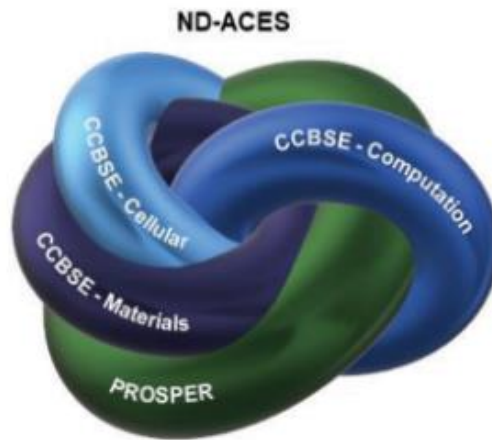


ND EPSCoR

Established Program to
Stimulate Competitive Research



New Discoveries in the Advanced Interface of Computation, Engineering, and Science

ND EPSCoR's NSF Research Infrastructure Improvement (RII) Track-1

Award #: 1946202

Establishing ND-ACES Working Relationships - Partnerships and Collaborations

June 30, 2021/Version 1.0

Introduction

ND EPSCoR's initiated a \$20M five-year National Science Foundation (NSF) Research Infrastructure Improvement (RII) Track-1 cooperative agreement on July 1, 2020; New Discoveries in the Advanced Interface of Computation, Engineering, and Science (ND-ACES). Contained within all NSF RII Track-1 cooperative agreements are the components of intellectual merit (ND-ACES Center for Cellular Biointerfaces in Science and Engineering [CCBSE]) and broader impacts (ND-ACES PROMoting Sustainable Partnerships in Education and Research [PROSPER]). ND-ACES PROSPER has four elements that are integrated to the CCBSE and with each other: 1) Education and Workforce Development, 2) Broadening Participation, 3) Partnerships and Collaborations, and 4) Communication and Dissemination. The combined and integrated efforts of CCBSE and PROSPER will position ND-ACES as ND's leading scientific and educational resource.

The anticipated ND-ACES outcomes are to:

- create new knowledge that expands ND's bioscience research, capacity, and expertise; catalyze ND's research/ computing capabilities; increase success in federal funding; support translation of research into use; inform citizens.
- establish diverse and sustainable bioscience/ STEM education and professional development pathways; seek to broaden the participation of underrepresented communities.
- impact beyond the project with partnerships and expanded internships

ND-ACES builds upon university-based scientific and translational research to increase capacity and competitiveness that will help drive the growth of ND's broad and emerging biosciences ecosystem. ND-ACES seeks to build North Dakota's research capacity to better understand design rules that govern *in vitro* biointerfaces and influence *in vivo* decisions surrounding the understanding of biochemistry and the cell biology of cancer cells and tumors. ND-ACES expands capacity by leveraging investments to generate new knowledge and increase ND's competitiveness in this arena.

Researchers within ND-ACES' Center for Cellular Biointerfaces in Science and Engineering (CCBSE) will work collaboratively to use computational modeling to achieve an improved interdisciplinary and convergent understanding of biological and engineered materials biointerfaces as related to cancer and cancer metastasis; expand expertise in novel cellular growth and analysis paradigms for mimicking the *in vivo* environment; catalyze research/computing capabilities; support the translation of research into use through products, partnerships, and collaborations with various stakeholders; and, inform ND's citizens.

To address the clinical need for more robust *in vivo*-like biointerfaces, CCBSE will rely on a coordinated effort across three pillars of scientific inquiry: 1) materials design at biointerfaces; 2) cellular systems at materials interface; and, 3) computation, machine learning, and predictive modeling. Computationally created design rules can enhance predictability of cellular responses to material surface characteristics and provide fundamental information to address many bioscience challenges. Thus, the integration of computational modeling as a prominent research tool allows for more extensive testing than possible with trial-and error methods. This acceleration of the design, manufacture, and validation stages not only provides quicker materials authentication for use in biologic applications to produce more *in vivo*-like behaviors but also offers a more streamlined laboratory method of predicting cellular responses while creating a directed workflow that expedites progress.

Industry and medical sector growth points to the tremendous potential of the bioscience sector within ND. Thus, in concert with CCBSE activities, ND-ACES will expand North Dakota's emerging biosciences

capacity through a STEM-enabled, well-trained workforce through the work of Promoting Sustainable Partnerships in Education and Research (PROSPER). PROSPER's efforts will incorporate both faculty and students at all participating institutions in collaborative research, early career development, education enhancement, and outreach to increase the abilities of early career faculty, increase advanced scientific computing capabilities, and broaden the participation and number of STEM undergraduate and graduate students. ND's K-12 sectors are also crucial to a sustainable ND STEM pathway; thus, another key component will be education and outreach in rural and tribal K-12 schools. Teachers, particularly those in grades 6-12, will receive tools to expose and engage their students in biosciences inquiry. Additionally, a suite of communication activities will engage, inform, and educate ND stakeholders and citizens, and national audiences about ND-ACES scientific and outreach efforts. Finally, to bring the new knowledge and companion products to industry, focused activities will build or expand on existing collaborative industry/medical partnerships. This i

ND-ACES Partnerships and Collaborations

The goal of the Partnerships and Collaborations (P&C) element is to ensure sustained educational and economic impact beyond the ND-ACES project. This goal will be realized through a variety of activities that assist ND-ACES researchers in forming partnerships and collaborations (particularly with industry in North Dakota and the region) and promoting North Dakota's research competitiveness, innovation, and bioscience pipeline development.

ND-ACES **internal collaborations (collaborations-I)** are relationships between ND-ACES participants, which have produced an ND-ACES related output/product (e.g., publication, patent, proposal, testing agreement, educational module/utilized lesson plan, etc.).

ND-ACES **external collaborations (collaborations-E)** are relationships between ND-ACES participants with non-ND-ACES participants/researchers at other not-for-profit academic institutions or national laboratories that has produced an ND-ACES related output/product (e.g., publication, patent, proposal, testing agreement, lesson plan/educational module). There are several types of external collaborations:

- Jurisdictional – a collaboration with an individual/researcher at a not-for-profit academic institution (located in North Dakota), which has produced an ND-ACES related output/product.
- National - a collaboration with a researcher at a not-for-profit academic institution or national laboratory (located outside of North Dakota), which has produced an ND-ACES related output/product.
- International - a collaboration with a researcher at a not-for-profit academic institution or laboratory (located outside of the United States), which has produced an ND-ACES related output/product.

ND-ACES **partnerships** is a relationship between a ND-ACES participant and an individual(s)/ researcher(s) within industry, economic development entities, or regional bioscience or health research organizations that has produced an ND-ACES related output/product (e.g., publication, patent, proposal, testing agreement, educational material, etc.).

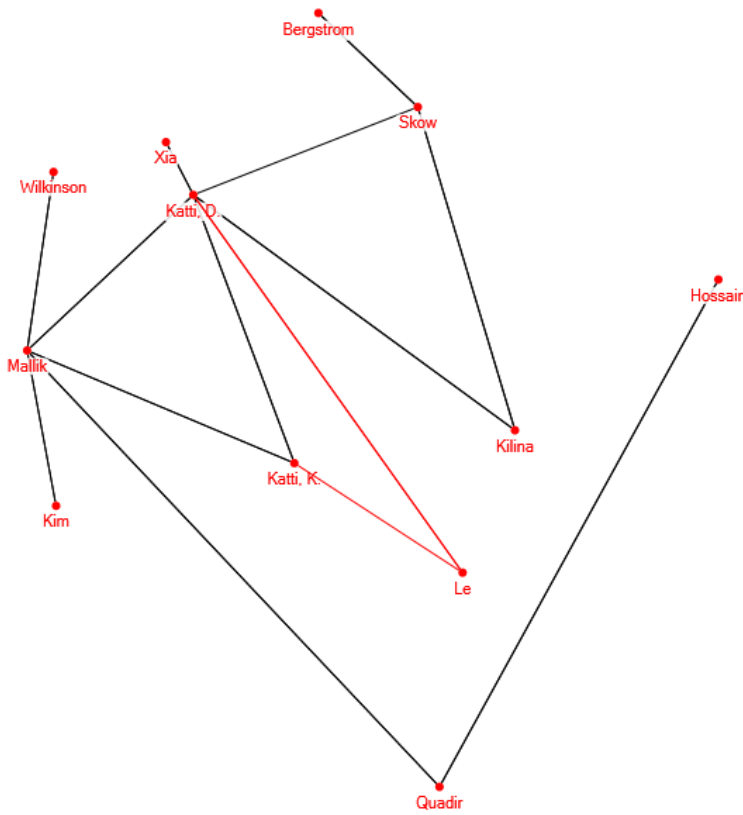
Baseline ND-ACES-related Collaborations (I and E) and Partnerships

The P&C team asked ND-ACES senior personnel to participate in three baseline surveys to document relationships (collaborations [I and E] and partnerships) existing prior to the start of the cooperative

agreement (July 1, 2020), and which had produced a ND-ACES topic related output/product (e.g., publication, patent, proposal, testing agreement, educational module, etc.).

ND-ACES Baseline Collaborations-I

Prior/existing relationships between ND-ACES senior personnel were measured during the ND-ACES strategic planning session (Figure 1). Thirty-four of the 42 ND-ACES senior personnel (>80%) reported prior collaborative relationships with other team members which had produced a ND-ACES related output/product (e.g., publication, patent, proposal, testing agreements, and outreach programming). Twelve of 42 (>28%) of the 42 reported CCBSE-like collaborations (Figure 1) and 24 of the 42 (>57%) reported PROSPER-like collaborations (Figure 2). Two of 42 reported collaborations with other ND-ACES team members in both CCBSE and PROSPER categories.



In the three years prior to ND-ACES, senior personnel reported receipt of 88 external awards totaling ~\$69.7M. Of those 88 awards, only two were collaborative (I) efforts between ND-ACES senior personnel (shown in red): 1) \$495,524 NSF campus cyberinfrastructure award (2018, #1826993, **Bergstrom and Skow**) and 2) \$884,596 NSF major research instrumentation and data cyberinfrastructure award (2020 #2019077, **Rasulev, Katti, D., Kilina, Hoang, and Skow**). [NOTE: Hoang replaced Skow as senior personnel on the ND-ACES cooperative agreement in February 2021.]

ND-ACES Baseline Collaborations-E

Prior/existing relationships between ND-ACES senior personnel and non-ND-ACES participants/ researchers at other not-for-profit academic institutions or national laboratories were measured during the first month of the NSF RII Track-1 cooperative agreement. Prior to the

Figure 1. ND-ACES related baseline CCBSE collaborations-I.

start of ND-ACES (July 1, 2020), 16 ND-ACES senior personnel reported 35 unique collaborations across 20 academic institutions (Figure 3). Of those institutional collaborations, three were internal to the state (designated by the green line in Figure 3) and 17 were external to the state. Of the 17 external institutional collaborations, 16 were domestic (within the United States, designated by the blue line in Figure 3) and one was international (designated by the yellow line in Figure 3).

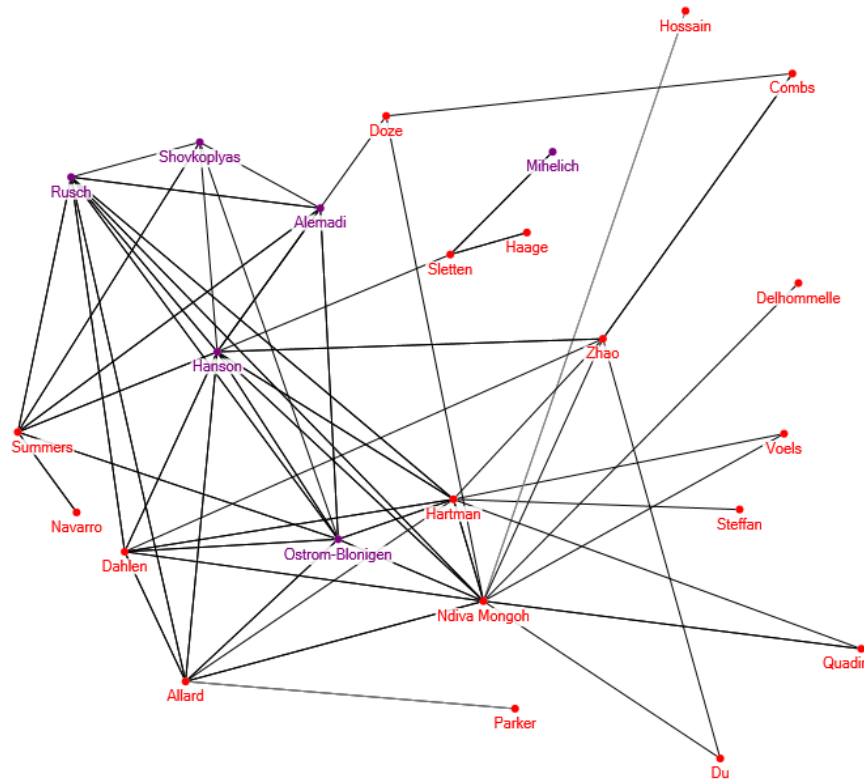


Figure 2. ND-ACES related baseline PROSPER collaborations-I (ND EPSCoR State Office staff and PI/Co-PI designated in purple).

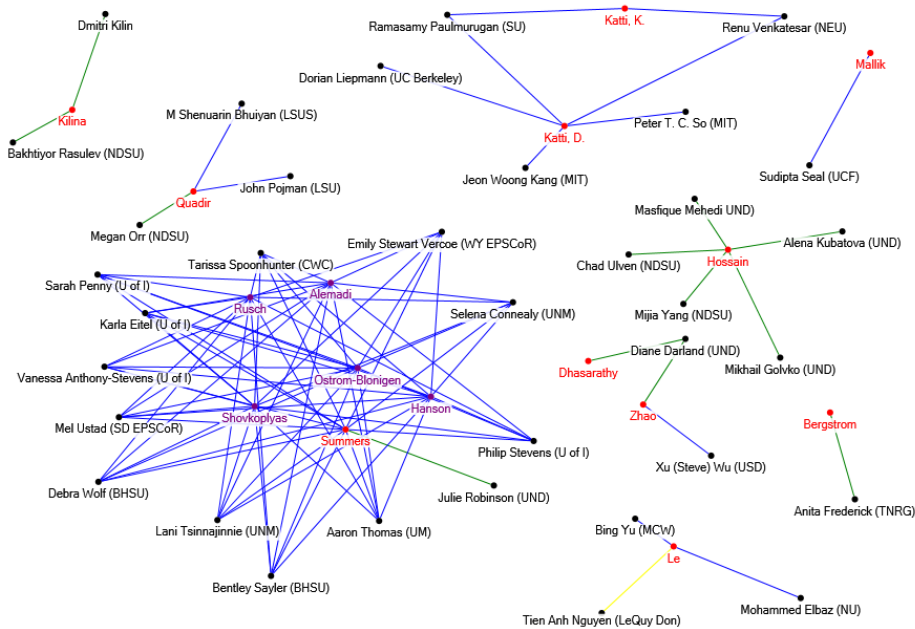


Figure 3. ND-ACES baseline collaborations-E (ND-ACES personnel are in red and purple [ND EPSCoR State Office staff and PI/Co-PIs] and external collaborators are in black).

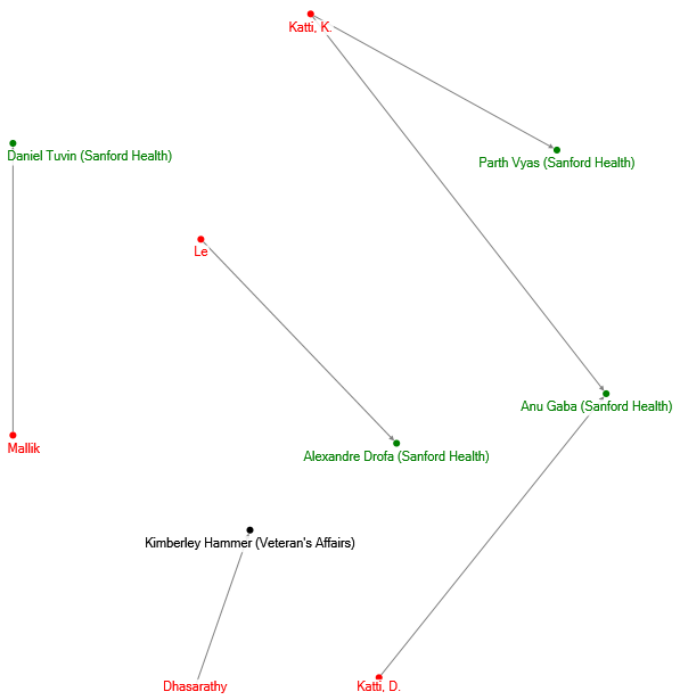


Figure 4. ND-ACES related baseline partnerships (ND-ACES personnel are in red) and partners are in green.

ND-ACES Baseline Partnerships

Prior/existing relationships between ND-ACES senior personnel and individual(s)/researcher(s) within industry, economic development entities, or regional bioscience or health research organizations were also measured during the first month of the NSF RII Track-1 cooperative agreement. In this survey, five ND-ACES senior personnel reported five unique partnerships with two Fargo, ND-based organizations (Figure 4): 1) Sanford Health (four partnerships, shown in green) and 2) Veteran’s Affairs (one partnership, shown in black).

Year 1 Partnerships and Collaborations Summary

Throughout Year 1, the P&C team met with subject matter experts at the state’s research universities (North Dakota State University and the University of North

Dakota) to determine a plan for Year 2 P&C communication efforts, to identify commercialization protocols, and to promote the enrollment of ND-ACES participants in [SHARPhub](#) - a National Institutes of Health (NIH) Small Business Technology Transfer (STTR) grant that “provides resources and assistance to help turn early-stage life sciences technologies into viable startup companies” within Kansas, Nebraska, Oklahoma, North Dakota (through the University of North Dakota), and South Dakota. As of June 30, 2021, five of the 27 CCBSE senior personnel had enrolled in SHARPhub. The Year 1 metric was to have 25% (6-7 CCBSE researchers) enrolled. The P&C team will work closely with the CCBSE senior personnel in Year 2 to determine the obstacles that prevented CCBSE researchers from enrolling.

During Year 1, the P&C team developed a panel workshop, *ABC’s of Patents and Commercialization Roundtable*, for the ND EPSCoR Annual State Conference in April 2021. Panel participants included Holly Gabriel, MPH, MLS, Business, Government Documents, & Patents Librarian, housed at UND; Jolynne Tschetter, Ph.D., Executive Director, Industry Engagement & Intellectual Property, NDSU; Amy Whitney, Ed.D., MBA, Director, Center for Innovation, UND; and Brian Kalk, Ph.D., Executive Director, Research and Technology Park, NDSU.

Finally, due to the COVID-19 pandemic, many ND-ACES participating institutions closed for a period of time (3 primarily undergraduate institutions [PUIs] and 1 master’s college/university [MCU]) or remain closed (4 tribal colleges/universities [TCUs]), which delayed P&C efforts to confirm IP protocols or to work with the TCUs to better understand how tribal laws impact IP disclosures. The pandemic also delayed conversations with the other EPSCoR states participating in SHARPhub.

Year 2 Partnerships and Collaborations Plans

The P&C plan for Year 2 includes:

1. Repeat the team collaborations (I and E) and partnerships surveys to demonstrate ND-ACES Year 1 progress against the baselines (Figures 1, 2, and 3). The surveys will be sent the week of July 12, 2021.
2. Support ND-ACES participant interactions with external collaborators (including those in other SHARPhub states) through travel funding.
3. Continue to work with the participating campuses to identify IP protocols; determine how inter-institutional, joint IP will be handled; and, identify impacts of tribal laws on IP disclosures with a goal of developing a ND-ACES prospectus for cultivating partnerships and exploring future external funding possibilities.
4. Work with Jolynne Tschetter, Ph.D., Executive Director, Industry Engagement & Intellectual Property, NDSU and Naomi Hansen, Director of Communication and Corporate Engagement, Office of the Vice President for Research and Economic Development, University of North Dakota to develop and hold three introductory virtual synchronous workshops for ND-ACES participants and other research faculty across the 10 participating campuses who wish to engage with industry. These workshops will be recorded so that they can be later viewed asynchronously by ND-ACES participants who are unable to attend. Our Y2 workshops are: 1) types of industry agreements, 2) student and faculty industry internships, and 3) partnering with industry. For workshop 2, the P&C team will discuss the potential inclusion of UND's Accelerate to Industry (A2i) program that targets graduate students and post-docs. The use of the A2i program would be in addition to the workshop. The workshops will be planned for mid-October (2021) through January (2022).