OHIO FEDERAL RESEARCH NETWORK

Defense & Aerospace Workforce Development Initiative

2018 Annual Report to the
Ohio Department of Higher Education

30-Jun-18

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 John Carey
Ohio Department of Higher Education

June 30, 2018

It is with great pleasure that we submit the third Annual Report for the Defense/Aerospace Workforce Development Initiative funded through Ohio HB 64 of the 131st General Assembly and Ohio HB 49 of the 132nd 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 Department of Defense (DoD) and National Aeronautics and Space Administration (NASA) requirements; enhancing university collaborations with Ohio-based small and medium size companies to engage them in innovation; creating and retaining jobs in Ohio for government and industry-related activities; and most importantly having a broad and significant impact on Ohio's economy.

To date, the OFRN has allocated just over $16 million in 18 research projects throughout the State. This has led to over $117 million in follow-on funding from key federal customers directly related to OFRN projects and sets up future program opportunities between OFRN affiliates and our federal partners to make Ohio a technology related economy powerhouse. Currently, there is over $350 million in new procurements pending with federal agencies as a result of OFRN business development requirements. OFRN expects to allocate ~$7M in its third offering of funds.

In early 2018, OFRN released a request for proposals for a new initiative: 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 (LDVs). SOARING projects will leverage Ohio's unique aerospace assets to overcome critical research needs of OFRN's federal partners and maintain Ohio's position as the number one supplier to Boeing and Airbus. Project selection under the RFP will be made in the summer of 2018.

In closing, the key to OFRN success to date has been its remarkable collaboration with the Ohio Department of Higher Education, JobsOhio, the Ohio Third Frontier, the DoD and NASA partners, and the Governor's Office. These partnerships and the partner's support of a requirements based model are what make OFRN unique and what have enabled it to capitalize on state and federal R&D investments in Ohio.

Sincerely,

Dennis Andersh
Program Executive - OFRN
Wright State Applied Research Corporation

Martin P. Kress
Program Executive - 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 of these 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

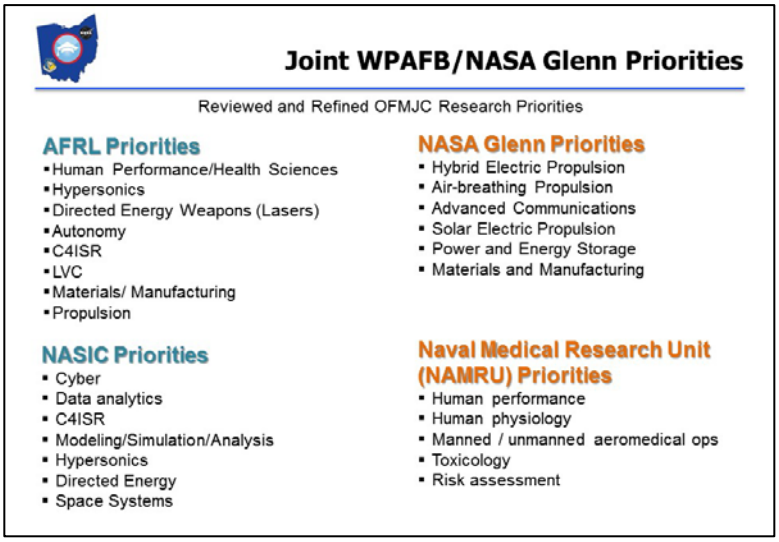


Figure 1 DoD/NASA Priorities

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.

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 11 Ohio Research Universities and 57 Ohio Industry Partners (35 Small Businesses; 22 Large Businesses) funded and engaged in the OFRN research activities. Universities that were included as of June 2018 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), and Wright State University (WSU)/Wright State Research Institute (WSRI). OFRN also has a subcontract in place with Cleveland State University (CSU) and Lorrain County Community College (LCCC) for support of its commercialization and workforce development activities. In response to OFRN's third round of funding, Sustaining Ohio's Aeronautical Readiness and Innovation in the Next Generation (SOARING), new engagement has occurred between OFRN and Bowling Green State University (BGSU), Sinclair Community College (SCC), Clark State Community College (CSCC), North Central State College (NCSC), and the University of Findlay (UF). 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 Vehicles (LDVs)

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

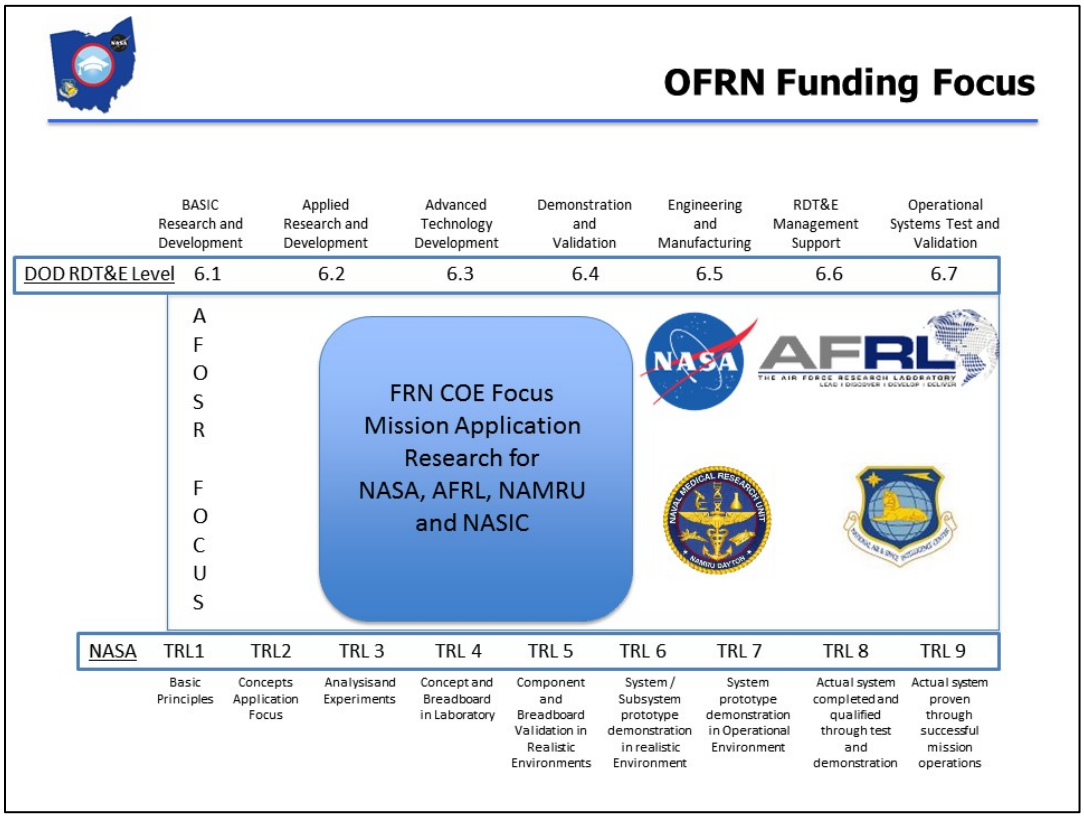


Figure 2 DoD/NASA TRL Levels

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 Cleveland State University, Lorrain County Community College, and a number of consultants to assist with commercialization and workforce development. The precise members of the commercialization team will evolve over the latter part of 2018 to best achieve results with the available funding.

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 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 Mr. Kress 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 and Ohio Third Frontier. 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.

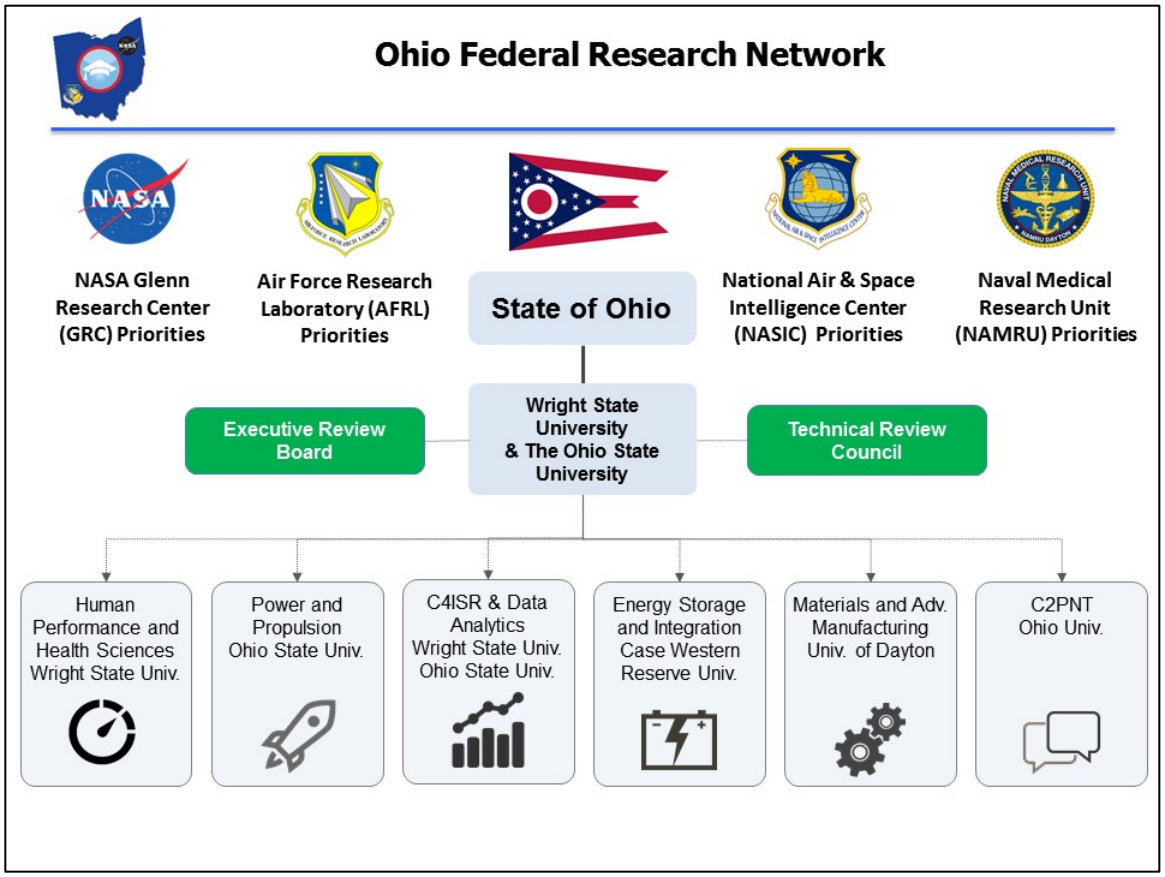


Figure 3 OFRN Organizational Chart

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 documenting of the White Paper and Proposal Review process; facilitates the ERB and TRC meetings and project reviews; is the funding agent for all COEs; 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)

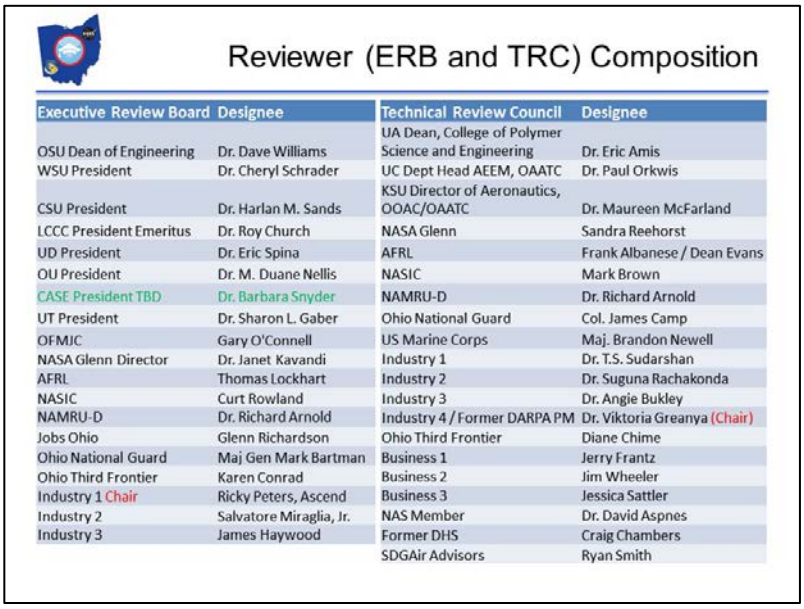
The TRC is responsible for comprehensive oversight of the portfolio of technologies that are used and developed by OFRN-funded projects. The TRC reviews all white papers and proposals; ranks them according to key criteria (established in RFPs), and then submits funding recommendations to the ERB.

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.

In the future, OFRN leadership hopes to further expand the role of the ERB to provide strategic guidance regarding new initiatives and activities, and to reassess some of the current criteria included within the OFRN proposal evaluation process.

Figure 4 shows the membership of the ERB and TRC, and each has representation from Federal and State government, industry, and universities. Mr. Ricky Peters (CEO, Ascend Innovations) chairs the ERB and Dr. Viktoria Greanya (CEO and Principal Consultant, MorphoSciences) chairs the TRC.



Reviewer (ERB and TRC) Composition

Executive Review Board	Designee
OSU Dean of Engineering	Dr. Dave Williams
WSU President	Dr. Cheryl Schrader
CSU President	Dr. Harlan M. Sands
LCCC President Emeritus	Dr. Roy Church
UD President	Dr. Eric Spina
OU President	Dr. M. Duane Nellis
CASE President TBD	Dr. Barbara Snyder
UT President	Dr. Sharon L. Gaber
OFMJC	Gary O'Connell
NASA Glenn Director	Dr. Janet Kavandi
AFRL	Thomas Lockhart
NASIC	Curt Rowland
NAMRU-D	Dr. Richard Arnold
Jobs Ohio	Glenn Richardson
Ohio National Guard	Maj Gen Mark Bartman
Ohio Third Frontier	Karen Conrad
Industry 1 Chair	Ricky Peters, Ascend
Industry 2	Salvatore Miraglia, Jr.
Industry 3	James Haywood

Technical Review Council	Designee
UA Dean, College of Polymer Science and Engineering	Dr. Eric Amis
UC Dept Head AEEM, OAATC	Dr. Paul Orkwis
KSU Director of Aeronautics, OOAC/OAATC	Dr. Maureen McFarland
NASA Glenn	Sandra Reehorst
AFRL	Frank Albanese / Dean Evans
NASIC	Mark Brown
NAMRU-D	Dr. Richard Arnold
Ohio National Guard	Col. James Camp
US Marine Corps	Maj. Brandon Newell
Industry 1	Dr. T.S. Sudarshan
Industry 2	Dr. Suguna Rachakonda
Industry 3	Dr. Angie Bukley
Industry 4 / Former DARPA PM	Dr. Viktoria Greanya (Chair)
Ohio Third Frontier	Diane Chime
Business 1	Jerry Frantz
Business 2	Jim Wheeler
Business 3	Jessica Sattler
NAS Member	Dr. David Aspnes
Former DHS	Craig Chambers
SDGAir Advisors	Ryan Smith

Figure 4 ERB and TRC Composition as of June 30, 2018

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.

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. Funding decisions associated with the third round of funding (SOARING) will be made in July 2018.

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

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.

Ohio Center for Power and Propulsion

OCPP – The Ohio State University

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.

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.

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

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.

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

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.

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

C4ISR – The Ohio State University/Wright State University

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

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.

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

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.

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 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

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)

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, 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 has also hosted the review of the Round 1 and Round 2 proposals as well as the ERB Meetings. They also 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.

The JobsOhio program 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 has also helped recruit key members of the ERB and TRC.

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 Adjunct General (TAG), Major General Mark Bartman, has interfaced with the OFMJC and with the OFRN since their inception. The OFRN is currently working with TAG and other key federal organizations to execute OFRN's SOARING initiative.

THE OHIO FEDERAL RESEARCH NETWORK (OFRN) PROGRAM PORTFOLIO

As of 30 June 2018, the OFRN has funded 18 major projects through two highly competitive procurements representing an approximately $16 million investment. 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 January 2018, OFRN released its third request for proposals, the SOARING initiative. Decisions on which projects will be funded are expected in July 2018.

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 ~$117 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). That shows a dramatic return on the State's $25 million investment to the OFRN program provided through Ohio HB 64 of the 131st General Assembly.

It also should be noted that the national labs are also investing in the OFRN approved proposals. Several of the most recently awarded contracts had matching funds from DoD labs.

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

Another program, initiated by OFRN in collaboration with ODHE is the I-Corps@Ohio Federal Research Network. This program, similar to that of the National I-Corps and to the State of Ohio I-Corps program, allowed OFRN teams to learn and understand business modeling concepts and how they are relevant towards commercialization. This program also allowed the teams to test their assumptions about the critical parameters of their OFRN funded projects' commercial potential and gain a richer understanding of the commercial marketplace. OFRN had eight teams across four of the six COEs. Below is a listing of those teams and their participants:

- **OCPP COE** *(Lead: The Ohio State University)*
  - Dr. Fang Luo; OSU – Modularized, High-Efficiency, Cost-effective and Compact Inverter
- **M&M COE** *(Lead: University of Dayton)*
  - Dr. Mohammad Elahinia; UT – Patient Specific Implants
  - Dr. James McGuffin-Cawley; CWRU – Laser Hot-Wire Technology as a High Throughput Metal Additive Manufacturing

- **PRESIDES COE** *(Lead: Case Western Reserve University)*
    - Dr. Priyanka Bhattacharya; UD – Lithium Sulfur Battery
    - Dr. Vikas Prakash; CWRU – Structural Energy Storage
    - Dr. Yu Zhu; UA – Cross Linked Polymer Binders for Electrochemical Energy Storage Devices
- **C2PNT COE** *(Lead: Ohio University)*
    - Dr. David Gross & Mr. Todd Norell; WSU – Test and Evaluation of Autonomous Systems
    - Dr. Zhiqiang Wu; WSU – Intelligent Channel Sensing

Joint OFRN-AFRL Research Landscaping Project

In cooperation with AFRL, OFRN has also started to explore and develop "big data" tools that have the potential to significantly improve and assist technology commercialization efforts, as well as aid Ohio researchers in building more competitive project teams for pursuing federal opportunities. This pilot effort, which will conclude in 2018, examines algorithms and visualization tools to map the research strengths and portfolios of several Ohio universities (WSU, OSU, and CWRU) and draw on business databases to discover actionable opportunities. The goal is to see if "big data" can remove some of the serendipity currently required for successful collaboration or tech transfer activities.

In mapping the research strengths of the universities, the tools may allow a project team to discover leading researchers with whom they have not worked in order to establish a more compelling project proposal. Similarly, AFRL could use this sort of deep-dive to discover researchers in areas of interest to AFRL that do not currently collaborate with AFRL scientists.

OFRN and AFRL hope that if validated, these sorts of tools can be deployable to any university or research lab without need for specialized knowledge of a given institution or data science in general.

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

In January 2018, OFRN released its third request for proposals (RFP), the SOARING initiative. This effort, referred to in previous reports as the OFRN Airspace Integration Challenge, is focused on expanding Ohio's leadership in federal and industry aerospace research, development and sustainment for unmanned air systems (UASs), personal air vehicles (PAVs), and logistics delivery air vehicles (LDVs). Across the different classes, target applications, and technologies, several barriers persist, including FAA flight certification, safety concerns, and specific technical and market validation needs. The focus of the SOARING RFP is to leverage the unique Federal and Ohio assets to systematically address these challenges. SOARING is OFRN's first challenge problem; OFRN leadership will deploy additional challenge problems in the future as funding is secured.

Request for Information

Prior to releasing the SOARING RFP, OFRN broadly issued a Request for Information to industry and interested aerospace groups to understand for key areas of development and opportunity in October 2017. Reaching out for industry guidance was done to help OFRN identify potential avenues to push the state of the art, continue to create federal/industrial/academic collaborations, and allow industry inside and outside of Ohio to capitalize on technology developed from the OFRN investments. The OFRN used this industry-focused RFI to determine how to best address the needs of aviation technology firms and

contribute to making Ohio a global leader in the prototyping, deployment, certification and testing of UASs, PAVs, and heavy-lift LDVs.

The RFI generated 27 responses from a variety of groups, from cybersecurity firms interested in hardware hardening to multinational companies interested in new manufacturing breakthroughs. There was significant interest in focusing on topics related to energy, autonomy, novel sensors and how new aerospace systems would be deployed in new applications. Specific to energy, most groups were interested in higher energy density systems but also the need for support infrastructure that could handle aircraft with different requirements. There was also significant interest in using Ohio based assets to supplant resources in flight certification and testing, and a strong desire for standardization or centralized certification. Many groups expressed interest in new prototyping and manufacturing techniques and how advanced computation and modeling could be used to reduce design time. Most respondents felt that automation based craft without passengers would be first to market, with PAVs having the longest time to market. The SOARING program areas of interest (AOIs) were specifically designed by focusing on needs that intersected both federal partner needs and industrial needs. This helps to ensure that projects not only have federal support but also help Ohio to garner additional industry interest in OFRN programs.

Call for White Papers and Request for Proposals

On January 19, 2018, the SOARING RFP was issued. As with previous OFRN RFPs, potential projects were first required to submit a white paper; however, some notable changes were made for this RFP compared with previous OFRN RFPs:

- **No COE**: As previously mentioned, white papers to SOARING could be submitted by any eligible lead applicant, not just a previously-funded OFRN COE
- **Eligible Lead Applicant**: proposed projects to SOARING could be led by either industry (either for- or not-for-profit) or an Ohio college or university
- **Two-university requirement**: previous rounds required three institutions, but frequently the third wasn't truly integrated into the project; so to ensure only meaningful collaborations were proposed, the RFP only required two universities on each project (although more were also allowed)
- **Required Proposal Training**: In order to be eligible to submit a full proposal, invited applicant teams were required to attend a proposal training program. The training, conducted over four weeks in Spring 2018, mirrored a light version of the NSF I-Corps process, with a focus on testing and validating the problem-solution fit of the proposed technology. Attendees worked toward articulating a clear and compelling value proposition for at least one customer and were provided weekly 1:1 time with a proposal development expert (Urban Venture Group)

A total of 33 white papers were submitted. At its first meeting on the SOARING initiative, held March 23, 2018 in Columbus, the TRC evaluated and discussed each white paper. From this set of 33, the TRC identified 17 projects that warranted the submission of full proposals. Based on the RFP's aims and listed criteria for white papers, 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 white papers that were not selected exhibited fundamental flaws or major misalignments with the SOARING initiative. Each applicant (selected or not) was offered a debrief call with the chair of the TRC and OFRN staff to provide feedback regarding the decision.

In May 2018, 17 full proposals were submitted and funding decisions will be finalized in July 2018. The SOARING RFP details the evaluation criteria utilized by the TRC. These criteria can be broadly categorized into six distinct sections. Below are several of the individual criteria, rewritten and paraphrased as questions to illustrate the overall breadth of the evaluation:

- *Alignment with Federal Needs and Ohio's Capabilities*. Does the project meet a federal research need? Does it leverage a supply chain or other capability specific to Ohio?
- *Technical Approach.* Does the research objective advance the state-of-the-art? Is the proposed technical approach reasonable to achieve the technical metrics? Is the risks section realistic? Did the proposal fail to discuss any significant risks? Are the plans to mitigate the risks appropriate? Is the project's plan for integrating their technology viable? How will the results of the project be demonstrated? Is the demo plan appropriate and feasible for the technology?
- *Commercialization Strategy.* Is the commercialization strategy reasonable? Are the most likely commercial applications actually the most likely commercial applications? Is there a compelling value proposition for the products/applications? Are the forecasts for time and capital required to achieve market entry reasonable? Is the IP strategy appropriate? Has the team already worked out some standard terms or ownership agreements?
- *Economic Impacts.* Are the jobs (at project end and in 2022) reasonable? Are they realistic? Is there sufficient justification for the numbers? Has the team identified a sufficient number of opportunities for follow-on funding such that it is believed this project can lead to real, new dollars for Ohio? If not, are there mitigating circumstances? Are there any compelling secondary impacts—i.e., those beyond jobs or federal follow-on funding?
- *Project Team.* Does the team have sufficient experience to complete a project of this sort? Is the team missing any critical qualifications? Has the team (or most of the team) delivered on OFRN projects before?
- *Schedule, Budget, and Cost Share.* Is the schedule realistic? Can the project be completed during the proposed timeframe? Does the cost share substantially exceed a 1:1 ratio? What form does the cost share take—cash, in-kind, something else? Is the cost share provided without reservation or are there contingencies? Is the cost share actually for achieving the project or does it appear to be more parallel in nature? Is the overall budget sufficient to actually get the project completed?

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 and/or Calamityville in Fairborn, OH. OFRN are planning for the demos to occur in early 2020.

Issues/Risks/Mitigations

Since the last annual report, the OFRN Leadership team has been required to deal with issues and to provide mitigation strategies.

- Due in large part to delays in starting projects (discussed in the previous report), all projects required no cost extensions. Round 1 projects are now scheduled to end in September 2018; Round 2 projects in January 2019. A subset of the projects are likely to receive additional extensions, but even with these, the expectation is that all 18 projects will be complete before the end of June 2019. These extensions carry an administrative cost for OFRN; efforts continue to diversify OFRN's funding sources to help mitigate this and to enable commercialization activities in 2019.

- As indicated in the previous report, within the COEs, Project PIs were/are struggling to report issues and risks that they are experiencing during the quarterly project review sessions. This difficulty extended to reporting the financial state of the project as well as current other basic project management details. To mitigate this, OFRN staff developed a new quarterly review template and worked with the PIs to ensure critical details were consistently included in the briefings.

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 three years, OFRN has attracted over $117 million in new research awards, with $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

Flexible Electronics and Polymers Project

- This project focuses on next-generation automotive polycarbonates and acrylics for solar PV applications.
- This project has resulted in five commercial investments with substantial Ohio economic impacts. Three of the five investments were attracted from outside of Ohio:
  - SABIC Venture Capital (Cambridge, MA) is finalizing an investment into a University of Toledo spin-out. This is SVC's first Ohio investment.
    - OFRN recruited SABIC Ventures to open an Ohio office, to facilitate future technology investment into Ohio companies.
  - A NY-based Private Equity firm is under contract to acquire a distressed Solar PV manufacturing company, incorporating IP from Toledo and Akron.
    - The estimated $100 million deal could create 100 new manufacturing and engineering jobs in 2019.
  - Soleeva Inc., a Silicon Valley-based solar installer, is under contract to combine its thermal capture IP with UT and UA IP.
    - OFRN facilitated Soleeva in acquiring solar thermal capture hardware from suppliers in Youngstown, OH.
- Orbital Research Inc. (Cleveland OH) licensed polymer IP from UA.
  - Orbital Research is prototyping Virtual Reality (VR) based headsets derived from OFRN- and AFRL-based cockpit hardware.
  - Orbital is working with a major Japanese mobile device manufacturer.
- AK Steel (Dayton, OH) has funded research by UT incorporating silicon-encapsulated steel into a solar PV panel.

Shape Memory Alloys Project

- This project's objective is to develop adaptive, bio-inspired aerospace structures actuated by shape memory alloys.
- Thermomorph LLC has begun clinical trials for a pulmonary thrombosis removal device, based on the shape memory alloy.
- Regenfix is developing 3D printing of nitinol for medical implants.
  - Regenfix has secured 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.

High Temperature Soft Magnetic Materials Project

- The project aims to develop new high performance magnetic materials for power applications at elevated temperatures which are becoming increasingly important to NASA and AFRL.
- Technology created at Case Western Reserve University has resulted in the formation of startup Fenix Magnetics LLC in Cleveland, OH.
    - Fenix has raised capital from Inner Product Partners LLC, a Venture Capital group formed by former DARPA leadership.

Laser Clad Welding Project

- This project develops laser clad welding technology, a collaboration between Lincoln Electric (Cleveland OH) and Case Western Reserve University.
    - Lincoln licensed the technology and committed over $5 million in R&D and commercialization funding.

HPHS: Human Performance and Health Sciences

Regional Live Virtual Constructive Assistant Project (RLVC)

- This project aims to integrate the cadaveric training with LVC training to improve medic readiness and reduce PS deaths.
- Technology was created at Wright State University (WSU) built on Amazon Alexa.
- This project resulted in a Public/Private partnership between Michigan-based Rubix Technologies LLC, WSU, and proof-of-concept partners CareSource Inc. and Metro Health Systems.
- In Q3 2018, WSU and Rubix Technologies LLC will announce the joint formation of a Dayton-based startup.
    - The joint venture will market Software as a Service (SaaS) Data Analytics and Alexa skill development for home health care Medicaid clients.
    - The team is negotiating with Amazon Alexa Venture Fund for an initial investment and strategic partnership.

Advanced Cognitive and Physical Sweat Bio Sensing Project

- This project developed a wearable sensor that detects analytes present in sweat.
- Patented technology from the University of Cincinnati has been licensed to a venture-backed start up, Eccrine Systems LLC.
- Team has attracted follow-on funding from AFRL and other sources in excess of $4.5 million with more than $2 million additional funding pending.
- Eccrine LLC expects to enter the market in early 2019.

Motion Sickness Interaction with Spine Disorders Project (MOSSD)

- This project examines the link between spine disorders and motion sickness. Back injuries are a major problem for the military.
- This project has device and database components developed at the Ohio State University (OSU).
- Technology has been licensed to startup SpineDynX LLC. Data from this project will support a commercial clinical version of the device.
- Follow-on funding proposals submitted to key federal customer NAMRU-D are under evaluation.

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

- This project explores improving human-machine teaming by incorporating the individual unique qualities, platform, and environmental states into a sliding scale autonomous workload.
- Based on technology developed and derived from pilot flight systems data and analysis provided by the Air Force.

- Technology has been commercialized by Dayton-based Perduco Inc.
  - Perduco has created 3D visual analytics systems and real-time haptic feedback instruments with DoD and commercial customers.

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

Test and Evaluation of Autonomous Systems Project (TEAS)

- This project commercializes technology created at Wright State University and the Air Force Research Laboratory (AFRL).
- This effort prompted Galois, a Portland Oregon company, to open a new office in Ohio.
- Galois will be announcing in 3Q 2018 a new Ohio-based spin-out that will expand core research beyond DoD markets.

Intelligent Channel Sensing, Secure, Cross-Layer Communication Project

- This project is focused on secure and persistent communication on land, air and space systems.
- This project combines spectrum analysis and communication, security and encryption, cognitive radio, and machine learning.
- This project addresses congestion in cellular systems, spectrum analysis, and interference mitigation in space-to-ground data transmission.
- Invention disclosures are in process with lead organization, Wright State University.
- Industry partner ComSat Architects, Inc. has executed a cooperative research and development agreement (CRADA) with the Air Force Institute of Technology (AFIT).
- The team has submitted several funding proposals (pending review) to DOD and NASA.

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

- This project focuses on engineering next-generation power Converters and electric motors.
- This project has attracted $10 million per year for 5 years (total $50 million) in follow-on funding from NASA in partnership with GE Aviation.
- OSU IP covering two power electronic devices is being evaluated by GE Aviation and Honda.

Advanced Turbine Cooling Project

- This project focuses on advanced sensors and turbine blade designs
- IP created OSU licensed to Honeywell Inc., a major supplier of turbine blades for the aviation and natural gas turbine blade industries.

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

Lithium Sulfur (Li-S) Battery Project

- This project is designed to develop batteries with higher energy density to meet next-generation defense and commercial needs.
- $2 million license of solid-state electrolyte IP licensed to a global smartphone and device company.
- Three issued patents with several more currently under process.

- Illinois-based Xerion Battery relocated to Dayton to prototype solid state Li-S battery with improved environmental or thermal runaway performance.

Li-Ion Battery Based on Advanced Silicon Anodes Project

- This project focuses on high energy density silicon anodes, to solve degradation challenges
  - Novel binder from UA and pH Matter LLC in Columbus, OH
- Two licenses executed with startup/small companies: pH Matter and Akron Polyenergy
- Team has attracted $1.6 million in follow-on funding from NASA, NSF, DoE and Rev1 Ventures.

C4ISR: Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance

Human Centered Big Data Project (HCBD)

- This project focuses on “de-black-boxing” algorithms to improve AI learning
- IP disclosures under review at Wright State University (WSU) and OSU
- Paxata Inc., a San Francisco-based Venture Capital firm, opened a Columbus office in partnership with In-Q-Tel. Paxata is focused on health care clinical trial analytics for simulated drug trials.

Industry Sponsored Research

OFRN’s industry outreach connects innovation-focused businesses with Ohio research universities. The vision is to attract sponsored research projects, partnerships, lab/facility use, subject matter expert (SME) inquiries, and internships.

OFRN compiled a target list of 140+ innovation focused Ohio companies. Over the past year, OFRN has generated 86 leads resulting in 24 pipeline opportunities and 3 signed programs implemented.

- **A $180,000 Aviation Virtual Reality sponsored research project with Ohio University.** A flight training school desired to use virtual reality (VR) in flight training. OFRN connected the company with Ohio University. An additional major commercial investment is being discussed. OFRN also connected the company with Air Force.
- **A $50,000 Materials and Manufacturing sponsored research project with Case Western University.** This project will develop procedures for its sponsor (a materials company) to reduce the time and risk of integrating new materials into customers’ products. OFRN identified an Ohio-based university researcher with specialized expertise to enable this project.
- **Sponsored research on Precision Agriculture.** Scotts Miracle-Gro worked with OSU to bring precision agriculture technology to the consumer market. OFRN facilitated peer to peer connections, enabling expansion of the scope of the Scotts-OSU relationship well beyond prior efforts.

Feedback from both Industry and Universities has been overwhelmingly positive. Industry appreciates curated assistance identifying what they often perceive as “finding a needle in a haystack.” Universities appreciate introductions to potential partners and exposure to a diverse range of industry technical needs. Both appreciate OFRN’s emphasis on simplicity and exposure to Ohio’s research assets.

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 $31.9 million for FY 16 through 19. This consists of three line items in the State Budget: (1) $20 million designated for WSARC, (2) $5 million designated for OSU, and $6.9M 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. $6.9M is designated for the SOARING programs. A breakdown of the funding is displayed in Figure 5.

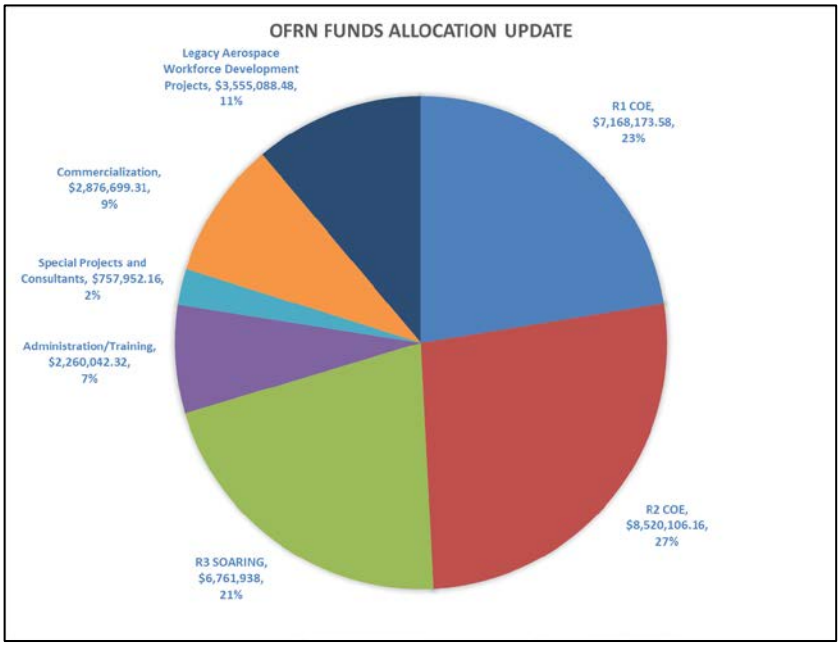


Figure 5 OFRN Allocated Funds

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 and $6.9M to support the

SOARING program. Figure 6 shows the current amounts funded to each COE as well as the amounts expended as of 30 June 2018.

ODHE FUNDING

Contracts	Prime	POP	ODHE Allocation	Funded to Date	Expensed to Date	Balance
ODHE-WSARC (OFRN) MOU Section 369.455 of Amended House Bill 64 of the 131st General Assembly, Defense/Aerospace Workforce Development Initiative	ODHE	1 Jul 15 - 30 Jun 19	$20,000,000	$20,000,000	-$14,821,150	$5,178,850
ODHE-OSU (OFRN) MOU Section 369.473 of Amended House Bill 64 of the 131st General Assembly, Emerging Missions and Job Growth Opportunities	ODHE	1 Jul 15 - 30 Jun 19	$5,000,000	$5,000,000	-$2,731,469	$2,268,531
ODHE-OSU (OFRN) MOU Section 381.440 of Amended Substitute House Bill 49 of the 132nd General Assembly, Emerging Missions and Job Growth Opportunities	ODHE	1 Jul 17 - 30 Jun 19	$6,900,000	$6,900,000	$0	$6,900,000
	TOTAL		**$31,900,000**	**$31,900,000**	**-$17,552,619**	**$14,347,381**

COE SUBCONTRACTS FUNDING

Contracts	COE	Round 1 Funding*	Round 2 Funding**	OFRN I-Corps Funding	Total Funded	Expensed to Date	Balance
1077-100/Case Western Reserve	PRESIDES	$1,649,726	$0	$15,000	$1,664,726.00	-$1,136,718.42	$528,007.58
1077-200/Ohio State University	OCPP	$2,000,000	$1,999,838	$5,000	$4,004,838.00	-$2,288,973.51	$1,715,864.49
1077-300/Ohio University	C2PNT	$0	$2,100,000	$10,000	$2,110,000.00	-$1,190,170.89	$919,829.11
1077-400/University of Dayton/UDRI	M&M	$1,999,997	$1,097,197	$10,000	$3,107,194.00	-$1,500,183.71	$1,607,010.29
1077-600/OSU/WSU	C4ISR	$0	$1,200,000	$0	$1,200,000.00	-$749,775.60	$450,224.40
1077-700/Wright State University	HPHS	$1,493,922	$2,115,001	$0	$3,608,923.00	-$2,399,471.30	$1,209,451.70
1077-500/Cleveland State University	C&W	$1,108,000	n/a	n/a	$1,108,000.00	-$890,443.18	$217,556.82
1077-510/Lorain County Community College	C&W	$1,000,736	n/a	n/a	$1,000,735.71	-$1,000,735.71	$0.00
	TOTAL	**$9,252,881**	**$8,512,036**	**$40,000**	**$17,804,417**	**-$11,156,472**	**$6,647,944**

*Round 1 Projects expire 30 Sept 2018
**Round 2 projects expire 31 Jan 2019

Figure 6 OFRN COE Allocation|Funded|Expensed

Figure 7 provides an overview of the staffing costs for the OFRN Administration with amounts funded and expensed as of 30 June 2018. All subcontracts have been approved through ODHE and assist the management team in training, program management, commercialization, Job Growth estimation, as well as the creation of a search capability of Ohio Small Businesses and Firms that provide systems or subsystems for each of the COE's research priority areas. These tools may be reached online at the OFRN webpage, www.ohiofrn.org, and they will be posted by the Ohio Third Frontier and JobsOhio.

STAFFING

	Role	Allocation	Funded	Expensed	Balance
OFRN Administration	OFRN Mgmt.	$1,976,938	$1,976,938	-$1,907,592	$69,346
UVG, Ltd Consultants	Training /Metrics Collection	$176,400	$176,400	-$59,638	$116,762
Global Glu Reporting Svs.	COE Handbook	$315,542	$315,542	-$315,542	$0
LMRS Info. Mgmt. PM	C&WD Mgmt.	$244,209	$244,209	-$244,209	$0
OSU/OFRN RDT&E Support	Research Scientist & PM	$568,126	$568,126	-$562,126	$6,000
OFRN I-Corps Training	OFRN I-Corps Training	$283,105	$283,105	-$253,620	$29,485

Figure 7 OFRN Administration and Management Allocation|Funded|Expensed

Funds Expended Report – As of 30 June 2018

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

Please Type all Information

Subaward No.: PO BOR01-000000004706/MOU DATED 12/1/15

Recipient:	Wright State Applied Research Corporation
Project:	Defense/Aerospace Workforce Development Initiative
Reporting Period:	July 1, 2017 - June 30, 2018

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	$1,668,959	$335,870	$800,849	$532,240	$1,136,718
OCPP COE - The Ohio State University	$4,010,374	$922,917	$10,382	$3,077,075	$933,299
M&M COE - University of Dayton	$3,114,574	$442,161	$1,058,023	$1,614,390	$1,500,184
HPHS COE - Wright State University	$1,501,302	$679,686	$34,502	$787,114	$714,188
C4ISR COE - Wright State University	$1,204,228	$155,994	$593,782	$454,452	$749,776
C2PNT COE - Ohio University	$38,842	$7,585	$17,639	$13,619	$25,224
C&WD Team - Cleveland State University	$1,113,077	$476,798	$413,645	$222,634	$890,443
C&WD Team - Lorain County Community College	$1,004,963	$665,122	$339,842	$0	$1,004,963
OFRN Legacy Workforce Development Programs	$3,555,088	$3,555,088	$0	$0	$3,555,088
OFRN Administration	$2,788,593	$1,341,652	$938,142	$508,799	$2,279,794
TOTAL	$20,000,000	$8,582,872	$4,206,805	$7,210,323	$12,789,677

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 lmited to, receipts or other evidence of payment, is on file and available as provided for in the Award Agreement.

Authorized Signature: _____ Date: _____

Typed Name _____

STATE USE ONLY BELOW THIS LINE

CAP: _____

Project Administrator: _____ Date: _____

Form B2

Cost Share Contribution Report – As of 30 June 2018

OHIO DEPARTMENT OF HIGHER EDUCATION
WORKFORCE DEVELOPMENT AND EMERGING MISSIONS MOUs
OFRN COST SHARE CONTRIBUTION REPORT

Please Type all Information

Subaward No.: PO BOR01-000000004706/MOU DATED 12/1/15

Recipient:	Wright State Applied Research Corporation
Project:	Defense/Aerospace Workforce Development Initiative
Reporting Period:	July 1, 2017 - June 30, 2018

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	$708,758	$150,619	$553,000	$5,139	$703,619
OCPP COE - The Ohio State University	$1,633,514	$493,581	$3,889,000	-$2,749,067	$4,382,581
M&M COE - University of Dayton	$1,635,423	$176,685	$1,627,000	-$168,262	$1,803,685
HPHS COE - Wright State University	$3,314,000	$0	$1,915,000	$1,399,000	$1,915,000
C4ISR COE - Wright State University	$534,000	$89,832	$285,000	$159,168	$374,832
C2PNT COE - Ohio University	$2,769,203	$0	$2,009,000	$760,203	$2,009,000
C&WD Team - Cleveland State University	$326,552	$86,228	$200,300	$40,024	$286,528
TOTAL	$10,921,450	$996,945	$10,478,300	-$553,795	$11,475,245

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 lmited to, receipts or other evidence of payment, is on file and available as provided for in the Award Agreement.

Authorized Signature: _____ Date: _____

Typed Name _____

STATE USE ONLY BELOW THIS LINE

CAP: _____

Project Administrator: _____ Date: _____

Form B2

Next Steps

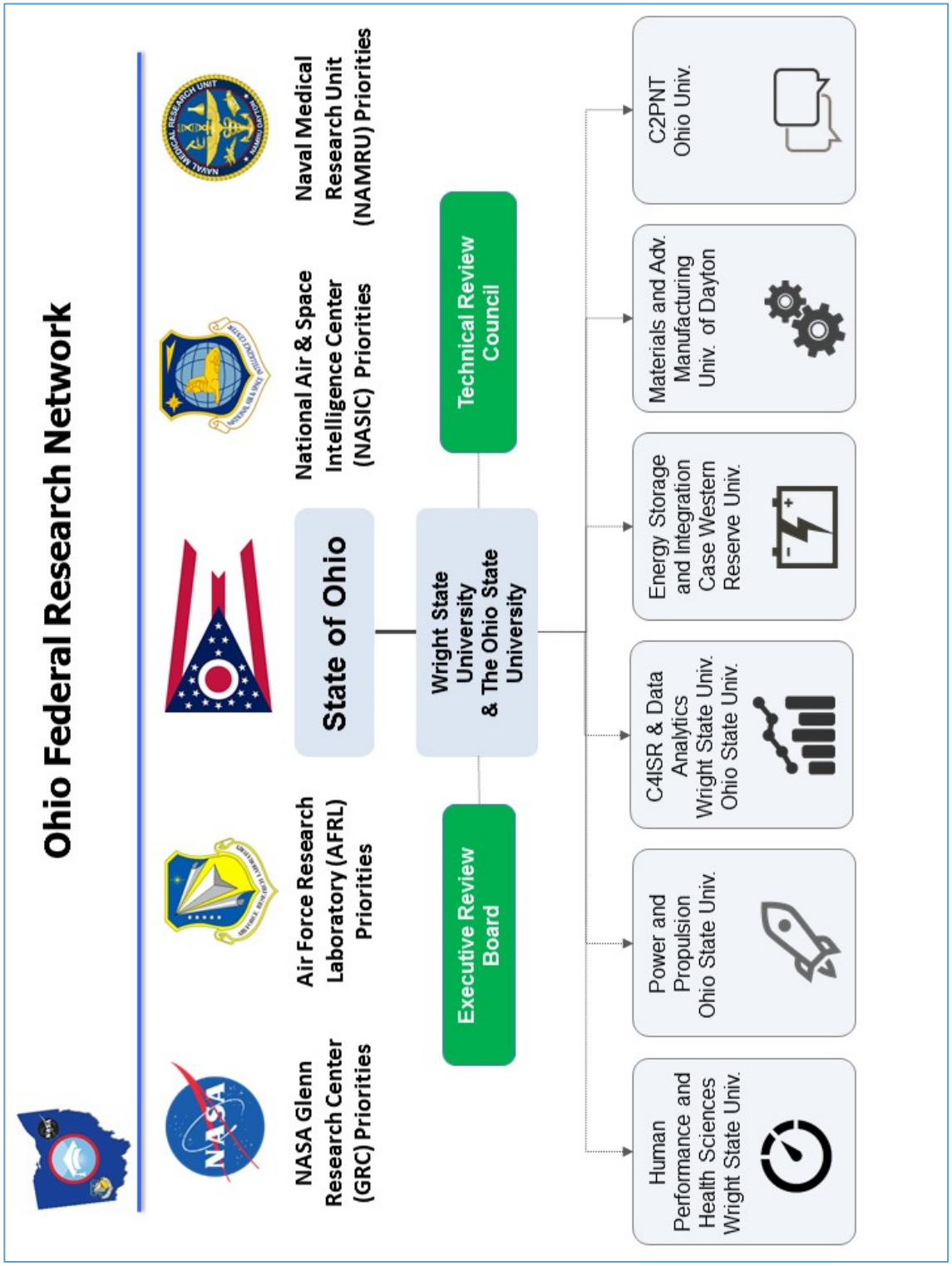
Going forward, OFRN will continue to:

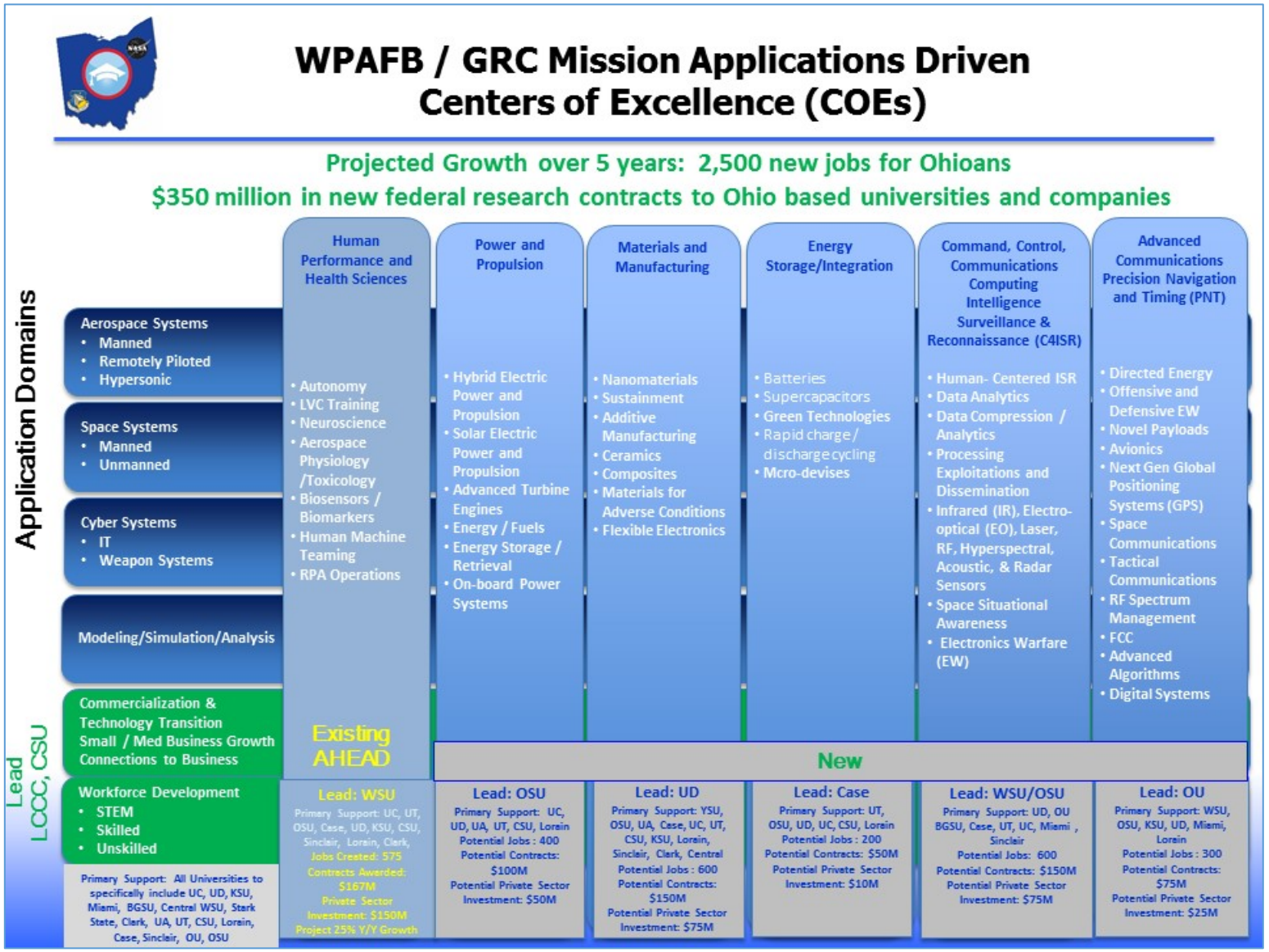
- Work to secure additional funds to enable funding of all recommended SOARING proposals
- Expand Ohio commercialization beyond four new companies in two years
- Leverage the seed funding provided by the State of Ohio to expand the OFRN federal R&D portfolio and to integrate key technical assets across the state
- Work actively with OFRN's federal partners Statewide to address pressing requirements 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
- Use Challenge Problems to address the emerging industry requirements enabling systems and subsystems
- Evolve OFRN's collaborative research activities with the State's R&D universities and businesses

- 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 this next year, OFRN leadership and staff intend to continue to engage with other organizations throughout the state, including: the Environmental Protection Agency (EPA) Lab in Cincinnati, the Cleveland Clinic Foundation, and the Ohio Third Frontier's Entrepreneurial Services Providers (ESPs). Also, OFRN will deploy a Quarterly Economic Impacts Survey to all funded PIs to more easily track and verify the results of their work.

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
Lead LCCC, CSU
Aerospace Systems
• Manned
• Remotely Piloted
• Hypersonic
Space Systems
• Manned
• Unmanned
Cyber Systems
• IT
• Weapon Systems
Modeling/Simulation/Analysis
Commercialization & Technology Transition Small / Med Business Growth Connections to Business
Workforce Development
• STEM
• Skilled
• Unskilled
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
Human Performance and Health Sciences
• Autonomy
• LVC Training
• Neuroscience
• Aerospace Physiology /Toxicology
• Biosensors / Biomarkers
• Human Machine Teaming
• RPA Operations
Existing AHEAD
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
Power and Propulsion
• Hybrid Electric Power and Propulsion
• Solar Electric Power and Propulsion
• Advanced Turbine Engines
• Energy / Fuels
• Energy Storage / Retrieval
• On-board Power Systems
Lead: OSU
Primary Support: UC, UD, UA, UT, CSU, Lorain
Potential Jobs : 400
Potential Contracts: $100M
Potential Private Sector Investment: $50M
Materials and Manufacturing
• Nanomaterials
• Sustainment
• Additive Manufacturing
• Ceramics
• Composites
• Materials for Adverse Conditions
• Flexible Electronics
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
Energy Storage/Integration
• Batteries
• Supercapacitors
• Green Technologies
• Rapid charge/ discharge cycling
• Mcro-devises
Lead: Case
Primary Support: UT, OSU, UD, UC, CSU, Lorain
Potential Jobs : 200
Potential Contracts: $50M
Potential Private Sector Investment: $10M
Command, Control, Communications Computing Intelligence Surveillance & Reconnaissance (C4ISR)
• 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)
Lead: WSU/OSU
Primary Support: UD, OU BGSU, Case, UT, UC, Miami , Sinclair
Potential Jobs: 600
Potential Contracts: $150M
Potential Private Sector Investment: $75M
Advanced Communications Precision Navigation and Timing (PNT)
• 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
Lead: OU
Primary Support: WSU, OSU, KSU, UD, Miami, Lorain
Potential Jobs : 300
Potential Contracts: $75M
Potential Private Sector Investment: $25M
New

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 (**OCPP**) 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

FOLLOW ON FUNDING

COE	PI Name / University	Client	Value	Description
C2PNT	**Chenji/OSU - ICS**	**NSF**	**$175,000**	**A Software Defined Approach to Laser-based Free Space Optical Networks - WON**
C2PNT	ICS	AFRL	$2,000,000	Full Spectrum Signals Intelligence and Cyber Operations Technology
C2PNT	ICS	AFRL	$1,000,000	Advanced Cyber, SIGINT, and Personal Communications Collection and Exploitation
C2PNT	ICS	AFRL	$20,000	Capabilities for Cyber Mission Assurance
C2PNT	ICS	AFRL	$500,000	Deep Learning for Actionable Intelligence Discovery and Exploitation
C2PNT	ICS	DARPA	$1,500,000	Strategic Technologies
C2PNT	**Stewart/OSU - ICS**	**NSF**	**$175,000**	**Distributed Systems w/ Verified Complexity by Design - WON**
C2PNT	**Wu / WSU - ICS**	**AF**	**$150,000**	**AF SBIR - Comsat Architects - Leveraging Emerging Satellite Constellations for Air Force Applications - WON**
C2PNT	**Wu / WSU - ICS**	**AFRL**	**$25,000**	**AFRL IDARE - Zhiqiang Wu, WSU - Radio Frequency Signal Detection in Spectrally Contested and Spectrally Congested Environment - WON**
C2PNT	Wu / WSU - ICS	NASA	$150,000	NASA SBIR - Comsat Architects - A System Design for Intelligent Space Communication - LOSS
C2PNT	**Wu / WSU - ICS**	**NIST**	**$500,000**	**NIST FirstNet - Harsha Chenji, OU - DistressNet-NG: Resilient Mobile Broadband Communication and Edge Computing for FirstNet - WON**
C2PNT	**Wu / WSU - ICS**	**NSF**	**$175,000**	**NSF CRII - James Stewart, OU, Distributed Systems With Verified Complexity By Design - WON**
C2PNT	**Wu / WSU - ICS**	**NSF**	**$175,000**	**NSF CRII - Harsha Chenji, OU - A Software Defined Approach to Laser-based Free Space Optical Networks - WON**
C2PNT	**Wu / WSU - ICS**	**NSF**	**$125,000**	**NSF EAGER - Joint Radar/Communication Waveform Design - WON**
C2PNT	Wu/WSU - ICS	NSF	$750,000	Enhancing RF Spectrum Access - LOSS
C2PNT	**ICS - Javaid/UT**	**NSF DRL**	**$1,800,000**	**Cybersecurity Education - WON**
C2PNT	**Wu/WSU - ICS**	**AFRL**	**$62,500**	**AFIT, Model and Analyze Space Systems Security esign, Architecture, and Resiliency Criteria - WON**
C2PNT	**Wu/WSU - ICS**	**AFRL**	**$33,000**	**AFIT, Platform Nxt Security Services - WON**
C2PNT/HPHS	**Gross / WSU - TEAS**	**AFRL**	**$750,000**	**Improve Software Security - Prattle Phase 2 SBIR - WON**
C2PNT/HPHS	Gross / WSU - TEAS	AFRL	$400,000	Avionics Vulnerability Assessment Mitigation and Protection
C2PNT/HPHS	Gross / WSU - TEAS	AFRL	$160,000	Multi-role Control Station

FOLLOW ON FUNDING				
COE	**PI Name / University**	**Client**	**Value**	**Description**
C2PNT/HPHS	Gross / WSU - TEAS	AFRL	$4,500,000	ATEV&V
C2PNT/HPHS	Gross / WSU - TEAS	AFRL	$3,750,000	LCAAT - Hunter Killer
C2PNT/HPHS	Gross / WSU - TEAS	AFRL	$12,500,000	Loyal Wingman
C2PNT/HPHS	Gross / WSU - TEAS	ARMY	$12,000,000	Autonomous Unmanned Systems Teaming & Collaboration
C2PNT/HPHS	Gross / WSU - TEAS	DARPA	$750,000	ACTUV Seedling
C2PNT/HPHS	Gross / WSU - TEAS	DARPA	$250,000	Swarm UAS Seedling
C2PNT/HPHS	Gross / WSU - TEAS	DARPA	$3,900,000	Scalable High Assurance Military Systems
C2PNT/HPHS	Gross / WSU - TEAS	OSD	$3,500,000	Software V&V/Flight Testing - LCAAT - Weapons Truck
C2PNT/HPHS	**Gross / WSU - TEAS**	**DARPA CASE**	**$4,700,000**	**TA3: Support Legacy Components (Galois Prime) - WON**
C2PNT/HPHS	**Gross / WSU - TEAS**	**AFRL/RQQA V&V**	**$420,000**	**Galois received additional AFRL support to further extend the TEAS development effort. - WON**
C2PNT/HPHS	**Gross / WSU - TEAS**	**AFRL/RQQA ICE-T**	**$800,000**	**WSRI: Conduct FY19 flight tests for the ICE-T program. - WON (RAST)**
C2PNT/HPHS	**Gross / WSU - TEAS**	**AFRL/RQQA V&V**	**$148,000**	**Galois received AFRL support to the Summer of Innovation. Deployed Open UxAS. - WON (RAST)**
C2PNT/HPHS	**Gross / WSU - TEAS**	**AFRL/RQQA V&V**	**$230,000**	**Galois received additional AFRL support to further extend the TEAS development effort. - WON (RAST)**
C2PNT/HPHS	**Gross / WSU - TEAS**	**DARPA**	**$4,900,000**	**DARPA CASE Prime (Galois) - WON**
C2PNT/HPHS	**Gross / WSU - TEAS**	**DARPA**	**$2,400,000**	**DARPA CASE Subcontract (Galois) - WON**
C2PNT/HPHS	**Gross / WSU - TEAS**	**AFRL/RHCI**	**$3,000,000**	**Heterogeneous-UAS Integration for a single-operator VSCS Environment (HIVE) - WSRI: Demonstrate Supervisory Control of multiple Group 3 UAS (Shadow, Tigershark, Bat 4) using the AFRL/RHCI Vigilant Spirit Control Station. - WON**
C2PNT/HPHS	**Gross/WSU - TEAS**	**AFRL**	**$225,000**	**CARP Phase II – WON**
C2PNT/HPHS	Gross/WSU - TEAS	Army	$2,387,000	Teaming-Enabled Architectures for Manned-Unmanned Systems (TEAMS) complimentary effort to AFRL/FAMUS program
C2PNT/HPHS	**Gross/WSU - TEAS**	**DARPA**	**$2,700,000**	**System of Systems Integration Technology and Experimentation (SoSITE) Follow-on (Galois) - WON**
C2PNT/HPHS	**Gross/WSU - TEAS**	**Air Force**	**$750,000**	**SBIR PRATTLE Follow-on: Deception and Anti-Reconnaissance via CyberChaff - WON**
C2PNT/HPHS	Gross/WSU - TEAS	DARPA	$600,000	JIT Certification Seedling (Galois) - in contracting
C4ISR/HPHS	Hitzler/WSU - HCBD	DARPA	$5,900,000	XAI Proposal - LOSS

FOLLOW ON FUNDING

COE	PI Name / University	Client	Value	Description
C4ISR/HPHS	Hitzler/WSU - HCBD	DARPA	$5,900,000	Causal Exploration - LOSS
C4ISR/HPHS	Raymer / WSU - HCBD	AFRL	$5,000,000	Human-Machine Teaming COE WSRI-WSU Prime
C4ISR/HPHS	Raymer / WSU - HCBD	DARPA	$1,000,000	DARPA DSO Seedling
C4ISR/HPHS	Raymer / WSU - HCBD	Google	$72,000	Google Faculty Award - OSU Prime
C4ISR/HPHS	Raymer / WSU - HCBD	NSF	TBD	NSF Explainable ML
C4ISR/HPHS	**Raymer / WSU - HCBD**	**DARPA-DSO**	**$950,000**	**Goal-driven Agil Teams and Environments (GATE) - WON**
C4ISR/HPHS	**Raymer / WSU - HCBD**	**Engility/DoD**	**$30,000**	**Reactionary Assistance Support for Container Technology - WON**
C4ISR/HPHS	**Raymer / WSU - HCBD**	**DARPA DSO**	**$3,700,000**	**Ground Truth Program – WON**
C4ISR/HPHS	**Raymer / WSU - HCBD**	**Raytheon-BBN/IARPA**	**$2,100,000**	**Hybrid Forecasting Competition - WON**
C4ISR/HPHS	Raymer / WSU - HCBD	Mile Two/WSARC	$150,000	Cognitive Systems Engineering
C4ISR/HPHS	Raymer / WSU - HCBD	ONR	$2,000,000	Integration of Domain Knowledge and Machine Learning
C4ISR/HPHS	Raymer / WSU - HCBD	IARPA	$500,000	Office-Wide BAA (1yr seedling project)
C4ISR/HPHS	Raymer / WSU - HCBD	IARPA	$1,916,000	Forecasting Counterfacturals in Uncontrolled Settings (FOCUS) - subcontract to Raytheon
C4ISR/HPHS	Raymer / WSU - HCBD	AFOSR	$450,000	Toward Undifferentiated Cognitive Agents: Determining Gaps in Comprehension - BAA-AFRL-AFOSR-2016-0007
HPHS	Devabhaktuni/UT – RLVC	DAGSI	$50,000	Workforce development support- Data to decision
HPHS	Devabhaktuni/UT – RLVC	NSF	TBD	Proposal focused on precision agriculture
HPHS	Ganapathy/ WSU – RLVC	DAGSI	$50,000	Workforce development
HPHS	**Malek/ WSU – RLVC**	**AFRL**	**$2,400,000**	**Recently awarded Mission Directed Learning Environment - WON**
HPHS	Malek/Hodge - WSU - LVC	AFRL	$50,000	AFRL- Visual based Map Nav Training
HPHS	**Malek/Hodge - WSU - LVC**	**AFRL**	**$2,600,000**	**Tech Warrior- WON**
HPHS	**Malek/Hodge - WSU - LVC**	**AFSOC**	**$1,800,000**	**AFSOC ACTOR- WON**
HPHS	Malek/Hodge - WSU - LVC	DHA	$30,000	SBIR PH I SBIR Topic DHA173-001 - Rubix
HPHS	**Malek/Hodge - WSU - LVC**		**$20,000**	**SBIR PH I PMAA Aptima - WON**
HPHS	**Malek/Hodge - WSU - LVC**		**$60,000**	**SBIR PH II CLEAR 1204- WON**
HPHS	**Malek/Hodge - WSU - LVC**		**$50,000**	**STTR ECCHO H17B- WON**
HPHS	**Malek/Hodge - WSU - LVC**		**$10,000**	**SBIR PH I TCCC3 - Aptima - WON**

FOLLOW ON FUNDING

COE	PI Name / University	Client	Value	Description
HPHS	Malek/Hodge - WSU - LVC		$50,000	Home Health Care POC - CareSource/Rubix
HPHS	Malek/Hodge - WSU - LVC	AFRL	$200,000	Dynamic Cadaver Training
HPHS	Malek/Hodge - WSU - LVC	AFRL	$60,000	CBRN Training - Dynamic Cadaver training with USAFSAM
HPHS	**Heikenfeld/UC – ACPSS**	**AFRL**	**$3,960,000**	**Recently awarded sweat sensing R&D project - WON**
HPHS	**Heikenfeld/UC - ACSB**	**DOD**	**$150,000**	**DOD (Eccrine Systems) -COMPLETED SBIR Phase I- WON**
HPHS	**Heikenfeld/UC - ACSB**	**DOD**	**$750,000**	**DOD (Eccrine Systems) - AWARDED SBIR Phase II- WON**
HPHS	Heikenfeld/UC - ACSB	DTRA	TBD	DTRA (Eccrine Systems)
HPHS	Heikenfeld/UC - ACSB	NIH	$2,000,000-3,000,000	NIH (Preconcentration)
HPHS	Heikenfeld/UC - ACSB	NIH	$2,000,000-3,000,000	NIH (Glucose)
HPHS	Heikenfeld/UC - ACSB	NSF	$700,000	NSF (Preconcentration)
HPHS	Heikenfeld/UC - ACSB	Epilepsy Foundation	$1,000,000	
HPHS	Heikenfeld/UC - ACSB	NSF	$150,000	SBIR Phase I - for preconcentration
HPHS	Heikenfeld/UC - ACSB	AFOSR	$900,000	
HPHS	Heikenfeld/UC - ACSB	American Heart Association	$200,000	
HPHS	**Heikenfeld/UC - ACSB**	**UC Accelerator**	**$40,000**	**Amplify Diagnostics- WON**
HPHS	**Heikenfeld/UC - ACSB**	**NSF**	**$375,000**	**Correlated Sweat Biosensing- WON**
HPHS	**Heikenfeld/UC - ACSB**	**UES, Inc.**	**$38,000**	**Physiological Biomarker Sensing- WON**
HPHS	**Heikenfeld/UC - ACSB**	**USAF-AFRL**	**$422,000**	**Sweat Biomarkers Assess. - WON**
HPHS	Heikenfeld/UC - ACSB	NIH	$5,000,000	Biofluid diagnostics
HPHS	Heikenfeld/UC - ACSB	NSF	$150,000	SBIR Phase I - Amplify Diagnostics
HPHS	Marras/OSU - MOSSD	AFRL/RQK	TBD	BAA-AFRL-RQKHC - Collaborations with NAMRU-D
HPHS	Marras/OSU - MOSSD	Army USAMRAA (DOD-AMRAA)	$2,000,000	FY17 – PRORP-CTRA - TEC BACK project
HPHS	Marras/OSU - MOSSD	MTEC	$2,900,000	MTEC-17-08 – Multi-Topic - Back FIQS
HPHS	Marras/OSU - MOSSD	MTEC	$3,900,000	MTEC-17-08 – Multi-Topic - Back FIQS (Large scale multi service)
HPHS	Marras/OSU - MOSSD	MTEC	$3,100,000	MTEC-17-08 – Multi-Topic - Neck FIQS
HPHS	Marras/OSU - MOSSD	NAVY	$248,000	DURIP - Instrumented Force plate
HPHS	Marras/OSU - MOSSD	NAVY	$515,000	DURIP - Biplanar Imaging system

FOLLOW ON FUNDING

COE	PI Name / University	Client	Value	Description
HPHS	Marras/OSU - MOSSD	ONR	$2,000,000	Validated Assessment of Neuromusculoskeletal Injuries
HPHS	Marras/OSU - MOSSD	ONR	$1,200,000	Capital Equipment (DURIP)
HPHS	Marras/OSU - MOSSD		TBD	JPC-5 Solicitations - Collaborations with NAMRU-D & USU*
HPHS	Marras/OSU – MOSSD	AFRL	$175,000	Integrated rucksack accessory to improve load distributions
HPHS	Marras/OSU – MOSSD	DoD	$350,000	AIMM
HPHS	Marras/OSU – MOSSD	DoD	$3,000,000	RIF
HPHS	**Minnery**	**DARPA**	**$3,700,000**	**WON**
HPHS	Norell/WSARC - CRAMMIT	ARO	$110,000	
HPHS	**Norell/WSARC - DTT**	**AFRL/RH**	**$345,000**	**WON**
HPHS	**Norell/WSARC - HMT TO4**	**AFRL/RH**	**$6,700,000**	**WON**
HPHS	**Norell/WSARC - LEAP**	**DARPA**	**$8,600,000**	**$14.6M available for Options - WON**
HPHS	**Norell/WSARC - MIDLE**	**AFRL/RH**	**$3,500,000**	**WON**
HPHS	**Norell/WSARC - TENET 3 Phase II**	**AFRL/RV**	**$220,000**	**STTR - WON**
HPHS	**Reiter/ WSU – SAPHYRE**	**AFRL**	**$75,000**	**Recently awarded SAVANT - WON**
HPHS	**Reiter/WSRI - SAPHYRE**	**AFRL**	**$350,000**	**Deployable Training Technologies (AFRL)- WON**
HPHS	Reiter/WSRI - SAPHYRE	AFRL 711th HPW/ RHXS	TBD	Trust in Autonomy
HPHS	Reiter/WSRI - SAPHYRE	AFRL and Air University/ ATEC	$250,000	Training
HPHS	Reiter/WSRI - SAPHYRE	AFRL/RQK	$5,000,000	Science and Technology for Autonomous Teammates (STAT) program
HPHS	Reiter/WSRI - SAPHYRE	FlightSafety International, Inc.	TBD	Discussing potential to leverage SAPHYRE to enable a more quantified assessment of training.
HPHS	**Reiter/WSRI - SAPHYRE**		**$3,000,000**	**Heterogenous Integration of UAVs (OSD)- Single operator control of 4 UAVs (Shadow, Tiger Shark and 2 Bat4's) - WON**
HPHS	Reiter/WSRI - SAPHYRE	DARPA	$1,000,000	Goal-driven Agile Teams and Environments (GATE)
HPHS	Reiter/WSRI - SAPHYRE	SOCOM	$150,000	STTR-TANDEMS
M&M	Elahinia / UT - Shape Memory Alloys	Boeing	$500,000	Fabricated sample AM NiTI parts for their evaluation
M&M	Elahinia / UT - Shape Memory Alloys	GE Additive	$1,000,000	New business opportunity with GE additive to qualify NiTi on the SLM and EMB machines

FOLLOW ON FUNDING				
COE	**PI Name / University**	**Client**	**Value**	**Description**
M&M	**Elahinia / UT - Shape Memory Alloys**	**NASA**	**$35,000**	**Pilot study in preparation for a large grant submission to NASA - WON**
M&M	Elahinia / UT - Shape Memory Alloys	NSF	$450,000	Optimizing shape for maximum actuation output
M&M	Elahinia/UT	NSF SBIR Phase 1	$250,000	Quick Flow Blood Clot Removal Device
M&M	Elahinia / UT - Shape Memory Alloys	NSF (ECI)	$96,245	GOALI: Smart Architecture: Shape Memory Alloys for Enhancing Buildings' Performance
M&M	Elahinia / UT - Shape Memory Alloys	NSF (MOMS)	$313,115	Cyclic Deformation, Functional and Structural Fatigue of Additively Manufactured Superelastic Nickel-titanium Alloys
M&M	Elahinia / UT - Shape Memory Alloys	NSF (MME)	$438,295	Collaborative Research: enabling additive manufacturing of porous superelastic functional systems
M&M	Elahinia / UT - Shape Memory Alloys	NSF (MPE)	$438,295	Collaborative Research: Understanding bioresorbable magnesium alloys and Materials Engineering and Processing
M&M	Elahinia / UT - Shape Memory Alloys	NIH		SBIR Phase I: QuickFlow: Treatment of Venous Thromboembolism Using a Mechanical Blood Clot Removal Device
M&M	Elahinia / UT - Shape Memory Alloys	OTF	$150,000	A minimally invasive rectal retractor for pelvic tumors radiation therapy
M&M	Elahinia / UT - Shape Memory Alloys	American Heart Association		Degradation and strength-tuned magnesium-based coronary stents
M&M	Elahinia / UT - Shape Memory Alloys	NSF (DMR)	$438,295	Collaborative Research: Design of the microstructure and functional properties of NiTiHf through selective laser melting
M&M	Elahinia / UT - Shape Memory Alloys	Osteo Science Foundation	$100,000	Resorbable Magnesium Alloy Maxillofacial Skeletal Fixation Hardware
M&M	**Elahinia / UT - Shape Memory Alloys**	**UT Rocket Fuel**	**$50,000**	**Organ repositioner: Enhancing the Safety of Radiation Therapy in Treating Pelvic Tumors - Won**
M&M	Szaruga / UDRI - LCM	AFRL	$100,000	FDM/BAAM tooling for composite repair @ AF depots/ALCs
M&M	**Szaruga / UDRI - LCM**	**AFRL**	**$35,000**	**Novel Hypersonic Materials (carbon/carbon, C/SiC) - Seed funding from AF, pursuing P1 SBIR w/round2 partner. Objective: stitched preforms (TFP) combined with advanced resins - WON**
M&M	Szaruga / UDRI - LCM	GE	$300,000	Thin Ply Polyimide Prepregs Utilizing Multi-Axial Fabrics
M&M	**Szaruga / UDRI - LCM**	**IACMI/Lockheed**	**$710,000**	**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) - WON**

FOLLOW ON FUNDING				
COE	**PI Name / University**	**Client**	**Value**	**Description**
M&M	**Szaruga / UDRI - LCM**	**IAMCI/Airbus**	**$1,006,000**	**Injection Overmolding of Continuous Carbon Fiber Preforms (Part of larger IACMI program w/Airbus. Objective: high rate production of complex airframe joints/attachments) - WON**
M&M	**Szaruga / UDRI - LCM**	**IAMCI/Airbus**	**$1,048,000**	**Hybrid Additively Manufactured Tooling for Large Composite Structures (Part of larger IACMI program w/Airbus. Objective: develop FDM/BAAM tooling & assembly concepts for large wing structures) - WON**
M&M	Szaruga / UDRI - LCM		$75,000	Seed funding from AF, pursuing P1 SBIR w/round2 partner. Objective: stitched preforms (TFP) combined with advanced resins
M&M	Szaruga / UDRI - LCM	AFRL/RXM	$510,000	Composite Tooling for Aircraft Sustainment
M&M	Szaruga / UDRI - LCM	IACMI	$1,200,000	Process Certification for Multi-Functional Composite Structures
M&M	Szaruga / UDRI - LCM	AFRL		LCAAT seeding
M&M	**Szaruga / UDRI - LCM**	**AFRL/RQ**	**$1,000,000**	**Reusable Hypersonic Vehicle Structures (M&P portion) - CMCs with improved mechanical properties via TFP - WON**
M&M	**Szaruga / UDRI - LCM**	**DARPA SBIR**	**$250,000**	**Innovative Carbon-Carbon Manufacturing (Cornerstone Research Corporation) - subcontractor to produce TFP preforms and processing - WON**
M&M	Szaruga / UDRI - LCM	IACMI	$850,000	Tailored Fiber Placement for Complex Preforms -- Teamed with Lockheed Martin for TFP of primary structure
M&M	Szaruga / UDRI - LCM	IACMI	$500,000	TFP for Complex Preforms Option
M&M	Szaruga / UDRI - LCM	AFRL	$100,000	Low Cost, Agile Methods for Tooling (SBIR)
M&M	TBD	ONR LIFT	$530,000	Metal Matrix Composites
M&M	**Vogt / UA - Flex Electronics**	**AFRL**	**$4,000,000**	**Trust in Flexible Electronics/ AFRL - Prime - WSU, $1.7MM to UA - WON**
M&M	**Vogt / UA - Flex Electronics**	**NSF**	**$300,000**	**NSF / low cost manufacture of tandem PV- Prime - UT - WON**
M&M	Vogt / UA - Flex Electronics	ODOT	$300,000	ODOT / Novel soil buried and environmental sensors - Prime OU
M&M	Vogt / UA - Flex Electronics	ONR	$450,000	ONR/ solar cell degradation - Prime - UT - WON
M&M	**Vogt / UA - Flex Electronics**		**$180,000**	**DuraMAT / Composite adhesives for PV- Prime - UA - WON**
M&M	**Vogt / UA - Flex Electronics**		**$500,000**	**FlexTech Alliance / Power pack for electronic print devices- Prime – ITN Energy Systems ($170K to Lucintech)- WON**

FOLLOW ON FUNDING				
COE	**PI Name / University**	**Client**	**Value**	**Description**
M&M	Vogt / UA - Flex Electronics	OFRN	$1,880,000	SOARING RFP: Light weight soloar for drone technologies
M&M	Vogt / UA - Flex Electronics	ARPA-E	$5,000,000	Net Zero Energy Greenhouses concept paper
M&M	Vogt / UA - Flex Electronics		$750,000	Improved stability of phosphorecent polymer particles for flex electronics for LDRD with Sandia
M&M	**Vogt / UA - Flex Electronics**	**AFRL**	**$1,870,000**	**AFRL funding on PV development (UT lead) - WON**
M&M	Willard / CWRU - Hi Temp Mag Mat	DARPA Seedling	$300,000	Iron Nitride Powder Processing
M&M	**Willard / CWRU - Hi Temp Mag Mat**	**NSF - DMREF**	**$1,600,000**	**Computational Alloy Design of Nanocomposite Soft Magnets - WON**
M&M	**Willard / CWRU - Hi Temp Mag Mat**	**DAGSI**	**$155,000**	**Spintronics materials prepared by sputtering (FeCoB) - WON (Heben)**
M&M	**Willard / CWRU - Hi Temp Mag Mat**	**DARPA DSO**	**$300,000**	**Ultra High Performance α"-Fe16N2 - WON**
M&M	Willard / CWRU - Hi Temp Mag Mat	DARPA MTO AMEBA	$1,849,908	Low-Power ULF Transmitters based on Rotating Permanent Magnets - LOSS
M&M	**Willard / CWRU - Hi Temp Mag Mat**	**NSF**	**$350,000**	**Magnetic nanoparticles for efficient energy applications NSF CMMI-1635089 - WON**
M&M	**Willard / CWRU - Hi Temp Mag Mat**	**DOE/EERE**	**$800,000**	**Advanced Manufacturing of Alpha Double Prime Iron Nitride (ADPIN) - WON**
M&M	Willard / CWRU - Hi Temp Mag Mat	NSF	$1,500,000	Magnetic nanoparticles for environmental protection of civic structures
M&M	**Willard / CWRU - Hi Temp Mag Mat**	**DOE**	**$50,000**	**Nano-Laminate soft Magnetics for Power Conversion - WON**
M&M	**Willard / CWRU - Hi Temp Mag Mat**	**AFRL**	**$2,600,000**	**University Cooperative Agreement - UT lead - WON**
M&M	Willard / CWRU - Hi Temp Mag Mat	Air Force (DESI program)	$1,500,000	PV for Power Beaming to UAVs - Lucintech/UT/Theiss UAV Solutions
M&M	Willard / CWRU - Hi Temp Mag Mat	UT/Lucintech - Atlas Venture Group	$500,000	sponsored research on PV
M&M	Willard / CWRU - Hi Temp Mag Mat	Air Force BAA	$2,500,000	Multijunction PV for space (UT)
M&M	Willard / CWRU - Hi Temp Mag Mat	Army SBIR	$150,000	Thin Film piezo-solar energy harvester for UAVs - Phase I (Lucintech/UT/EnrG/ITN)
M&M	Willard / CWRU - Hi Temp Mag Mat	Toledo Company		Licensing agreement of TVSF-funded effort
OCPP	Gregory / OSU - UAV Icing	AFRL		Discussing future BAAs with ARFL and what an Ohio response would be
OCPP	Gregory / OSU - UAV Icing	DOD	$5,000,000	Rapid Innovation Fund Phase II - Install HeatCoat on MQ-9
OCPP	Gregory / OSU - UAV Icing	FAA		FAA-12-01 BAA, "Aircraft Safety Technology"
OCPP	Mathison / OSU - ATC	AFRL	$1,000,000	AFRL Partnership

FOLLOW ON FUNDING				
COE	**PI Name / University**	**Client**	**Value**	**Description**
OCPP	**Mathison / OSU - ATC**	**Honeywell**	**$261,000**	**Honeywell Aerospace (2018) Funds included in final budget- WON**
OCPP	Mathison / OSU - ATC	NASA	$3,000,000	NASA Small Core Turbomachinery
OCPP	Mathison / OSU - ATC	Industry (Anonymous)	$750,000	proprietary
OCPP	Mathison / OSU - ATC	ONR	$250,000	FOA for STEM Education and workforce Program
OCPP	Mathison / OSU - ATC	NASA	$6,000,000	University Leadership Initiative - submitted Step A
OCPP	OSU	AFRL	$48,000	OSU New Project Collaboration – Electric Propulsion
OCPP	OSU	AFRL	$400,000	Power America – Invited for Full Proposal
OCPP	OSU	AFRL	$15,000,000	Advanced Manufacturing/High Temp. Turbines. OSU/Honeywell/ITI
OCPP	TBD	NASA	$50,000,000	Invited for Step B Proposal – Electric Propulsion
OCPP	**Wang / OSU - Control Architecture**	**AFRL**	**$7,300,000**	**Power, Thermal and Control Technologies and Experimental Research - WON**
OCPP	Wang / OSU - Control Architecture	AFRL	$1,500,000	Open Real-time, Model Based, learning Enable Intelligent Agent System Development
OCPP	Wang / OSU - Control Architecture	NAVY	$750,000	Department of Navy/ Naval Facilities Engineering - Real-time Data-driven Model based Energy Optimizer for Utility Monitor and Control Systems
OCPP	Wang / OSU - Control Architecture	NSF	$700,000	NSF - energy optimization and control
OCPP	**Wang / OSU - Control Architecture**	**NSF**	**$500,000**	**Cybersecurity proposal related to control of power systems - WON**
OCPP	**Wang / OSU - Control Architecture**	**Future Motors**	**$69,000**	**Inverter Drive and Power Architecture System for Electric Bike- WON**
OCPP	Wang / OSU - Control Architecture	GE EPIScenter	$175,000	Real-time modeling and simulation for commercial aircraft
OCPP	Wang / OSU - Control Architecture	DOE/ARPA-E	$750,000	Real-time hardware accerated, Power flow solver and Optimizer for Power Grid Operations
OCPP	**Wang / OSU - Control Architecture**	**American Electric Power**	**$250,000**	**Cybersecurity testbed of power systems - WON**
OCPP	Wang / OSU - Control Architecture	Sloan Foundation	$200,000	Energy Optimization Methods
OCPP	Zhang / OSU - Hybrid/ Turboelectric Propulsion	Boeing	TBD	Provides Boeing aircraft system requirements; Sends Boeing team to OSU to see our project live demonstration; Provides Boeing facility to test and verify our designs.
OCPP	Zhang / OSU - Hybrid/ Turboelectric Propulsion	DOE	$150,000	DOE STTR "Exploratory Low Cost Motor Designs for Electric Drive Vehicles" - Working with Asymmetric Technologies. Potential collaboration with Ford Motor Co.

FOLLOW ON FUNDING				
COE	**PI Name / University**	**Client**	**Value**	**Description**
OCPP	**Zhang / OSU - Hybrid/ Turboelectric Propulsion**	**NASA**	**$10,000,000**	**NASA University Leadership Initiative (ULI) Program - Megawatt electrical propulsion to power future commercial aircraft - WON**
OCPP	Zhang / OSU - Hybrid/ Turboelectric Propulsion	NASA	$2,000,000	High power brushless doubly-fed induction machine for aerospace application
OCPP	**Zhang / OSU - Hybrid/ Turboelectric Propulsion**	**SAFRAN**	**$105,367**	**Brushless doubly-fed induction machine for aerospace application - WON**
OCPP	**Zhang / OSU - Hybrid/ Turboelectric Propulsion**	**GE/State of Ohio**	**$2,500,000**	**Education of engineers and students -- faculty and lab facility support - WON**
OCPP	Zhang / OSU - Hybrid/ Turboelectric Propulsion	OFRN	$2,000,000	SOARING RFP: Brushless doubly-fed machine for electric propulsion
OCPP	**Zhang / OSU - Hybrid/ Turboelectric Propulsion**	**DoE**	**$150,000**	**STTR Phase I: Variable flux machine and drive for hybrid electric vehicles - WON**
OCPP	Zhang / OSU - Hybrid/ Turboelectric Propulsion	DoE	$1,500,000	STTR Phase II: Variable flux machine and drive for hybrid electric vehicles
OCPP	**Zhang / OSU - Hybrid/ Turboelectric Propulsion**	**DoE/Power America**	**$240,000**	**Developing SiC Inverter Driver for switched reluctance motor - WON**
PRESIDES	**Abramson/CWRU Heben/UT**	**PNNL/DOE**	**$910,000**	**Grid Modernization demonstration project, which involves using batteries to reduce peak loads - WON**
PRESIDES	Akolkar / CWRU	DOE	TBD	Stable, long life Li metal electrodes for rechargeable batteries
PRESIDES	**Jitendra Kumar /UD**	**NASA**	**$600,000**	**Integrated high temperature battery and micro-controller with active cooling for Venus and Mars applications - WON**
PRESIDES	Kumar / UD	NASA/US Army	$1,300,000	3 proposals to NASA; 2 proposals to Army
PRESIDES	**Kumar / UDRI - Li-S Battery**	**AFRL**	**$150,000**	**AFRL-SBIR phase 1 (UES + UDRI) - ceramic electrolyte coated separator along-with IL will be explored for high safety Li-ion battery - WON**
PRESIDES	Kumar / UDRI - Li-S Battery	AFRL	$1,800,000	AFRL BAA-FA8650-18-S-2003 (UDRI) - Design and demonstration of structural Li-ion battery for small UAVs
PRESIDES	**Kumar / UDRI - Li-S Battery**	**NASA**	**$750,000**	**NASA HOTTech UDRI, UA, NASA-Glenn - High temperature battery for Venus exploration - WON**
PRESIDES	Kumar / UDRI - Li-S Battery	NSF	$250,000	NSF-SBIR phase 1 (PH Matter + UDRI) high energy LiS battery
PRESIDES	**Kumar / UDRI - Li-S Battery**	**US ARMY**	**$150,000**	**US Army SBIR phase I (CRG + UDRI) - New polymer-ceramic electrolyte will be explored - WON**
PRESIDES	**Kumar / UDRI - Li-S Battery**	**NASA**	**$900,000**	**Phase I + II: development of high energy lithium-sulfur battery for manned space mission (UDRI, CRG lead) - WON**
PRESIDES	Kumar / UDRI - Li-S Battery	OFRN	$1,500,000	SOARING RFP: Hybrid power (LIB + LSB) for next generation UAVs

FOLLOW ON FUNDING

COE	PI Name / University	Client	Value	Description
PRESIDES	Kumar / UDRI - Li-S Battery	OFRN	$1,000,000	SOARING RFP: LSB - supercapacitor hybrid power for fast chargeable UAVs batteries
PRESIDES	Kumar / UDRI - Li-S Battery	Army	$150,000	STTR ph I - Development of novel Li anode (pH Matter (lead), UDRI
PRESIDES	Kumar / UDRI - Li-S Battery	Army	$150,000	STTR ph I - Flexible Li anode (CRG (lead), UDRI)
PRESIDES	**Prakash / CWRU - Multifunction Structural Energy Storage**	**NASA**	**$1,300,000**	**Structural Battery Project- WON**
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) - WON**
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) - WON**
PRESIDES	Prakash / CWRU - Multifunction Structural Energy Storage	AFRL		AFRL 2018 SSP
PRESIDES	**Prakash / CWRU - Multifunction Structural Energy Storage**	**AFRL**	**$600,000**	**AFRL–RQ -- CWRU Educational Partnership Agreement (EPA) on Structural Batteries (2017-2021) -Facilitate educational and research collaboration in structural batteries between AFRL & CWRU - FULLY EXECUTED- WON**
PRESIDES	Prakash / CWRU - Multifunction Structural Energy Storage	AFRL	$1,800,000	AFRL BAA FA8650-18-S-2003 Safe and Structurally Integrated Advanced Battery Development - Lockheed (Lead), Solid Power, CRG, CWRU
PRESIDES	Prakash / CWRU - Multifunction Structural Energy Storage	AFRL		DAGSI: Mechanical Strengthened Interfaces of 3D Printable Multifunctional Solid State Structural Batteries
PRESIDES	**Prakash / CWRU - Multifunction Structural Energy Storage**	**NASA**	**$1,300,000**	**NASA :Electric Propulsion – Challenges and Opportunities - Development of Structural Batteries for Electric aircrafts - WON**
PRESIDES	Prakash / CWRU - Multifunction Structural Energy Storage		TBD	Development of Structural Battery concepts for PAVs and UAVs - Pursuing with Boeing
PRESIDES	Prakash / CWRU - Multifunction Structural Energy Storage	OFRN	$2,000,000	SOARING RFP: Advanced hybrid electric power solutions for sUAS
PRESIDES	**Prakash / CWRU - Multifunction Structural Energy Storage**	**DAGSI**	**$60,000**	**DAGSI/AFRL Faculty-Student Fellowship -- structural battery - WON**
PRESIDES	Prakash / CWRU - Multifunction Structural Energy Storage	AFRL	$150,000	SBIR Phase I - Advanced Thermal Runaway Solutions (CRG, Inc. (PI)

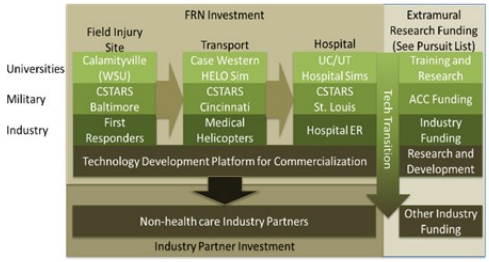
FOLLOW ON FUNDING				
COE	**PI Name / University**	**Client**	**Value**	**Description**
PRESIDES	**Zhu / UA - Li-Ion Battery**	**DOE**	**$150,000**	**DOE EERE SBIR "High Energy Density Lithium Ion Battery Component" -pH Matter LLC and UA team - WON**
PRESIDES	**Zhu / UA - Li-Ion Battery**	**DOE**	**$420,000**	**Northern Ohio Grid Modernization from PNNL/DOE - UT (PI: Michael Heben) , this project involves connecting a large battery system (Li-ion, 130 kW-hr) via an inverter to a 1 MW PV array, the grid, and buildings on one of our campuses. - WON**
PRESIDES	**Zhu / UA - Li-Ion Battery**	**NASA**	**$600,000**	**NASA "High Energy, Long Cycle Life, and Extreme Temperature Lithium-Sulfur Battery for Venus mission" (UDRI and UA team) - WON**
PRESIDES	**Zhu / UA - Li-Ion Battery**	**NSF**	**$300,000**	**NSF "In-situ Raman Spectroscopy Study if Lithium-Air Battery with Bi-Continuous Sers-Active Electrode and Membrane" - WON**
PRESIDES	Zhu / UA - Li-Ion Battery	NSF	$225,000	NSF SBIR "High Energy Density Lithium Ion Battery Component" - LOSS
PRESIDES	Zhu / UA - Li-Ion Battery	NSF	$400,000	NSF "Integrated Characterization of Lithium Dendrite Formation at Nanostructured Electrodes"
PRESIDES	**Zhu / UA - Li-Ion Battery**	**Rev**	**$100,000**	**Rev1 Ventures for purchasing pouch cell equipment (pH Matter with the license option of UA binder patent) - WON**
PRESIDES	Zhu / UA - Li-Ion Battery		$100,000	Spark
PRESIDES	Zhu / UA - Li-Ion Battery	NASA	$75,000	NASA Hot program
PRESIDES	Zhu/UA	Navy SBIR	$150,000	Superior All Solid State Battery - WON

APPENDIX 2 – OFRN PROJECT DETAIL

Round 1 Projects Awarded

HPHS COE - Regional LVC Enterprise (RLVC)

Technical Concept & Approach



Project Requirement, Federal Alignment, Sponsoring Organization (s)

- Research Requirement: Defragmenting healthcare delivery for aeromedical missions
- Research Requirement: Performance Augmentation
- Research Requirement: Persistent, affordable, integrated LVC Training
- Sponsor - 711 HPW/RHAS POC: Wink Bennett, Ph.D.
- Creates a realistic immersive environment infrastructure to support education, training, technology development, and technology testing capabilities

Team & Economic Impact For State of Ohio

Team

- PI: Doug Hodge, Ali Reiter (Wright State University)
- U of Toledo, Case Western, Wright State University, and U of Cincinnati, Orbita Health, Rubix Technologies, Metro Health

Economic Impact

- Expansion of research and commercial development with CWRU
- Private industry investment into research and commercial capability development with Rubix Technologies and Orbita Health Care
- Continued development for WSARC & newco with AFRL will be primary areas of growth in 2018
- Rubix will hire 1-2 people in Ohio in Q1 2018
- NewCo will hire 5-10 people in 2018

Budget, Schedules, Deliverables, & Risks

- **Period of Performance:** 24 months
- **Milestones:**
  - LVC Environment – Month 19
  - HMT Architecture – Month 19
  - Concept Abstraction – Month 17
  - Exercise – Month 24
- Software, HMT User Requirements Document, LVC Environment Requirements
- Aligning work development plan to coincide with exercises to demonstrate technical development (limitation of exercise participants)

Rev 06-18

HPHS COE – Sliding-Scale Autonomy Through Physiological Rhythm Evaluations (SAPHYRE)

Technical Concept & Approach

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.

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.

Project Requirement, Federal Alignment, Sponsoring Organization (s)

Federal Needs:

- Augmentation of human performance
  - Heart Rate Variability methodology (AFRL/RH)
- Performance Augmentation of Human Machine Teaming
  - Individualized performance assessment in HMT environments (AFRL/RH), cognition and performance simulations (AFRL/RH)

Approach:

- 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.

Team & Economic Impact For State of Ohio

- PI: 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.

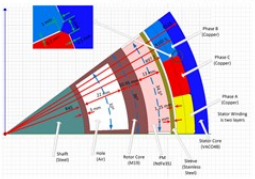
Budget, Schedules, Deliverables, & Risks

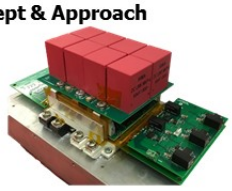
- **Period of Performance:** 24 months
- **Milestones:** IRB Approval (November 2016), System Design & Build Complete (October 2016), Completion of Testing & Analysis (January 2018)
- **Deliverables:**
  - Fiscal and programmatic reports necessary for WSARC to meet its quarterly reporting requirements to the State
  - Site visits
  - Periodic meetings
- **Risk:** Time to complete collection with new experimental design and development of algorithm in compressed schedule.

Rev 06-18

OCPP COE - Hybrid/Turboelectric Propulsion and Power

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-typte 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

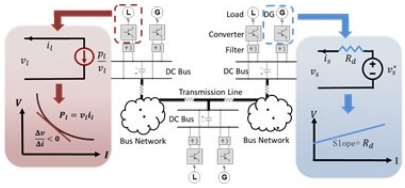
- **Period of performance:** 36 months.
- **Major milestones:**
  - Converter: tested the 3-phase 300-kW converter under full load using a 100-kW permanent magnet machine
  - Machine: rotor failure analysis finished, rotor redesigned, sent for manufacturing
  - Drive system: converter integrate with 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

Rev 06-18

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, Mehash Ilindala, 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

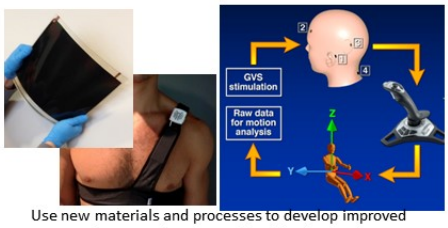
Period of Performance: 24 months

Rev 06-18

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

Budget, Schedules, Deliverables, & Risks

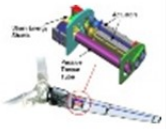
- Period of Performance: 7/12/16 -1/31/18
- Milestones:
  - Methodology to generate substrate protrusions for
  - High temperature, high dielectric constant polymer for printable electronics
  - Printed passive and PV testbeds developed
- Deliverables:
  - High temperature plastic substrate with > 350 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.

Rev 06-18

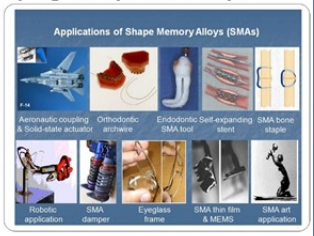
M&M COE – Adaptive Bio-Inspired Aerospace Structures Actuated by Shape Memory Alloys

Technical Concept & Approach

OBJECTIVE: Develop High Temperature Shape Memory Alloys



actuators



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

- **PI:** Mohammad Elahinia, University of Toledo
- Univ. 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

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

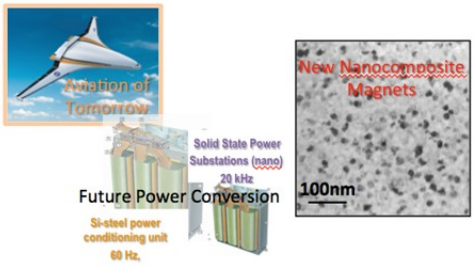
Deliverables
- Alloy development for High Temperature SMAs by adding different amounts of ternary elements
- Create functional shape memory and superelastic NiTiHf

Risks
- Thermodynamic stability of ternary additions to Ni-Ti
- Embrittling

Rev 06-18

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 DMREF – 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

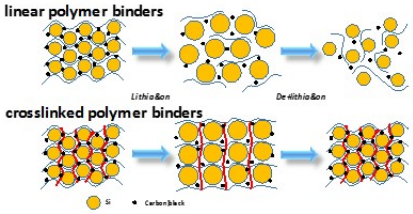
Technical Risks:
- Experiencing a ribbon production bottleneck

Rev 06-18

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



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, University of Akron

NASA: James Wu

AFRL: Michael Rottamayer, 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

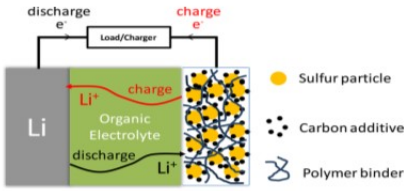
Key deliverable: Li-ion Si anode full cell with 1000 mAh/g

Key risk: Inability to meet technical targets

Rev 06-18

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

Team
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

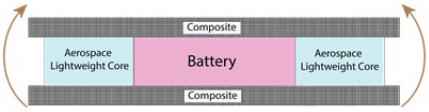
Budget, Schedules, Deliverables, & Risks

- **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

Rev 06-18

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), B. Henslee (CRG Inc.)

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

Rev 06-18

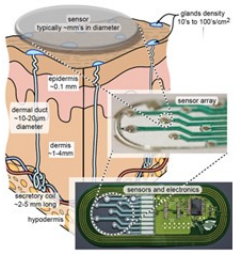
Round 2 Projects Awarded

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
- PI: 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

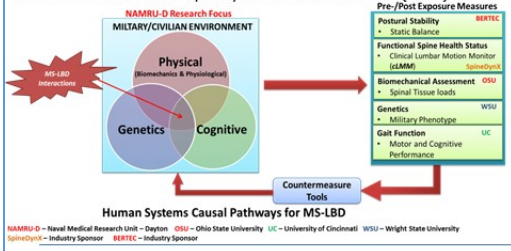
- **Period of Performance:** 24 months
- **Milestones:**
  (1) Clinically downselect analytes (vasopressin, adrenal, creatine kinase, neuropeptides, cortisol, etc.)
  (2) Robust electrochemcial sensors for analytes.
  (3) Sweat sensing patch integration and pilot manufacturing
  (4) Clinical validation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

Rev 06-18

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
SpineDynX – 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 Broderick/Ali 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: SpineDynX 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

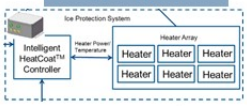
Rev 06-18

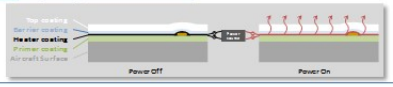
OCPP COE – UAV Icing Protection

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 retrofittable 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

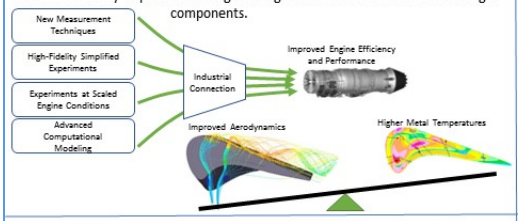
Risks: Cost is the biggest risk: cost of development of model support stand, and cost of wind tunnel time. Risk is decreasing as we make technical progress.

Rev 06-18

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 Inc.
- 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

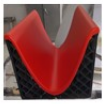
Rev 06-18

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 Attritable Aircraft Technology goals.

Advanced Composite Manufacturing



Additively Manufactured Tools

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 modelling/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

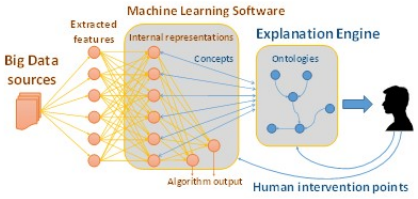
- **Period of Performance:** 24 months
- **Milestones:**
  - Cost/Risk model verification and validation
  - Demo small scale tools using low CTE designs/matls
  - Mechanical characterization of woven composites
- **Deliverables:**
  - 1. Cost/Risk Model
  - 2. LCAAT tool demo
  - 3. Woven composite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

Rev 06-18

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

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

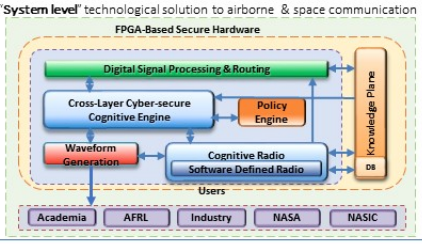
- **Period of Performance:** 24 months
- **Milestones:** 1) Demo active learning in interactive search; 2) Demo proof-of-concept explainable machine learning; 3) Demo interactive visualization for knowledge discovery concept
- **Deliverables:** 1) Active learning algorithms for human-in-the-loop information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

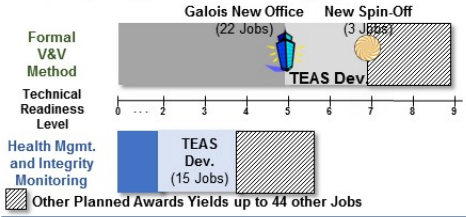
- Period of Performance: 24 months
- **Significant Milestones**
  - Cognitive networking algorithms designed to enable spectrum sensing, interference mitigation, and high data-rate communications
  - Machine learning enabled cross-layer cybersecurity algorithms/models designed and implemented for optimal 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 06-18

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

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