OHIO FEDERAL RESEARCH NETWORK
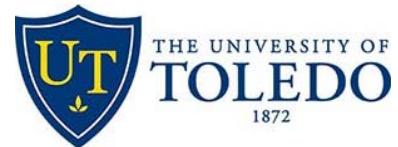
Defense & Aerospace Workforce Development Initiative

2017 Annual Report to the
Ohio Department of Higher Education

30-Jun-17

CURRENTLY ENGAGED OHIO UNIVERSITIES IN OFRN

WRIGHT STATE UNIVERSITY

THE OHIO STATE UNIVERSITY

UNIVERSITY of DAYTON

CASE WESTERN RESERVE UNIVERSITY EST. 1826

CLEVELAND STATE UNIVERSITY 1964

University of CINCINNATI

OHIO UNIVERSITY 1804

Lorain County Community College

THE UNIVERSITY OF TOLEDO 1872

The University of Akron

AFIT AIR FORCE INSTITUTE OF TECHNOLOGY

Youngstown STATE UNIVERSITY

BGSU Bowling Green State University

KENT STATE UNIVERSITY

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, 2017

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

Driven by the requirements of the national labs, the OFRN investments are growing federal research spending in Ohio; advancing research initiatives aimed at emerging Department of Defense and 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 created 6 Centers of Excellence (COEs) across the state that have created new collaborations and research initiatives across our universities and industry to increase federal partner engagement. This has led to $42 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 $200 million in new procurements pending with federal agencies as a result of OFRN business development requirements.

In closing, the key to OFRN success to date has been its remarkable collaboration with ODHE, 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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Our Mission

To stimulate Ohio's innovation economy by building state wide, vibrant, university-industrial collaborations for federal needs.

Our Goal

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.

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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 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
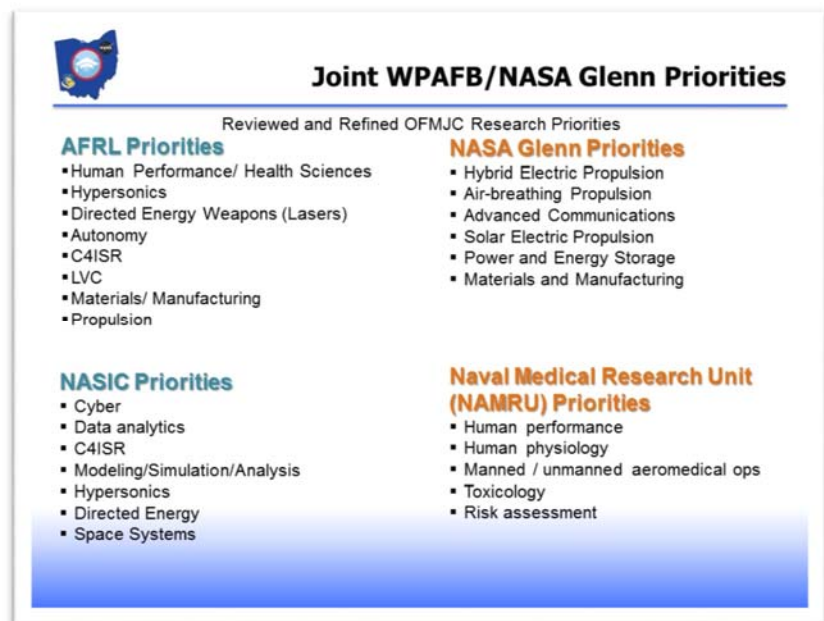

Figure 1 DoD/NASA Priorities

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researchers with insights into the requirements for each of the priority research areas. The OFRN investment is being utilized as seed funding and the catalyst for additional federal procurement and industry sponsored research. The OFRN also provides an impetus for the state's leading research universities to frame a new requirements-focused/application-oriented set of projects and activities that will stimulate economic development and job creation here in Ohio.

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 through HB 64 of the 131st General Assembly. 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 52 Ohio Industry Partners (28 Small Businesses; 24 Large Businesses) funded and engaged in the OFRN research activities. OFRN would hope that this number will expand in the next round of funding so that by the end of 2018, all Ohio research universities are engaged. Universities included at present are: Case Western Reserve University, University of Cincinnati, University of Dayton/University of Dayton Research Institute, University of Akron, Ohio University, University of Toledo, Youngstown State University, the Air Force Institute of Technology, The Ohio State University, and Wright State University/Wright State Research Institute. OFRN also has a subcontract in place with Cleveland State University and Lorrain County Community College for support of its commercialization and workforce development activities.

For an in-depth background on the strategic planning of this initiative and the overall HB 64, 131st General Assembly guidance, please read the Ohio Federal Military Jobs Commission Annual Report to Governor John Kasich dated 31 December 2015. http://ong.ohio.gov/OFMJC.html

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 National Aeronautics and Space Administration – Glenn Research Center (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.

The focus for the Centers of Excellence in terms of Technology Readiness Level is displayed in Figure 2.
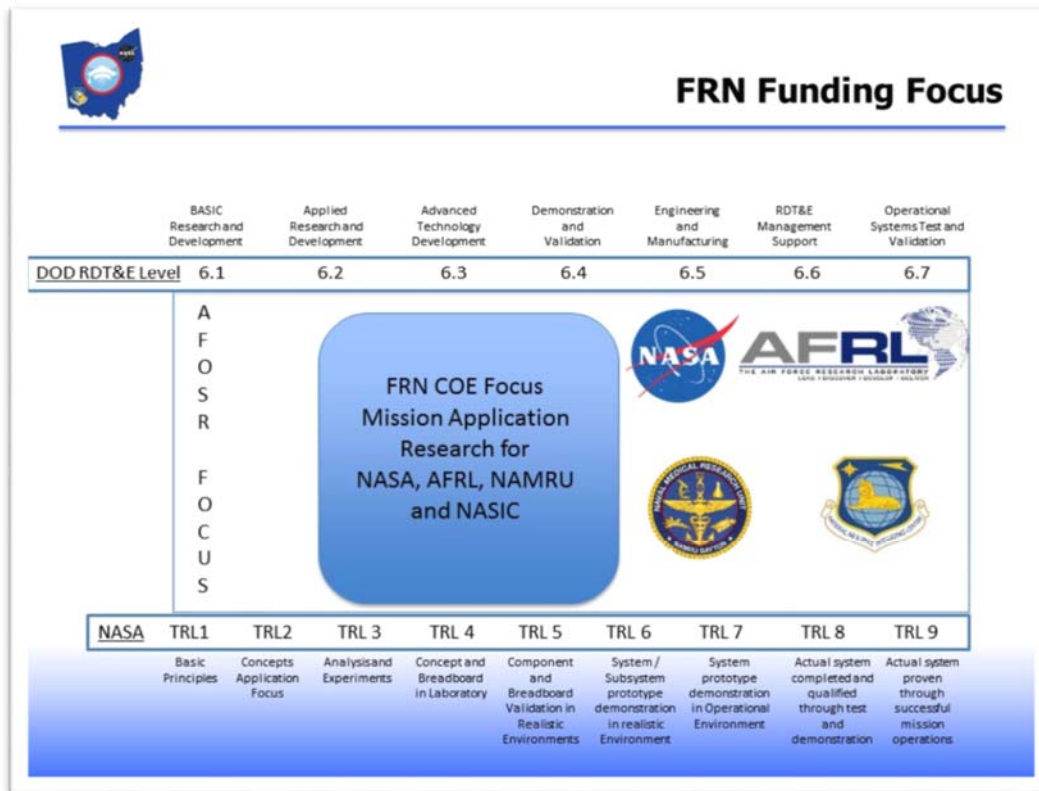

Figure 2 DoD/NASA TRL Levels

ORGANIZATIONAL MANAGEMENT

The OFRN program is made up of six Centers of Excellence, a Technical Review Council, an Executive Review Board, and is managed by the Wright State Applied Research Corporation on behalf of the Ohio Department of Higher Education (ODHE), see Figure 3. OFRN currently reports to the ODHE. The OFRN also has contracts in place with Cleveland State University and Lorrain County Community College to Staff the Commercialization and Workforce Development (C&WD) to support the priority commercialization and workforce development activities.

The OFRN Leadership

Prior to the awarding of the ODHE funds, Dennis Andersh, Chief Executive Officer of the Wright State Applied Research Corporation, and Martin Kress, Vice President for Research for The Ohio State University were asked to take the day-to-day leadership role for framing the OFRN. This includes supporting the activities of the OFMJC, compiling the Research and Development section of the OFMJC Annual Report to the Governor, and the proposed organizational/ management model. In addition, the two leaders acted as the key interface to the federal labs and key state offices and they framed the charters and helped recruit the members, for the Executive Review Board (ERB) and Technical Review Council (TRC). The members of both the ERB and TRC are vetted and approved by the OFMJC, with recommendation and advice from the key state offices. They also led the establishment of the six university Centers of Excellence (COE). 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 WSARC support staff and the support of key state offices – in particular: ODHE, JobsOhio and the 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.
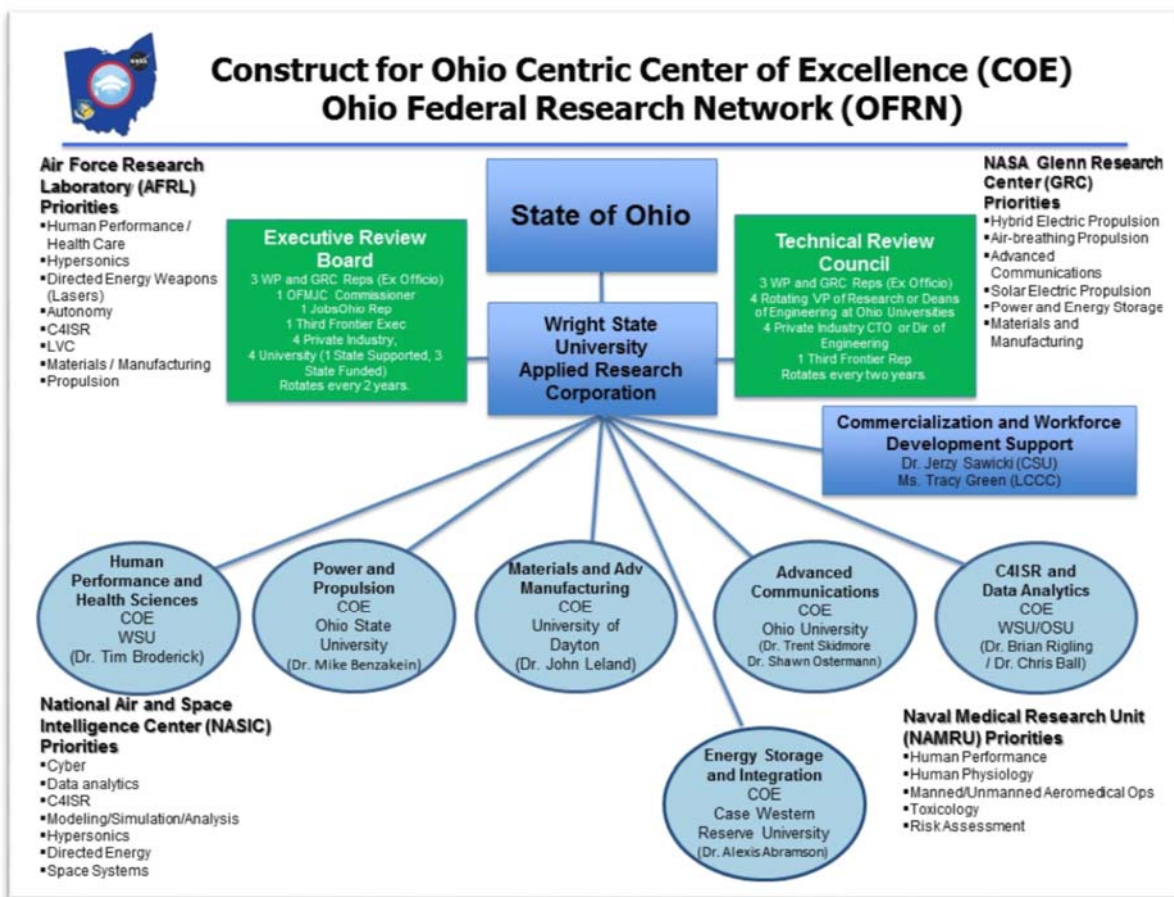

Figure 3 OFRN Organizational Chart

Wright State Applied Research Corporation (WSARC)

The WSARC acts as the contracting, technical and program management agent for the OFRN. Specifically the WSARC 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 for OFMJC's review and approval; 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.

Executive Review Board (ERB)

The ERB is responsible to oversee the development, funding and performance of the OFRN. The ERB provides ongoing oversight of the OFRN to support the research priorities of the federal installations and build capabilities within Ohio to expand and focus research, workforce development, and technology commercialization. The ERB reviews and can concur in or reject the recommendations of the TRC as to funding of the OFRN programs and projects that have been reviewed pursuant to the OFRN's request for proposals. It also must approve the award of subcontracts by the 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, the OFRN 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.

Technical Review Council (TRC)

The TRC is responsible to the ERB for comprehensive oversight of the portfolio of technologies that are used and developed by the Centers of Excellence as part of the OFRN in the execution of their programs. The TRC reviews all White Papers and Proposals; then ranks them according to the key criteria established by the OFRN and approved by the ERB, and then submits them to the ERB for approval or modification.

Reviewer (ERB and TRC) Composition

Executive Review Board	Designee	Technical Review Council	Designee
Cleveland State President	Dr. Ron Berkman	UT VP of Research	Dr. Frank Calzonetti
OSU Dean of Engineering	Dr. Dave Williams	UC Dept Head AEEM, OAATC	Dr. Paul Orkwis
WSU President Emeritus	Dr. Dave Hopkins	OU Dean of Engineering	Dr. Dennis Irwin
LCCC President Emeritus	Dr. Roy Church	CWRU VP of Research	Dr. Suzanne Rivera
OFMJC	Gary O'Connell	UDRI	Dr. John Leland
NASA Glenn Director	Dr. Janet Kavandi	OFMJC	Don Campbell
AFRL	Jack Blackhurst	NASA Glenn	Sandra Reehorst
NASIC	Curt Rowland	AFRL	Frank Albanese
NAMRU-D	Dr. Richard Arnold	NASIC	Mark Brown
Jobs Ohio	Glenn Richardson	NAMRU-D	Dr. Richard Arnold
Ohio National Guard	Maj Gen Mark Bartman	Ohio National Guard	Brig Gen Gregory Schnulo
Ohio Third Frontier	Karen Conrad	Ohio Third Frontier	Paul Jackson
Industry 1 Chair	Ricky Peters, Ascend	Industry 1, Chair	Dr. Carlos Grodsinsky
Industry 2	Salvatore Miraglia, Jr.	Industry 2	Ed Morris
Industry 3	James Haywood	Industry 3	Dr. T. S. Sudarshan
Industry 4	Jim Free	Industry 4	Dr. Darren McKnight
		Industry 5	Dr. Suguna Rachakonda

Items in green are in their Corporate review process.

Figure 4 ERB and TRC Composition

Figure 4 shows the membership of ERB and the TRC and each has representation from Federal and State government, industry, and universities. Mr. Ricky Peters (Chief Executive Officer, Ascend Innovations) chairs the ERB and Dr. Carlos Grodsinsky (Chief Operating Officer and Sr. Vice President of Technology, ZIN Technology) chairs the TRC. Both chairpersons were recruited from industry.

Centers of Excellence (COEs)

The COEs are the collaborative research leads for 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 them frame and submit proposals for the OFRN for funding. Only a COE can submit a proposal to the OFRN and that proposal must be consistent with the requirements of the Request for Proposals (RFPs) for White Papers and full proposals. 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 Brief to the OFRN Leadership Team and submit a quarterly report to the OFRN Program Manager. This ensures that deliverables are turned in and that any risks are capable of being mitigated in a timely manner.

For the first two rounds of OFRN funding, the win rate is about 40% for COE 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.

Human Performance and Health Sciences

HPHS – Wright State University/Wright State Research Institute

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

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, National Air and Space Intelligence Center, Naval Medical Research Unit – Dayton, and National Aeronautics and Space Administration on human performance and health challenges while driving economic growth across Ohio with the creation or retention of 575 jobs in the State. 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

> **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

> *"…goal is to provide a solid return on investment with the creation or retention of 400 jobs in the State."*

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, and their goal is to provide a solid return on investment with the creation or retention of 400 jobs in the State.

Materials and Advanced Manufacturing

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

> **Vision**
> *Develop 600 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*

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.

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 increase economic Growth by creating 200 jobs 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

This COE is focused on supporting the direct needs of the National Aeronautics and Space Administration and the Air Force Research Laboratory on 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. Its mission is to (1) build stronger collaborative research relationships among Ohio universities in the area of C4ISR; (2) Develop human capital within the state of Ohio in the area of C4ISR to improve regional competitiveness in the pursuit of federally funded work; and (3) transition research from Ohio universities into economic development opportunities for the state in the form of advanced research and development contracts, commercialization of C4ISR technologies into the private sector, deployment of research enabling toolsets to federal government entities and supporting contractors, and the creation of 600 jobs in the State.

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, National Air and Space Intelligence Center, and the National Aeronautics and Space Administration. 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 in an effort to create 300 new jobs in Ohio that are directly traceable to the efforts and products of the C2PNT COE.

Ohio Federal Laboratories

The Ohio Federal Laboratories are the key interface to the COE Projects and with each projects Principal Investigators. At the outset of the program, the Ohio Federal Laboratories key project managers briefed hundreds of university researchers in special sessions held at NASA-GRC and Wright State University on

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)

the priorities of the national labs. Following those briefings, they have provided their strategic research priorities to the OFRN and allowed WSARC to post their strategic opportunities on the OFRN website, www.ohiofrn.org. Not only have the Federal Laboratories allowed the OFRN access through day-to-day engagements within their labs, but they

have provided the OFRN access to key staff and laboratory leadership allowing the TRC and ERB to receive alignment rankings and project comments straight from the customer. In year one, this day-to-day type engagement has led to a significant strengthening of the relationship between the Federal Labs and Ohio's Higher Education Institutions. Due to the program, there are separate interactions between the researchers and the labs also taking place, and the labs are investing their own capital and time into the OFRN projects.

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 our Executive Review Board and a Program Manager on our Technical Review Council (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. They have also helped recruit key members of the ERB and TRC.

The JobsOhio program also provides a key executive to the ERB and the TRC and has also been most 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 identify a candidate project for the OFRN's pending Challenge Grant Initiative. The challenge problem will likely center around command and control, cyber, unmanned aerial vehicles, or air traffic control. The OFRN hopes to announce the Challenge Grant topic in 2017 and utilize it to integrate the capabilities of multiple COEs.

THE OHIO FEDERAL RESEARCH NETWORK (OFRN) PROGRAM PORTFOLIO

As of 30 June 2017, the OFRN has funded 18 major projects through two highly competitive procurements representing a $15.8 million investment over the next 2+ years. 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 the State of Ohio for future Department of Defense (DoD) and NASA initiatives.

The OFRN also carries out many other related project activities with its core federal customers and other federal R&D organizations that are intended to identify emerging opportunities that Ohio research universities and companies can compete for.

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 ~$42 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 OFFN. 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> It also allowed the teams to test their assumptions about the critical parameters of their OFRN funded projects' commercial potential and a richer understanding of the commercial marketplace. OFRN had eight (8) teams across four of the six Centers of Excellence. 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-Cawly; 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

Industry Sponsored Research

This year OFRN initiated pursuit of Industry Sponsored Research topics that aligned with OFRN COE areas of expertise and interest. As of 30 June 2017, the Commercialization and Workforce Development (C&WD) Team has interacted with over 100 Ohio companies and has identified four potential sponsored research opportunities worth $750K. There have also been multiple funding opportunities by partner, Ohio-based companies. This is an excellent sign of interest and cross pollination of technology.

A summary of the C&W Teams results this past year are summarized below:

1. Completed initial commercialization opportunity analysis of 18 OFRN funded projects
   - Interacted with over 100 Ohio companies to explore potential for commercialization partnerships with Rounds 1 and 2 OFRN projects.
   - Identified value added commercial partners for projects (9 currently) which have near term commercialization opportunities, e.g.:
     - HPHS/RLVC-Orbita Healthcare/Rubix Technologies/Metro Hospitals/Care Source Inc/Amazon Web Services
     - C4ISR/HCBD-Hureka Software
     - C2PNT/TEAS-Asymetric Technologies, Galois
     - M&M/Flexible Electronics-Pureti Inc, Sky Sun Solar, Lucintech, Lithium Innovations, Sabic Ventures

- o P&P/UAV Icing-Battelle, Smart Paint LLC, U.S. Gypsum
- o PRESIDES/Li-S Battery- Cornerstone Research Group, Xerion Battery, Apple Inc.

2. Initiated focused effort to identify and pursue industry sponsored research topics aligned with OFRN COE areas of expertise and interest.
   - Identified 5 potential opportunities with General Electric Aviation, GrafTech, and Access Flight Services, Pureti Inc., totaling $875K
   - Convened first of a series of industry/government/academia special interest groups (SIG), focused on polymers. Meeting held at University of Akron Polymer Composites Center and drew over 40 people. Positive feedback received from participants about value of such SIGs to identifying collaborative efforts in areas of opportunity/need that could benefit state economically.

3. Identify Federal government SBIR/STTR topics aligned with COE capability and areas of interest including OFRN funded projects.
   - Sent 82 SBIR/STTR topics to COEs/PIs which align with OFRN projects/COE areas of interest (>$12M value based upon maximum Phase 1 award levels)
   - Submitted 21 SBIR proposals involving OFRN PIs/Projects
   - To date have won 2 of 7 with 16 pending notification
   - Interfaced with 27 Federal Agency SBIR program managers who have indicated they are willing to consider topic abstracts aligned with OFRN areas of emphasis/interest for future SBIR/STTR offerings.

4. Non-Directly OFRN funded Projects impacted by OFRN funding:
   - Dr. Frank Kraft OU High Efficiency thermally conductive copper extrusions – DOE Proposal
   - Dr. Alexis Abramson CWRU EDIFES Smart Grid Data Analytics – Commercial Spin out partnerships and DOE reporting
   - Dr. Alexis Abramson CWRU Thermally Conductive Polymers – Commercial Spin out, License Agreement, TVSF funding
   - Dr. Lai Ming Dai CWRU- Polymer based catalysts – Material Supply Industry Partner introduced
   - Dr. Ozan Akkus CWRU – Spin out formation and TVSF application/ESP engagement with Jumpstart
   - Dr. Michael Heben UT- Industry Sponsored Research for self cleaning solar arrays - $75,000
   - Dr. Mark Moucek UA – UV Curable Coatings Commercialization Analysis and Industry Partner introduction

5. OFRN Industry Members Recruited – 20+ in 2017
   - Sabic Ventures – Boston, MA
   - Rubix Technologies – Grand Rapids, MI
   - Care Source, Dayton, OH
   - PH Matters, Columbus, OH
   - Asymetric Technologies, Columbus, OH
   - Inner Product Partners Venture Investments, San Francisco, CA
   - Infield Capital, Boulder, CO
   - Pureti Inc. NY, NY
   - Norman Nobel, Cleveland, OH
   - Lincoln Electric Co, Cleveland, OH
   - Smart Paint LLC

- Warner Babcock, Boston, MA
- Broadline Capital, Columbus, OH
- Xerion Battery, Dayton, OH
- Galois, Dayton, OH

6. In Kind Contributions recruited into OFRN YTD
   - $75,000- Elite Manufacturing Industries – C&W
   - $25,000- Pureti Inc., Flexible Electronics
   - $50,000- Rubix Technologies, RLVC

7. Initiatives of note underway:
   - Sabic Ventures - $43B in Global Revenue
     - Providing strategic acquisition roadmap of investment/acquisition targets to OFRN
     - Will visit Ohio in Q4 2017 to investigate opening an office (would like to meet with Gov. Kasich's team and Jobs Ohio)
     - Investigating creating a pool investment capital for Ohio based tech companies with University Technologies
     - Evaluating OFRN funded polymer research projects for potential investment targeting
     - Evaluating several Sponsored Research Opportunities with University of Akron
   - University of Toledo Sustainable Technology Center of Excellence
     - Currently being evaluated with Pureti Inc., Warner Babcok, Dysol, Crystal Ti & Solar City as immediate Industry Partners
     - Rep. Marcy Kaptur has been briefed by University of Toledo on potential COE and focused areas of:
       - Renewable Energy
         - Self Cleaning Solar Panels
         - Next Gen Solar Cells manufactured in Toledo
       - Clean Tech/Green Materials
       - Water & Air purification
       - Agricultural and Industrial runoff mitigation
   - Amazon Web Services/Alexa Ventures
     - Currently reviewing RLVC project for potential spin out investment Q2 2018.
   - US Gypsum Corp, Chicago IL
     - Have funded $50,000 to Smart Paint (Columbus, OH) for product development of Battelle's 'Heat Cote' technology
     - Potential project value of $25M in yr 1 Ohio based production for Concrete Dry Wall heaters in FY 2019
   - Apple Inc. Cupertino, CA
     - Have invested several million dollars into OFRN pre-cursor technology (UDRI)
     - Currently renewing an additional $1MM in licensing fees for Solid State Battery

8. New major win wins:
   - A multi university team led by The Ohio State University was recently awarded a $10M, 5 year contract by the NASA Aeronautics Mission Directorate as part of the Agency's University Leadership Initiative (ULI). The NASA award is to establish a multi ye effort in critical technology development for future generation hybrid/turbo electric propulsion and power systems. The six member university team led by OSU includes Case Western Reserve

University. Dr. Mike Benzakein of Ohio State University leads the NASA ULI team and has indicated in writing that the OFRN project in hybrid/turbo electric propulsion was a major reason the OSU led team won the competitive award. NASA recently awarded 5 ULI contracts for various areas of emphasis after a national competition. NASA views these ULI awards as a key element of a strategic partnership with the US university community that will make major contributions in both technology development and workforce development for the US aviation industry.

Challenge Problem Initiative

In March 2017, the Ohio Federal Research Network Challenge Problem Planning Team held their first meeting. The overall goal of the initiative is to integrate a systems solution to a key customer requirement. Following the first meeting they came out with four topic areas: (1) Integrated UAV experiments – this project would optimize the Springfield Sense and Avoid System; (2) Personal Aircraft Research and Development; (3) Cyber experimentation; and (4) Advanced Optical Communications. Through the months that followed, the focus was narrowed to two key topics: (1) OFRN Airspace Integration Challenge, which would help federal agencies learn how to conduct beyond visual line of sight unmanned aerial systems projects, and (2) Personal Aircraft Challenge, which could possibly establish Ohio as technology validation and the supply chain for personal aircraft.

Both of these options leverage key in state assets: the NASA's "ground controlled" T-34 research aircraft and the Ground Based Sense and Avoid complex at the Springfield-Beckley Municipal Airport (KSGH. Candidate projects would be executed in three phases:

- Phase 1: Optionally piloted (ground controlled)
- Phase 2: Remotely piloted (ground controlled)
- Phase 3: Autonomous

OFRN Airspace Integration Challenge

The Executive Review Board met on 13 June 2017 and approved OFRN Airspace Integration Challenge as the first Challenge Problem topic.

The idea is to aggregate federal agency requirements and perform a flying demo at the end of the challenge problem. In March 2017, at the Federal UAS Workshop, there were three UAS requirements discussed:

1. Persistent Sensing – high revisit rate over target for 4-5 days
2. Rapid Inspection – UAS ready to respond within hours to a natural disaster (i.e. dam failure, forest fire hot spots, etc…)
3. Large Area Sensing – efficient full spectrum mapping covering large area but no temporal constraint

This challenge directly ties into multiple existing university programs: OSU Field to Faucet, CWRU long duration power supplies, KSU air traffic control, OU FAA partnership, and WSU multi-aircraft control. It also leverages AFRL's vision for Beyond Visual Line of Sight not being tied to a specific geographic location and also optimizes the mobile (RV) control system at the Springfield-Beckley Municipal Airport (KSGH). The challenge also looks into industry market opportunities for the Ground-Based Sense and Avoid Radar

System and how this may translate into autonomous system and emergency response control. The first flight demo at KSGH using the T-34 asset would be planned for Spring 2018.

The Planning Team has assessed the proposed Challenge Grant against federal requirements. Now they will assess each project against industry needs.

Issues/Risks/Mitigations

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

o   After the Round 1 project awards were made, the start-up time of the projects was an issue for OFRN. The universities' RSP/Legal departments had never pushed projects to another university and were having difficulty releasing the projects from their charge. Although start-up on the projects was slow, there are currently no requests or changes to the executive timeline schedule.

o   As the TRC members were reviewing the Round 1 proposals, it came to their attention that the OFRN COE members needed training in writing Federal Proposals. As a result, the OFRN Leadership hired UVG Ltd to instruct researchers on how to write competitive Federal Proposals. The UVG Ltd training sessions on White Papers and Proposals resulted in significant improvement in the white papers submitted in Round 2.

o   The export control of the projects for which the universities are working on became a risk as non-US Citizens began working on the projects. This risk was mitigated by asking the compliance offices to ensure that all personnel working on the projects were US Citizens or Green Card holders. If non-US Citizens were working on the project, the government sponsor was asked to ensure that non-US Citizens were approved to work on the tasks assigned to them. This risk is being monitored continuously, however there has been no major setbacks by the government sponsors or the universities.

o   Across the state, second and third tier university subcontracts are continuing to have issues in contracting, accounting and compliance. These issues are generated due to: (1) a lack of participation in meetings from university contracting, accounting and compliance departments; (2) this type of collaboration work being new to the university system; and (3) lack of communication between PIs and their university departments. As a result, the OFRN Program Manager and Lead Scientist are meeting with the contracting, accounting and compliance offices at each Lead University with the PI in the room to (1) let the departments voice their opinions/issues for which they are experiencing; (2) answer any questions they have but also explain to them how subcontracting through the COEs are meant to work; and (3) work with the departments to come up with a solution that results in an efficient process for all the institutions involved

o   Within the COEs, Project PIs were/are struggling to report issues and risks that they are experiencing within the Project Management Review Sessions due to other persons in the room being potential future clients/partners. To mitigate this issue, the OFRN Program Manager and Chief Scientist are currently meeting with each project team individually to gain a deeper understanding on the status of the project. Upon completion, they will provide a status report to the OFRN Directors for review.

FINANCES - OFRN PROGRAM FUNDS ALLOCATION/EXPENDITURES

Total State Operation Funding for the OFRN program for defense, aerospace, workforce development is $25 million for FY 16 and 17. This consists of two line items in the State Budget: (1) $20 million was designated for WSARC and (2) $5 million was designated for OSU. $20 million was allocated to the OFRN program for research projects executed by the COEs, for the commercialization and workforce development activities of Lorain County Community College and Cleveland State University, and for the pending Challenge Grant. A breakdown of the funding is displayed in Figure 5.

It should be noted that $5 million was revectored by WSARC to the OFRN from its own funding prior to the release of ODHE funds to assist in workforce development and small business growth through the Aerospace Professional Development Center.
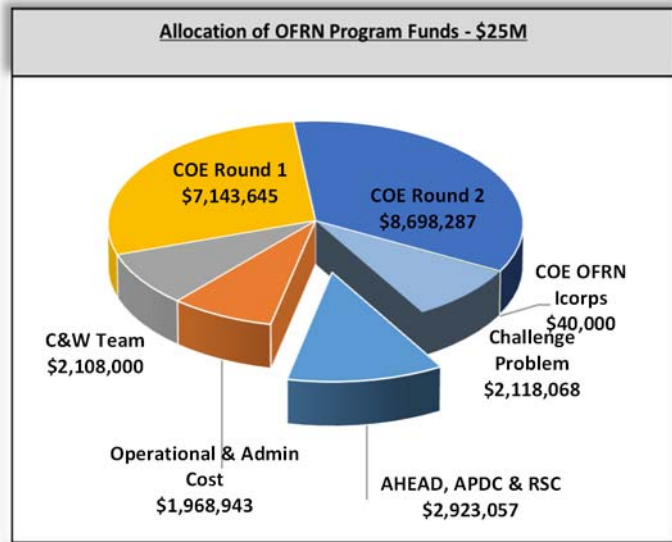
Figure 5 OFRN Administration Allocated Funds

Operations/Administrative Costs of the OFRN.

Consistent with the legislative intent, The Ohio State University and WSARC have a contract arrangement in place to receive the $5 million from ODHE to support COE activities and the proposed Challenge Grant. Figure 6 shows the current amounts funded to each COE as well as the amounts expended as of 30 June 2017.

FUNDING						
Contract		**Prime**	**POP**	**Allocation**	**Funded to Date**	**Expensed to Date**
5JC0/HB 64 Defense/Aerospace Workforce Development Initiative		ODHE	1 Jul 15 – 18 Sep 18	$17,076,943	$17,076,943	($5,189,849)
5JC0/HB 64 AHEAD/RSC/APDC		ODHE	1 Jul 15 – 30 Jun 17	$2,923,057	$2,923,057	($2,923,057)
235616/HB 64 Ohio State University Federal Research Center Initiative		ODHE	1 Jul 17 – 30 Jun 18	$5,000,000	$5,000,000	($393,436)
			TOTAL	$25,000,000	$25,000,000	($8,506,342)
Contract	**COE**	**POP**	**Round 1 Allocation**	**Round 2 Allocation**	**OFRN ICorps Allocation**	**Funded to Date**	**Expensed to Date**
1077-100/Case Western Reserve	PRESIDES	1 Feb 16 – 25 Aug 18	$1,649,726	$0	$15,000	$1,664,726	($331,642)
1077-200/Ohio State University	OCPP	1 Feb 16 – 31 Jan 19	$2,000,000	$1,999,838	$5,000	$2,877,120	($830,836)
1077-300/Ohio University	C2PNT	26 Aug 16 – 18 Sep 18	$0	$2,286,251	$10,000	$1,214,131	($222,616)
1077-400/University of Dayton/UDRI	M&M	1 Feb 16 – 18 Sep 18	$1,999,997	$1,097,197	$10,000	$2,580,430	($648,154)
1077-600/OSU/WSU	C4ISR	26 Aug 16 – 25 Aug 18	$0	$1,200,000	$0	$600,000	($151,766)
1077-700/Wright State University	HPHS	1 Feb 16 – 18 Sep 18	$1,493,922	$2,115,001	$0	$2,709,175	($801,618)
1077-500/Cleveland State University	C&W	1 Feb 16 – 2 Feb 18	$1,108,000	N/A	N/A	$1,108,000	($471,721)
1077-510/Lorain County Community College	C&W	1 Feb 16 – 2 Feb 18	$1,000,000	N/A	N/A	$1,000,000	($660,894)
		COE SUB TOTAL	$9,251,645	$8,698,287	$40,000	$13,753,582	($4,119,247)

Figure 6 OFRN COE Allocation|Funded|Expensed

Figure 7 provides an overview of the OFRN Administration and Management costs. It depicts the OFRN subcontracts, with amounts funded and expensed as of 30 June 2017. All subcontracts have been

approved through ODHE and assist the management team in training, program management of the C&WD Team, Job Growth estimation for use in COE proposal writing, 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
FRN Administration	FRN Mgmt	$1,350,975	$1,350,975	($901,650)
UVG, Ltd.	Trng Consultant	$18,122	$18,122	($13,138)
Global Glu	COE Handbook	$248,041	$248,041	($248,041)
LMRS Info Systems	C&WD Mgmt	$160,000	$160,000	($146,398)
OSU Support	Associate PM	$85,000	$85,000	($47,996)
OFRN ICorps	OFRN ICorps	$106,815	$106,815	($106,815)
	SUB TOTAL	$1,968,953	$1,968,953	($1,464,038)

Figure 7 OFRN Administration and Management Allocation|Funded|Expensed

Funds Expended Report – As of 30 June 2017

OHIO DEPARTMENT OF EDUCATION WORKFORCE MOU FUNDS EXPENDED REPORT						
OFRN ROUND 1 FUNDS EXPEDED REPORT						
Please Type all Information			Subaward No.:		1077	
Recipient:		Wright State Applied Research Corporation				
Project:		Defense/Aerospace Workforce Development Initiative				
Reporting Period:		July 1, 2016 - June 30, 2017				

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	$1,664,726	$0	$331,642	$1,333,084		$331,642
OCPP COE - The Ohio State University	$4,004,838	$118,064	$712,772	$3,174,002		$830,836
M&M COE - University of Dayton	$3,107,194	$43,727	$604,427	$2,459,040		$648,154
HPHS COE - Wright State University	$2,502,905	$260,991	$411,315	$1,830,599		$672,306
C4ISR COE - Wright State University / The Ohio State University	$1,200,000	$0	$151,766	$1,048,234		$151,766
C2PNT - Ohio University	$205,639	$0	$6,488	$199,151		$6,488
C&WD Team - Cleveland State University	$1,108,000	$213,233	$258,488	$636,279		$471,721
C&WD Team - Lorain County Community College	$1,000,000	$274,830	$386,064	$339,106		$660,894
OFRN Administration	$1,883,953	$657,617	$758,425	$467,911		$1,416,042
OFRN APDC/RSC	$2,923,057	$1,930,252	$992,804	$0		$2,923,057
Challenge Problem Set-Aside	$399,688	$0	$0	$399,688		$0
TOTAL	$20,000,000	$3,498,714	$4,614,191	$11,887,094		$8,112,906

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 2017

OHIO DEPARTMENT OF EDUCATION
WORKFORCE MOU
COST SHARE CONTRIBUTION REPORT

OFRN ROUND 1 COST SHARE CONTRIBUTION REPORT

Please Type all Information			Subaward No.:	1077

Recipient:	Wright State Applied Research Corporation
Project Name:	Defense/Aerospace Workforce Development Initiative
Reporting Period:	July 1, 2016 - June 30, 2017

Budget Categories (Projects)	(A) FRN 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	$1,844	$148,775	$558,139	$150,619
OCPP COE - The Ohio State University	$1,633,514	$143,551	$350,030	$1,139,933	$493,581
M&M COE - University of Dayton	$1,635,423	$0	$176,685	$1,458,738	$176,685
HPHS COE - Wright State University	$854,536	$0	$0	$854,536	$0
C4ISR COE - Wright State University / The Ohio State University	$550,117	$0	$89,832	$460,285	$89,832
C2PNT - Ohio University	$2,769,203	$0	$0	$2,769,203	$0
C&WD Team - Cleveland State University	$326,552	$0	$86,228	$240,324	$86,228
C&WD Team - Lorain County Community College	$0	$0	$0	$0	$0
OFRN Administration	$0	$0	$0	$0	$0
TOTAL	$8,478,103	$145,395	$851,551	$7,481,157	$996,946

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-A

NEXT STEPS

The OFRN will continue to build and strengthen linkages and collaboration across Ohio's research universities, industry and Federal Partners. The longer- term plan of the OFRN is to continue to enhance business development statewide through STTR and SBIR as well as other Federal Opportunities alongside industry partners. The OFRN will also continue to build Industry Sponsored Research Opportunities and seek ways to include all of the Ohio research universities into OFRN.

This next year the OFRN also wants to engage with other organizations throughout the state to include: the Environmental Protection Agency (EPA) Lab in Cincinnati, the Northern Ohio Energy Storage Cluster, and the Cleveland Clinic Foundation. Also, OFRN will conduct an assessment of modeling and simulation (M&S) capabilities currently available at Ohio universities, which will open the door to seeing what assets are available at each university across the state and to the potential creation of an additional COE.

APPENDIX 1 – OFRN PROJECT OVERVIEW

Construct for Ohio Centric Center of Excellence (COE) Ohio Federal Research Network (OFRN)
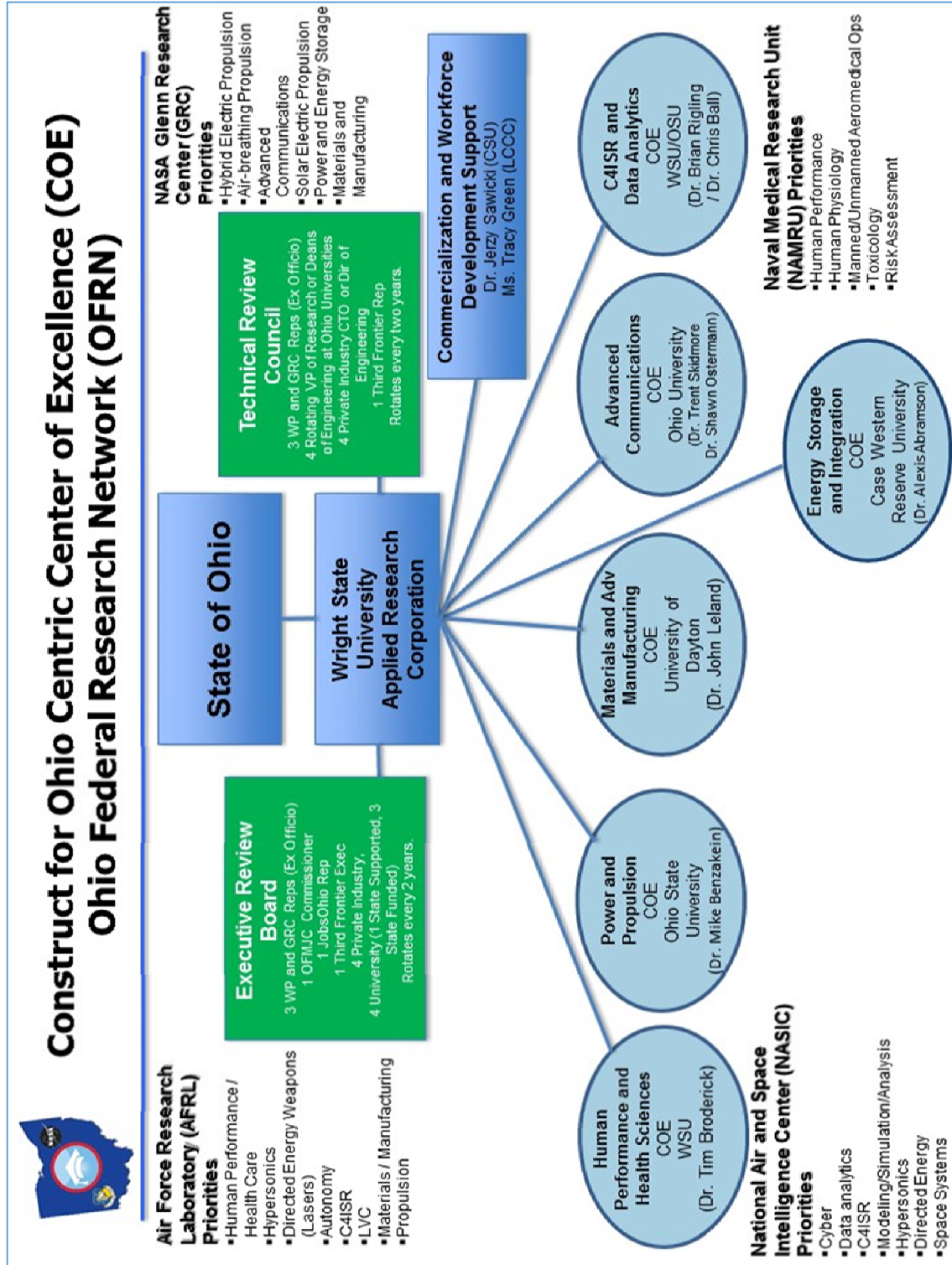
WPAFB / GRC Mission Applications Driven Centers of Excellence (COEs)

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

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

Lead: LCCC, CSU

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
- Micro-devises

Lead: Case
Primary Support: UT, OSU, UD, UC, CSU, Lorain
Potential Jobs: 200
Potential Contracts: $50M
Potential Private Sector Investment: $10M

New

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

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	**T**he 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/HPHS	**Gross/WSU - TEAS**	**AFRL**	**$225,000**	**CARP Phase II – WON**
C2PNT/HPHS	**Gross/WSU - TEAS**	**OSD**	**$3,000,000**	**AFRL Rapid Innovation Fund - WON**
C2PNT	TEAS	AFRL	$750,000	Improve Software Security - Prattle Phase 2 SBIR
C2PNT	TEAS	OSD	$3,500,000	Software V&V/Flight Testing - LCAAT - Weapons Truck
C2PNT	TEAS	AFRL	$400,000	Avionics Vulnerability Assessment Mitigation and Protection
C2PNT	TEAS	AFRL	$160,000	Multi-role Control Station
C2PNT	TEAS	AFRL	$4,500,000	ATEV&V
C2PNT	TEAS	AFRL	$3,750,000	LCAAT - Hunter Killer
C2PNT	TEAS	DARPA	$750,000	ACTUV Seedling
C2PNT	TEAS	DARPA	$250,000	Swarm UAS Seedling
C2PNT	TEAS	ARMY	$12,000,000	Autonomous Unmanned Systems Teaming & Collaboration
C2PNT	TEAS	DARPA	$3,900,000	Scalable High Assurance Military Systems
C2PNT	TEAS	AFRL	$12,500,000	Loyal Wingman
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	DARPA	$1,500,000	Strategic Technologies
C2PNT	ICS	AFRL	$500,000	Deep Learning for Actionable Intelligence Discovery and Exploitation
C2PNT	**Stewart/OSU - ICS**	**NSF**	**$175,000**	**Distributed Systems w/ Verified Complexity by Design – WON**
C2PNT	**Chenji/OSU - ICS**	**NSF**	**$175,000**	**A Software Defined Approach to Laser-based Free Space Optical Networks - WON**
C2PNT	Wu/WSU - ICS	NSF	$750,000	Enhancing RF Spectrum Access
C4ISR/HPHS	**Hitzler/WSU - HCBD**	**DARPA**	**$5,900,000**	**XAI Proposal - LOSS**
C4ISR/HPHS	**Minnery/WSU-HCBD**	**IARPA**	**$2,000,000**	**Hybrid Forecasting Competition - (Raytheon Prime - WON)**
C4ISR/HPHS	**Hitzler/WSU - HCBD**	**DARPA**	**$5,900,000**	**Causal Exploration - LOSS**

FOLLOW ON FUNDING

COE	PI Name / University	Client	Value	Description
HPHS	Marras/OSU – MOSSD	AFRL	$175,000	Integrated rucksack accessory to improve load distributions
HPHS	**Heikenfeld/UC – ACPSS**	**AFRL**	**$3,960,000**	**Recently awarded sweat sensing R&D project - WON**
HPHS	**Norell/WSARC - LEAP**	**DARPA**	**$8,600,000**	**$14.6M available for Options - WON**
HPHS	Norell/WSARC - CRAMMIT	ARO	$110,000	
HPHS	**Norell/WSARC - HMT TO4**	**AFRL/RH**	**$6,700,000**	**WON**
HPHS	**Norell/WSARC - MIDLE**	**AFRL/RH**	**$3,500,000**	**WON**
HPHS	**Norell/WSARC - DTT**	**AFRL/RH**	**$345,000**	**WON**
HPHS	**Hodge/WSARC - RLVC**	**AFRL/RY**	**$1,000,000**	**ACE-EM - WON**
HPHS	**Norell/WSARC - TENET 3 Phase II**	**AFRL/RV**	**$220,000**	**STTR - WON**
HPHS	Devabhaktuni/UT – RLVC	NSF	TBD	Proposal focused on precision agriculture
HPHS	Devabhaktuni/UT – RLVC	DAGSI	$50,000	Workforce development support- Data to decision
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	**Reiter/ WSU – SAPHYRE**	**AFRL**	**$75,000**	**Recently awarded SAVANT - WON**
HPHS	Norell/WSARC - SAPHYRE	AFRL/RY	$10,000,000	ALAS
HPHS	Marras/OSU - MOSSD	ONR	$2,000,000	Validated Assessment of Neuromusculoskeletal Injuries
HPHS	Marras/OSU - MOSSD	ONR	$1,200,000	Capital Equipment (DURIP)
M&M	Dr. Willard/CWRU	NSF - DMREF	$1,600,000	Computational Alloy Design of Nanocomposite Soft Magnets
M&M	Dr. Willard/CWRU	DARPA Seedling	$300,000	Iron Nitride Powder Processing
M&M	TBD	ONR LIFT	$530,000	Metal Matrix Composites
M&M	Szaruga/UDRI	AFRL/RXM	$510,000	Composite Tooling for Aircraft Sustainment
M&M	Elahinia/UT	NSF SBIR Phase 1	$250,000	Quick Flow Blood Clot Removal Device
M&M	Szaruga/UDRI	IACMI	TBD	Low-Cost-Composite Manufacturing
PRESIDES	Jitendra Kumar /UD	NASA	$600,000	Integrated high temperature battery and micro-controller with active cooling for Venus and Mars applications

FOLLOW ON FUNDING				
COE	**PI Name / University**	**Client**	**Value**	**Description**
PRESIDES	Prakah / CWRU	NASA	$1,300,000	Structural Battery Project
PRESIDES	Akolkar / CWRU	DOE	TBD	Stable, long life Li metal electrodes for rechargeable batteries
PRESIDES	**Abramson/CWRU Heben/UT**	**PNNL/DOE**	**$910,000**	**Grid Modernization demonstration project, which involves using batteries to reduce peak loads - WON**
PRESIDES	**Zhu/UA**	**Navy SBIR**	**$150,000**	**Superior All Solid State Battery - WON**
PRESIDES	Kumar / UD	NASA/US Army	$1,300,000	3 proposals to NASA; 2 proposals to Army
OCPP	TBD	NASA	$50,000,000	Invited for Step B Proposal – Electric Propulsion
OCPP	OSU	AFRL	$48,000/yr	OSU New Project Collaboration – Electric Propulsion
OCPP	OSU	AFRL	$400,000/yr	Power America – Invited for Full Proposal
OCPP	OSU	AFRL	$15,000,000	Advanced Manufacturing/High Temp. Turbines. OSU/Honeywell/ITI
OCPP	**Benzakein/OSU - OCPP**	**NASA**	**$10,000,000**	**Electric Propulsion: Challenges and Opportunities - WON**

APPENDIX 2 – OFRN PROJECT DETAIL

Round 1 Projects Awarded
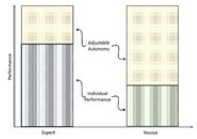
HPHS COE – Regional LVC Enterprise (RLVC)

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: Dave Malek, Doug Hodge (Wright State University)
- U of Toledo, Case Western, Wright State University, and U of Cincinnati

Economic Impact
- Expansion of UT research with Microsoft
- Expansion of research and commercial development with CAE
- Private industry investment into research and commercial capability development
- Projected 73 new jobs
  - Logistics, healthcare, and defense will be primary areas of growth

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)

HPHS COE – Sliding-Scale Autonomy Through Physiological Rhythm Evaluation (SAPHYRE)
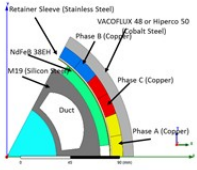
Technical Concept & Approach

Problem: Individual variability, experience, trust in the system, and proficiency present a challenge in design of autonomous systems.
Challenge: These variables change throughout a mission based on mission requirements.

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
- Bruce Howard, Wright State University
- Vijay Devabhaktuni, PhD University of Toledo
- Jeff Weir, PhD AFIT
- James Curro, 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: 24mos

Milestones: Needs Assessment (May 2016), Software and Hardware Install (July 2016), Initial Data Collection and Analysis (Oct 2016), Test and Evaluation of Augmentation Using Sliding Scale Autonomy (July 2017).

Deliverables:
- Description of Industry needs and potential performance indicators of systems and individuals.
- Data architecture / Software including user interfaces for the collection, storage, analysis, and reporting/visualization of data.
- Sliding scale autonomy methods and performance indicators.

Risk: IRB approval delay (mitigation-early submission & ample time between initial data collect and augmentation task.)

OCPP COE - Hybrid Turbo Electric Propulsion

Technical Concept & Approach

- In progress with motor and converter phase-leg fabrication
- **Challenges**: high-speed mechanical stability and thermal management in motor ; phase-leg module assembly and parasitic control in converter; converter control strategy

Project Requirement, Federal Alignment, Sponsoring Organization (s)

- Federal Stakeholder: NASA, requirements align with proposed project goals
- Elaborate on the potential impact on federal stakeholder mission.
- ✓ Current design scalability is under discussion
- ✓ Current design voltage may be lower
- ✓ New structure for the motor design, new topology and packaging of the converter design
- ✓ All the technologies that under investigation can be directly applied in future designs to meet federal agency requirements

Team & Economic Impact For State of Ohio

- PI: Fang Luo, Ohio State University
- Teams: Ohio State University, University of Akron, Meggitt, AFRL
- Elaborate on potential economic development impact for the state of Ohio.
  - Fed Grants: NASA ULI (10M for 5 years), PowerAmerica (400k for 1 year), NSF (300k for 3 years), NASA SBIR (120 k for 1 year)
  - Potential power module commercialization by Ohio Companies
  - 1 team was awarded OFRN i-Corp
- Generated technologies can support Meggitt, Parker. Contact with SMART Microsystems and Asymmetric Co.

Budget, Schedules, Deliverables, & Risks

Period of Performance: 36 months

Milestones:
  - ➢ FEA analysis has been complete for motor, PO has been in progress
  - ➢ Phase-leg fabrication in progress
  - ➢ Basic modeling for fault modes

Deliverables: motor FEA model, converter phase-leg design, loss and weight estimation results

Key technical risks: high speed motor fabrication, converter layout and assembly to achieve designed efficiency

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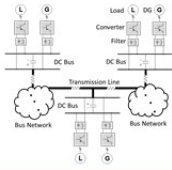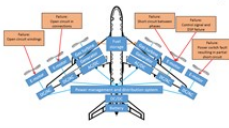
OCPP COE - Intelligent Control architecture for aviation electric power systems

Technical Concept & Approach

- Control (distributed cooperative control)
- Energy optimization (benchmarking 4 major approaches)
- Reliability (microgrid reliability analysis reverted from the device-level)

Project Requirement, Federal Alignment, Sponsoring Organization (s)

- This program responds AFRL's request on research for control architectures for intelligent power systems.
- It is a leveraged effort based on previous and ongoing collaboration between OSU and AFRL.
- ***Potential impact on federal stakeholder mission***.
  - The proposed program will produce system modeling of hybrid control architecture and protection scheme for aviation electric power systems, with demonstration and validation of control and protection effectiveness.
  - The research results will be coded into core analytical models and simulation modules, which can be generalized to prototypes for application of various layouts of aviation electric power systems.

Team & Economic Impact For State of Ohio

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

Potential economic development impact
- External funding agencies, including Department of Energy (DOE), offices under Department of Defense (DOD), and National Science Foundation (NSF), have been seeking for solutions to effective control architecture of future power systems.
- The proposed research will create jobs in the industries in the collaborative area.
- The high-quality education of students will contribute to the local industry development.

Budget, Schedules, Deliverables, & Risks

Period of Performance: 24 months
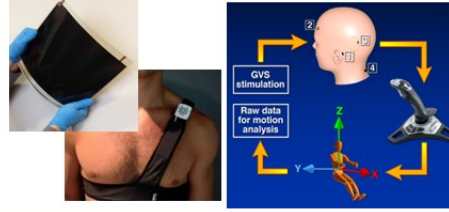
M&M COE - High Performance Plastic Substrates for Flexible Electronics
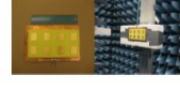
Technical Concept & Approach

OBJECTIVE: Develop high performance polymer substrates/films tailored for flexible Electronics

Project Requirement, Federal Alignment, Sponsoring Organization (s)

- AFRL Functional Materials: Flex Hybrid Electronics
- Flexible electronics are proposed as an enabling disruptive technology for both the AF and NASA.
- Flexible electronics enable survivable electronics for munitions or impact at terrestrial surfaces.
- Conformal materials for high performance beyond line of sight communication antennas

Team & Economic Impact For State of Ohio

- PI: Bryan Vogt, University of Akron
- University of Akron (Lead), University of Toledo, Ohio University
- Akron Polymers, Orbital research, Hana Microdisplay Systems, Lucintech

Budget, Schedules, Deliverables, & Risks

Period of Performance: 24 months

Milestones:
- Fabrication of high temperature polyi(a)mide substrates
- Characterization of the thermomechanical properties and deliver substrates
- Fabrication of skin tolerant soft substrates for human health monitoring

Deliverables:
- Transparent plastic substrate with $T_g > 375°C$
- 10%, 1 cm^2, efficiency device on one or more flex substrates
- Galvanic vestibular stimulation with no to little pain during long term use

Risks:
- Film compatibility with microelectronics
- Uniform thermal expansion coefficients
- Advances in flexible glass
- Equipment failures / staffing / contracts
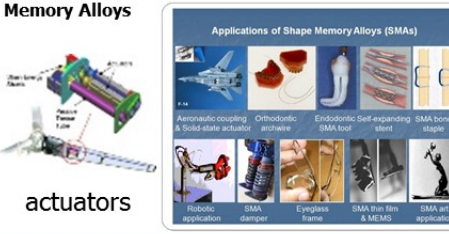
M&M COE – Adaptive Bio-Inspired Aerospace Structures Actuated by Shape Memory Alloys

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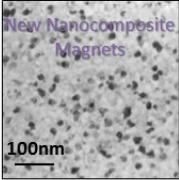
Deliverables
- Alloy development for High Temperature SMAs by adding different amounts of ternary elements
- Create functional shape memory and superelastic NiTiHf

Risks:
- Thermodynamic stability of ternary additions to Ni-Ti
- Embrittling
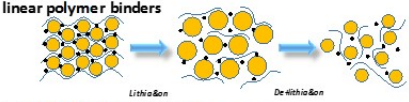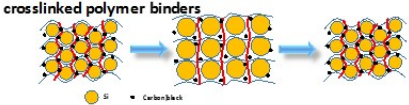
M&M COE - High Temperature Magnetic Materials

Technical Concept & Approach

Aviation of Tomorrow

Solid State Power Substations (nano) 20 kHz

Future Power Conversion

Si-steel power conditioning unit 60 Hz.

New Nanocomposite Magnets

100nm

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
- Aligns well with the investigation for 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
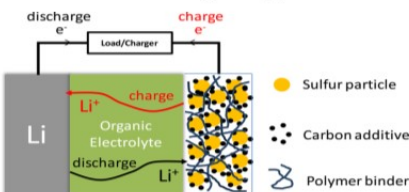
Ohio PRESIDES COE - High Energy Density Li-Ion Battery Based on Advanced Silicon Anodes

Technical Concept & Approach

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

linear polymer binders

Lithiation   Delithiation

crosslinked polymer binders

Si   Carbon Black

Project Requirement, Federal Alignment, Sponsoring Organization (s)

NASA & AFRL: Rechargeable batteries; high energy density; > 300 Wh/kg; lightweight; > 100 cycles (AFRL), > 200 cycles (NASA).

NASA: Load-leveling and electrical power on solar-powered missions, for EVA suits and Mars landers/rovers

AFRL: Soldier-worn systems, UAVs

Team & Economic Impact For State of Ohio

PI: Yu Zhu, UA
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), B. Deveney, (GrafTech), 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.
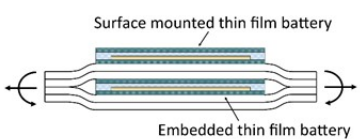
Key risk: Inability to meet technical targets

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

Technical Concept & Approach

- Sulfur particle
- Carbon additive
- Polymer binder

Potential: Li-S is well suited for energy density required;
Challenges: poor cycle life, high self-discharge and limited temp. 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).

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. Already we were awarded NASA Phase I on solid-state Li-S battery with strong possibility of Phase II (submitted).

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

Potential economic impact (in 2 years):
- Jobs: 3+
- Follow-on funding: $200K+ via fed agencies

Budget, Schedules, Deliverables, & Risks

Period of performance: 24 months

(Milestones: M1.1-M1.5, M2.1, M3.1-M3.3, M4.1, M5.1)

Key deliverable: high energy density, durable and safe Li-S battery prototype.

Key risk: Inability to meet technical targets during period of performance.

Ohio PRESIDES COE - High Performance Multifunctional Structural Energy Storage

Technical Concept & Approach

Surface mounted thin film battery

Embedded thin film battery

Create high-performance multifunctional structural energy storage systems. Establish multifunctional design rules and performance guidelines for their integration.
Challenges: Manufacturing compatibility; Electrochemical & mechanical performance and degradation (life-cycle).

Project Requirement, Federal Alignment, Sponsoring Organization (s)

NASA + AFRL: multifunctional load-bearing structures with energy storage functionality; mass & volume savings; Increase mission range and payload capacity; specific energy density >400 Wh/kg; long-life >1000 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: P. Loyselle and J. M. Pereira

AFRL: J. Baur, M. Durstock and M. Rottmayer

University partners: R. Akolkar (CWRU); Bang-Hung Tsao and Luis Herrera (UD)

Industry partners: Jim Green (CSA America), Jeff Taylor (Event 38 Unmanned Systems), A. Sane (Americarb/Volt)

Potential economic impact: (in 2 years): Jobs: 4+; Follow-on funding: $300K/year + via federal agencies

Commercial Impact (sectors): Energy; Aerospace; Automotive; Surveillance; 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 power modules: sandwich structures, I-beams etc. Focus--UAVs

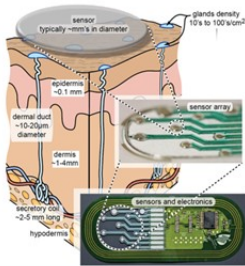**Key risk:** Inability to meet technical targets

Round 2 Projects Awarded

HPHS COE - Advanced Cognitive and Physical Sweat Sensing (ACPSS)

Technical Concept & Approach

Wearable biosensing will soon hit a glass ceiling without access to and sensing of actual chemical analytes. The most compelling biofluid for non-invasive continuous monitoring is sweat. However, sweat biosensing is in its infancy and commercialization is currently limited to only sweat electrolytes.

Project Requirement, Federal Alignment, Sponsoring Organization (s)

- AFRL - Josh Hagen, Scott Galster / NAMRU-D – Mike Gargas – *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

- PI: Jason Heikenfeld (UC) – global leader in sweat biosensing
- Brent Cameron (Toledo) – electrochemical biosensor expert.
- William Kraemer (Ohio State) – global leader, physical perf.
- Ali Rezai (Ohio State) – global leader, cognitive 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.
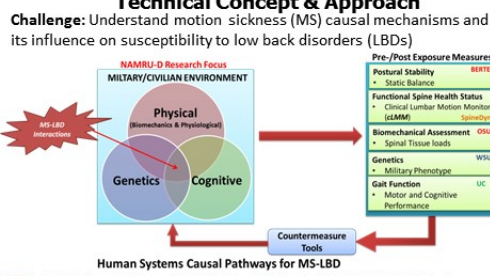
Budget, Schedules, Deliverables, & Risks

- **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.

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)

Project Requirement, Federal Alignment, Sponsoring Organization (s)

- NAMRU-D: CDR Rich Folga, richard.folga@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: Ali Reiter, Ph.D.
- **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 and KRAKEN data acquisition with human testing
    - Data Integration and Human-in-loop tests in the KRAKEN
- List Deliverables
    - **MS-LBD susceptibility report**
    - **Countermeasure test protocol**
    - **Spine Health testing service**
- Identify key technical risks: **KRAKEN availability, test subject recruitment**

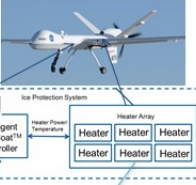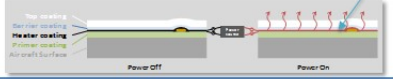## OCPP COE - UAV Icing Protection

Technical Concept & Approach

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

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

Project Requirement, Federal Alignment, Sponsoring Organization (s)

The Air Force Life Cycle Management Center (AFLCMC) requires a 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; CW: 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
CW: 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 Partners: 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 for development of engine inlet test stand is the biggest risk. Currently do not have CAD models or specifics regarding the icing wind tunnel interface.

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

Budget, Schedules, Deliverables, & Risks

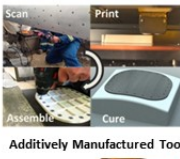| Month	Method Development	Computational Modeling	Stationary Experiment	Rotating Experiment
1-6	Test PSP	Develop model using existing data	Update Hardware	Hardware Modifications
7-12	Determine optimal technique	Comparison to stationary expt.	Surface and Flow field data	Experiment Assembly
13-18	Impact of wakes on film cooling	Detailed validation, create rotating model	Investigate revised geometries	Experiment Execution
19-24	Comparison to rotating experiment			Data Analysis

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

Technical Concept & Approach

OBJECTIVE: Reduce the fabrication time and cost of composite structures by 25% to meet AF Low Cost 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, University of Dayton Research Institute
- UDRI: lead, Case Western Reserve, Univ 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
- **Risks:** Access to proprietary cost items for composites, durability of additively manufactured composites tools
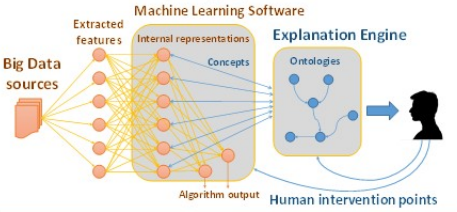

C4ISR w/HPHS COEs - Human-Centered Big Data (HCBD)

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 often "black boxes" lacking transparency.
- **Our solution:** Leverage semantic ontologies to generate *human-understandable explanations* of an algorithm's internal representations & outputs. Develop methodology for optimally combining human & machine judgments.
- **Impact:** Optimal integration of human & machine intelligence will greatly improve accuracy & reliability of analytic products.
- **Sponsors:** NASIC/GXKA (J. Homer, M. Brown), AFRL/RYW (M. Nowak).

Team & Economic Impact For State of Ohio

- **PI:** Michael Raymer, Wright State University & Brad Minnery, WSRI
- **Team members:** WSRI/WSU, Ohio State, Case Western. Industry partners: 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 HFC program, IARPA Stories program, IARPA-wide BAA, DARPA Explainable AI, DARPA Information Innovation Office, NSF (multiple programs)
- **Est. 40 new jobs** (established industries & start-ups)
- **Broad potential impact extends to non-DoD industries.** Near-term focus on commercializing health care analytics applications (matching patients to drugs / clinical trials). Additional market opportunities in 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) Concept assignment for cluster analysis; 2) Concept assignment for deep learning; 3) Initial methodology for hybridizing human-machine judgments; 4) Validation of hybridized judgments
- **Deliverables**
  - Algorithms for enabling knowledge discovery from high-dimensional cross-modal data
  - "Readable" machine learning systems
- **Key technical risks:**
  - Diffuse or uninterpretable results
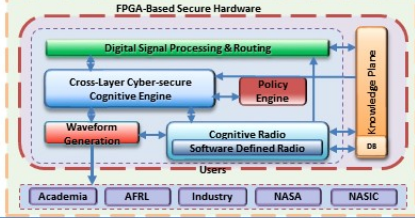 - Insufficient ontology richness for generating explanations

C2PNT– 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) Tech Advisor, Spectrum Warfare, Sensors Directorate, WPAFB
- **NASA:** Space-based spectrum sharing, assured access to spectrum, cognitive technologies
  - POC: Elias Naffah (elias.t.naffah@nasa.gov) Chief, Space Communications & Spectrum Management, NASA
- **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), Cyber Analysis, NASIC/ACYM, and David Fay (david.fay@us.af.mil) Satellite Systems, NASIC/SMSM

Team & Economic Impact For State of Ohio
University Partners
- Wright State University: Dr. Zhiqiang Wu (PI)
- 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
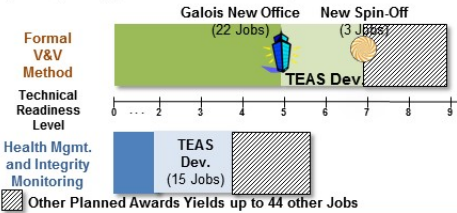

C2PNT w/HPHS – Test & Evaluation of Autonomous Systems (TEAS)

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 – Matt Clark, AFRL/RH – Jason Clark

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