights of experts to automate analysis process
 - Will provide new capability, increase efficiency, lower personnel costs, address critical shortage of reversers

Team & Economic Impact For State of Ohio

- Team: Riverside Research, Unmanned Science, Inc., University of Dayton, University of Cincinnati
- Potential economic development impact for the state of Ohio.
 - Skilled reversers are highly sought after by the Federal government, law enforcement, intelligence agencies, and defense contractors
 - Ability to fill this need with less experience personnel can increase grants, contracts, workforce development opportunities
- CHIRP2C can be applied to commercial domain in the areas
 - Workforce development – skills enhancement/development
 - Address need for high demand/highly-skilled positions with critical shortages

Budget, Schedules, Deliverables, & Risks

- Requested Budget Total: \$1,176,717**
- Year 1:** \$784,478, **Year 2:** \$392,239
- Period of Performance:** 18 months
- Milestones:**
 - Capture reverse engineering workflow using human factors
 - Develop an AI context processor for accelerated training
 - Improve efficiency by 10X and reduce cognitive load by 80%
 - Demonstrate counter UAS capabilities
- Deliverables:** Software and codes to accelerate reverse engineering, CHIRP2C SOP, technical and status reports, final reports, algorithms to implement context AI processing
- Key technical risks**
 - Signal interference, statistical errors, overtraining of AI





Pathological Geometries LLC: 3D Printed Antennas for UAS

Technical Concept & Approach

3D Printed Antennas targeting UASs:

- Pathologically-complex
- Customized envelopes
- Spatially Varying Electromagnetic Lattices

Project Requirement, Federal Alignment, Sponsoring Organization (s)

- NASA Glenn Research Center, Mike Zemba
 - Aerospace-related antennas
 - ADS-B Collision Detection Protocol for UASs
 - Antennas studied will advance antenna knowledge for a broad range of NASA aerospace applications
 - Improved spatial efficiency
 - Spatial modulation of permittivity for new classes of light-weight microwave devices.
 - Improved directionality

Team & Economic Impact For State of Ohio

- Youngstown Business Incubator (YBI)
- Youngstown State University (YSU)
- Kent State University (KSU)
- Event 38 LLC
- Universal Technology Corporation Dayton (UTC)
- Event 38 to hire 2-3 engineers
- UTC to hire up to 4 new positions
- General advancement in aerospace friendly (light weight, aerodynamic antennas with 3D printing) could lead to 10's of jobs in Ohio – a state in the vanguard of UAS R&D
- With a strong relationship to America Makes, the work will have visibility to defense primes: Raytheon, NGC, LMC, etc.

Budget, Schedules, Deliverables, & Risks

- Requested Budget Total: [\$1,085,000]
- YSU \$450,000, YBI \$175,000, Event38 \$150,000, KSU \$110,000, UTC \$200,000
- Year 1: [\$651,000], Year 2: [\$434,000]
- Period of Performance: 18 months
- Milestones:**
 - Selection of UAS feature to replace/augment
 - Selection of AM process
 - Selection of electromagnetic device
 - Wind tunnel evaluation of final structure
 - Electromagnetic evaluation (Glenn)
 - Flight demonstration
- One antenna system with improved performance within geometric constraints of the UAS – to be flown in May 2021.

APPENDIX 3 – OFRN FUNDS EXPENDITURE AND COST SHARE REPORTS

Funds Expended Report – As of 30 June 2020

OHIO DEPARTMENT OF HIGHER EDUCATION WORKFORCE DEVELOPMENT AND EMERGING MISSIONS MOU's OFRN FUNDS EXPENDED REPORT					
Please Type all Information		Subaward No.: PO BOR01-00000004706/MOU DATED 12/1/15			
Recipient:	Wright State Applied Research Corporation				
Project:	Ohio Federal Research Network - Centers of Excellence				
Reporting Period:	July 1, 2019 - June 30, 2020				
Budget Categories (Subawards)	(A) Budgeted Amount	(B) Total Costs Through Last Report	(C) Costs Incurred This Period Only	(D) Balance A- (B+C)=D	Cumulative Expenditures B+C
PRESIDES COE - Case Western Reserve	\$1,633,806	\$1,633,806	\$0	\$0	\$1,633,806
OCPP COE - The Ohio State University	\$3,745,145	\$3,745,145	\$0	\$0	\$3,745,145
M&M COE - University of Dayton	\$3,024,438	\$3,024,438	\$0	\$0	\$3,024,438
HPHS COE - Wright State University	\$1,493,922	\$1,493,922	\$0	\$0	\$1,493,922
C4ISR COE - Wright State University	\$1,200,000	\$1,149,841	\$50,159	\$0	\$1,200,000
C2PNT COE - Ohio University	\$20,118	\$20,118	\$0	\$0	\$20,118
C&WD Team - Cleveland State University	\$1,108,000	\$1,108,000	\$0	\$0	\$1,108,000
C&WD Team - Lorain County Community College	\$974,884	\$974,884	\$0	\$0	\$974,884
OFRN Legacy Workforce Development Programs	\$3,555,088	\$3,555,088	\$0	\$0	\$3,555,088
OFRN Administration	\$3,244,599	\$2,863,682	\$374,878	\$6,040	\$3,238,560
TOTAL	\$20,000,000	\$19,568,923	\$425,037	\$6,040	\$19,993,960
<p>CERTIFICATION: I hereby certify that the above amounts are true and accurate to the best of my knowledge; that all costs incurred are solely for the purpose set forth in ODHE MOU. Appropriate documentation, including, but not limited to, receipts or other evidence of payment, is on file and available as provided for in the Award Agreement.</p> <p>Authorized Signature: _____ Date: _____</p> <p>Typed Name: Dennis Andersh _____</p> <p style="text-align: center;">STATE USE ONLY BELOW THIS LINE</p> <p>CAP: _____</p> <p>Project Administrator: _____ Date: _____</p>					

Form B2

OHIO DEPARTMENT OF HIGHER EDUCATION WORKFORCE DEVELOPMENT AND EMERGING MISSIONS MOU's OFRN FUNDS EXPENDED REPORT					
Please Type all Information			Subaward No.: 60065626/Sec.369.473, Ohio H.B. 64 of 131		
Recipient:	Wright State Applied Research Corporation				
Project:	Ohio Federal Research Network - Centers of Excellence				
Reporting Period:	July 1, 2019 - June 30, 2020				
Budget Categories (Subawards)	(A) Budgeted Amount	(B) Total Costs Through Last Report	(C) Costs Incurred This Period Only	(D) Balance A- (B+C)=D	Cumulative Expenditures B+C
C2PNT COE - Ohio University	\$2,087,478	\$2,087,478	\$0	\$0	\$2,087,478
HPHS COE - Wright State University	\$2,072,220	\$2,072,220	\$0	\$0	\$2,072,220
OFRN CONSULTANTS	\$223,337	\$223,337	\$0	\$0	\$223,337
OFRN ADMIN G&A	\$40,255	\$40,255	\$0	\$0	\$40,255
OSU PROJECTS & ADMIN	\$576,710	\$576,710	\$0	\$0	\$576,710
TOTAL	\$5,000,000	\$5,000,000	\$0	\$0	\$5,000,000
<p>CERTIFICATION: I hereby certify that the above amounts are true and accurate to the best of my knowledge; that all costs incurred are solely for the purpose set forth in ODHE MOU. Appropriate documentation, including, but not limited to, receipts or other evidence of payment, is on file and available as provided for in the Award Agreement.</p> <p>Authorized Signature: _____ Date: _____</p> <p>Typed Name: <u>Dennis Andersh</u></p> <p style="text-align: center;">STATE USE ONLY BELOW THIS LINE</p> <hr/> <p>CAP: _____</p> <p>Project Administrator: _____ Date: _____</p>					

Form B2

**OHIO DEPARTMENT OF HIGHER EDUCATION
WORKFORCE DEVELOPMENT AND EMERGING MISSIONS MOU's
OFRN FUNDS EXPENDED REPORT**

Please Type all Information

Subaward No.: 60064366/Sec.381.440, Ohio H.B. 49 of 132nd G.A.

Recipient: Wright State Applied Research Corporation
 Project: Ohio Federal Research Network - Centers of Excellence
 Reporting Period: July 1, 2019 - June 30, 2020

Budget Categories (Subawards)	(A) Budgeted Amount	(B) Total Costs Through Last Report	(C) Costs Incurred This Period Only	(D) Balance A- (B+C)=D	Cumulative Expenditures B+C
PERSISTENT SURVEILLANCE SYSTEMS	\$1,998,349	\$1,363,733	\$582,721	\$51,894	\$1,946,454
GHOST WAVE	\$1,344,597	\$621,042	\$693,325	\$30,229	\$1,314,368
UNIVERSITY OF CINCINNATI	\$968,947	\$147,016	\$652,604	\$169,327	\$799,620
OFRN CONSULTANTS	\$213,986	\$135,018	\$78,968	\$0	\$213,986
WSARC UNALLOCATED	\$13,049	\$0	\$13,049	\$0	\$13,049
OSU PROJECTS & ADMIN	\$2,361,072	\$576,710	\$473,290	\$1,311,072	\$1,050,000
TOTAL	\$6,900,000.00	\$2,843,520	\$2,493,957	\$1,562,523	\$5,337,477

CERTIFICATION: I hereby certify that the above amounts are true and accurate to the best of my knowledge; that all costs incurred are solely for the purpose set forth in ODHE MOU. Appropriate documentation, including, but not limited to, receipts or other evidence of payment, is on file and available as provided for in the Award Agreement.

Authorized Signature: _____ Date: _____
 Typed Name Dennis Andersh

STATE USE ONLY BELOW THIS LINE

CAP: _____
 Project Administrator: _____ Date: _____

**OHIO DEPARTMENT OF HIGHER EDUCATION
WORKFORCE DEVELOPMENT AND EMERGING MISSIONS MOU's
OFRN FUNDS EXPENDED REPORT**

Please Type all Information

Subaward No.: 60073805/Sec.381.440, Ohio H.B. 166 of 136th G.A.

Recipient: Wright State Applied Research Corporation
 Project: Ohio Federal Research Network - Centers of Excellence
 Reporting Period: July 1, 2019 - June 30, 2020

Budget Categories (Subawards)	(A) Budgeted Amount	(B) Total Costs Through Last Report	(C) Costs Incurred This Period Only	(D) Balance A- (B+C)=D	Cumulative Expenditures B+C
ASYMMETRIC TECHNOLOGIES	\$1,450,071	\$0	\$272,841	\$1,177,230	\$272,841
CAL ANALYTICS	\$1,399,882	\$0	\$307,756	\$1,092,126	\$307,756
GHOST WAVE	\$1,262,622	\$0	\$212,358	\$1,050,264	\$212,358
KENT STATE UNIVERSITY	\$1,214,202	\$0	\$14,445	\$1,199,757	\$14,445
RIVERSIDE RESEARCH	\$1,176,717	\$0	\$146,742	\$1,029,975	\$146,742
YOUNGSTOWN BUSINESS INCUBATOR	\$972,877	\$0	\$117,880	\$854,997	\$117,880
OFRN ADMINISTRATION	\$1,928,629	\$0	\$699,485	\$1,229,144	\$699,485
TOTAL	\$9,405,000	\$0	\$1,771,508	\$7,633,492	\$1,771,508

CERTIFICATION: I hereby certify that the above amounts are true and accurate to the best of my knowledge;
 that all costs incurred are solely for the purpose set forth in ODHE MOU.
 Appropriate documentation, including, but not limited to, receipts or other evidence of payment, is on file and available
 as provided for in the Award Agreement.

Authorized Signature: _____ Date: _____
 Typed Name Dennis Andersh

STATE USE ONLY BELOW THIS LINE

CAP: _____
 Project Administrator: _____ Date: _____

Form B2

Cost Share Contribution Report – As of 30 June 2020

OHIO DEPARTMENT OF HIGHER EDUCATION WORKFORCE DEVELOPMENT AND EMERGING MISSIONS MOUs OFRN COST SHARE CONTRIBUTION REPORT					
Please Type all Information			Subaward No.: PO BOR01-00000004706/MOU DATED 12/1/15		
Recipient:	Wright State Applied Research Corporation				
Project:	Ohio Federal Research Network - Cost Share Contribution				
Reporting Period:	July 1, 2019 - June 30, 2020				
Budget Categories (Subawards)	(A) Budgeted Amount	(B) Total Cost Share Through Last Report	(C) Costs Share This Period Only	(D) Balance A- (B+C)=D	Cumulative Cost Share B+C
PRESIDES COE - Case Western Reserve	\$708,758	\$820,258	\$0	-\$111,500	\$820,258
OCPD COE - The Ohio State University	\$4,247,733	\$4,862,032	\$0	-\$614,299	\$4,862,032
M&M COE - University of Dayton	\$2,983,670	\$2,676,861	\$0	\$306,809	\$2,676,861
HPHS COE - Wright State University	\$3,339,576	\$2,871,275	\$0	\$468,301	\$2,871,275
C4ISR COE - Wright State University	\$589,117	\$441,232	\$90,840	\$57,045	\$532,072
C2PNT COE - Ohio University	\$2,769,203	\$3,145,983	\$0	-\$376,780	\$3,145,983
C&WD Team - Cleveland State University	\$326,552	\$477,166	\$0	-\$150,614	\$477,166
TOTAL	\$14,964,609	\$15,294,807	\$90,840	-\$421,038	\$15,385,647
<p>CERTIFICATION: I hereby certify that the above amounts are true and accurate to the best of my knowledge; that all costs incurred are solely for the purpose set forth in ODHE MOU. Appropriate documentation, including, but not limited to, receipts or other evidence of payment, is on file and available as provided for in the Award Agreement.</p> <p>Authorized Signature: _____ Date: _____</p> <p>Typed Name <u>Dennis Andersh</u></p> <p style="text-align: center;">STATE USE ONLY BELOW THIS LINE</p> <p>CAP: _____</p> <p>Project Administrator: _____ Date: _____</p>					

Form B2

Note: A negative number in column D represents cost share provided in excess of budget.

OHIO DEPARTMENT OF HIGHER EDUCATION WORKFORCE DEVELOPMENT AND EMERGING MISSIONS MOUs OFRN COST SHARE CONTRIBUTION REPORT					
Please Type all Information			Subaward No.: 60065626/Sec.369.473, Ohio H.B. 64 of 131st GA		
Recipient:	<u>Wright State Applied Research Corporation</u>				
Project:	<u>Ohio Federal Research Network - Cost Share Contribution</u>				
Reporting Period:	July 1, 2019 - June 30, 2020				
Budget Categories (Subawards)	(A) Budgeted Amount	(B) Total Cost Share Through Last Report	(C) Cost Share Incurred This Period Only	(D) Balance A- (B+C)=D	Cumulative Cost Share B+C
C2PNT COE - Ohio University	\$0	\$0	\$0	\$0	\$0
HPHS COE - Wright State University	\$0	\$0	\$0	\$0	\$0
TOTAL	\$0	\$0	\$0	\$0	\$0
<small>* Duplicate of \$20M report.</small> CERTIFICATION: I hereby certify that the above amounts are true and accurate to the best of my knowledge; that all costs incurred are solely for the purpose set forth in ODHE MOU. Appropriate documentation, including, but not limited to, receipts or other evidence of payment, is on file and available as provided for in the Award Agreement.					
Authorized Signature:	_____			Date:	_____
Typed Name	Dennis Andersh _____				
STATE USE ONLY BELOW THIS LINE					
CAP:	_____			Date:	_____
Project Administrator:	_____			Date:	_____

Form B2

Note: The Cost Share was reported with the \$20M where it was a requirement.

OHIO DEPARTMENT OF HIGHER EDUCATION WORKFORCE DEVELOPMENT AND EMERGING MISSIONS MOUs OFRN COST SHARE CONTRIBUTION REPORT					
Please Type all Information		Subaward No.: 60064366/Sec.381.440, Ohio H.B. 49 of 132nd G.A.			
Recipient:	Wright State Applied Research Corporation				
Project:	Ohio Federal Research Network - Cost Share Contribution				
Reporting Period:	July 1, 2019 - June 30, 2020				
Budget Categories (Subawards)	(A) Budgeted Amount	(B) Total Cost Share Through Last Report	(C) Cost Share Incurred This Period Only	(D) Balance A- (B+C)=D	Cumulative Cost Share B+C
PERSISTENT SURVVEILLANCE	\$5,482,826	\$3,573,111	\$576,954	\$1,332,761	\$4,150,065
GHOST WAVE	\$1,247,722	\$465,644	\$798,229	-\$16,151	\$1,263,873
UNIVERSITY OF CINCINNATI	\$1,009,024	\$189,043	\$678,114	\$141,867	\$867,157
OSU	\$2,230,000	\$80,000	\$906,000	\$1,244,000	\$986,000
TOTAL	\$9,969,572	\$4,307,798	\$2,959,297	\$2,702,477	\$7,267,095
<p>CERTIFICATION: I hereby certify that the above amounts are true and accurate to the best of my knowledge; that all costs incurred are solely for the purpose set forth in ODHE MOU. Appropriate documentation, including, but not limited to, receipts or other evidence of payment, is on file and available as provided for in the Award Agreement.</p> <p>Authorized Signature: _____ Date: _____</p> <p>Typed Name: <u>Dennis Andersh</u></p> <p style="text-align: center;">STATE USE ONLY BELOW THIS LINE</p> <hr/> <p>CAP: _____</p> <p>Project Administrator: _____ Date: _____</p>					

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OHIO DEPARTMENT OF HIGHER EDUCATION WORKFORCE DEVELOPMENT AND EMERGING MISSIONS MOUs OFRN COST SHARE CONTRIBUTION REPORT					
Please Type all Information		Subaward No.: 60073805/Sec.381.440, Ohio H.B. 166 of 136th G.A.			
Recipient:		<u>Wright State Applied Research Corporation</u>			
Project:		<u>Ohio Federal Research Network - Cost Share Contribution</u>			
Reporting Period:		July 1, 2019 - June 30, 2020			
Budget Categories (Subawards)	(A) Budgeted Amount	(B) Total Cost Share Through Last Report	(C) Cost Share Incurred This Period Only	(D) Balance A- (B+C)=D	Cumulative Cost Share B+C
ASYMMETRIC TECHNOLOGIES	\$1,352,278	\$0	\$839,283	\$512,995	\$839,283
CAL ANALYTICS	\$1,177,798	\$0	\$314,252	\$863,546	\$314,252
GHOST WAVE	\$1,396,614	\$0	\$21,506	\$1,375,109	\$21,506
KENT STATE UNIVERSITY	\$1,011,776	\$0	\$0	\$1,011,776	\$0
RIVERSIDE RESEARCH	\$748,260	\$0	\$119,439	\$628,821	\$119,439
YOUNGSTOWN BUSINESS INCUBATOR	\$434,229	\$0	\$25,234	\$408,995	\$25,234
TOTAL	\$6,120,955	\$0	\$1,319,714	\$4,801,242	\$1,319,714
<p>CERTIFICATION: I hereby certify that the above amounts are true and accurate to the best of my knowledge; that all costs incurred are solely for the purpose set forth in ODHE MOU. Appropriate documentation, including, but not limited to, receipts or other evidence of payment, is on file and available as provided for in the Award Agreement.</p> <p>Authorized Signature: _____ Date: _____</p> <p>Typed Name <u>Dennis Andersh</u></p> <p style="text-align: center;">STATE USE ONLY BELOW THIS LINE</p> <hr/> <p>CAP: _____</p> <p>Project Administrator: _____ Date: _____</p>					

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