Celebrating the Present and Focusing the Future: Research, Creative Endeavors, and Innovation at NDSU

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Vice President - Office of Research and Creative Activity
Executive Director - North Dakota EPSCoR
June 4, 2018, Mayville State University,
NDSU’s Position - Present and Future

- Research Landscape
- Creating Solutions to Complex Problems
- Nontraditional Funding Sources
- Faculty and Students
- Institutional Core Facilities
- Economic Development
Research Landscape
Research is an ecosystem that advances scientific inquiry, learning, and innovation

Research is core to a university’s mission

• Enhances student learning, retention and success
• Fosters faculty excellence
• Drives discovery and new knowledge [basic]
• Provides solutions to meet societal needs [user-inspired basic and applied]
• Facilitates knowledge/technology transfer
• Cultivates innovation
• Guides cultural learning

An ecosystem of deep thinkers, communicators, and collaborators
Today’s Higher Education Landscape Relies on Strong Partnerships between Communities and Universities

Change is the new normal - need to be contemporary and non-traditional in strategies to move forward

Innovation, agile, hub, networks, partners, entrepreneur, changed boundaries, fluidity, systems thinking, flexibility, actionable data, courage, synergy, adaptive, trust
The Landscape has Changed

Higher Education Research and Development Expenditures

(in billions; not adjusted for inflation)

Federal funds account for only ≈ 54% of all funding (2016) versus 61% in 2010

The Landscape has Changed

Implications & Opportunities
- Institutional funding - unstable
- Federal agencies – look for diversification opportunities
- Industry – opportunities exist
- Nonprofits – opportunities exist [including philanthropy]

Actions
- Support and training for researchers to pursue nonfederal funding sources – more outcomes based
- Align strengths with new federal opportunities
- Strengthen G-U-I-F partnerships

$ for basic research dropped from 68% to 64% (2010 vs. 2016)
$ for applied research increased from 25% to 28% (2010 vs. 2016)

Source: EAB, 4 Things CROs can Learn from Higher Ed R&D Survey, January 30, 2018
Today’s Greatest Challenges are More Complex

- How research offices support basic to commercialization
- How we create interdisciplinary/transdisciplinary teams
- How we think about faulty hires
- How we train our students
- How we develop partnerships external to campus
- How we move products to the private sector

Actions
- Support and training for collaborative teams
- Create integrated campus efforts
- Engage external constituents in long-term partnerships
- Function as innovation and entrepreneurial hub
Basic research is a bedrock of the research enterprise
How do we catalyze and develop collaborations to create sustainable and impactful efforts?

Individual investigation will always be an important part of an university, but it can no longer alone sustain the research enterprise

- Financially
- Problems are growing too complex
- Public pressure for impact and benefit
- Alternative funding sources are outcome based

Moving University Research Forward

ND Interim Higher Education Committee
New Pathways Forward

Engagement

HIBAR

Pasteur

Bohr

Edison

Research, Science & Technology
HIBAR: Transforming Research
The Highly Integrative Basic and Responsive (HIBAR) Research Alliance is a network of research leaders who believe that universities can improve research outcomes and increase benefits to society by engaging theory with practice for transformative solutions.

The New ABCs of Research

Context

- Immense Problems
- New Technologies
- Raised Ambitions

Guiding Principles

- Applied & Basic Combined
- Science, Engineering & Design

Lifecycle Strategies

- Choose actionable problems: civic, business & global priorities
- Apply observation, intervention & controlled experiments
- Form teams with diverse individuals & organizations
- Test ideas & prototypes with realistic interventions
- Promote adoption & assess impact

New Knowledge

- Solutions
- Theories

Creating Solutions to Complex Problems
Creating Solutions to Complex Problems

1. Food systems and security
2. Healthy populations and vital communities
3. Sustainable energy, environment, and societal infrastructure
Nanotechnology for Healthier Food

STUDY: Center for Technology Research for Agricultural Food Safety and Security under Changing Global Climate

- Approximately 2 million people across the globe suffer from iron deficiency with the majority being women in reproductive age
- This study has produced tangible results in terms of producing new nano-based fertilizers that can fortify crops with Fe, Zn, and Se (much needed micronutrients in human diet)
Center for Engineered Cancer Test Beds

**Challenge**
Current drug delivery techniques do not work once cancer has metastasized. Developing new drug delivery therapies is very time consuming.

**Solution**
Develop and implement engineered cancer test beds combined with advanced scientific modeling to reduce development time of new drug therapies.
Center for Engineered Cancer Test Beds

biology
- computational
- cancer manufacturing
- mechanobiology
delivery sociology cellular
modeling sensors systems
scaffold
- engineer drug visualization
- materials medical marketing
- biomedical multi-scale communication
Center for Engineered Cancer Test Bed
In vitro Creation of Prostate Cancer Metastasis

Prostate cancer tumor on bone site - Different components of cytoskeleton in a tumoroid

Single Cancer Cell on Scaffold

Cybersecurity Research Capabilities at NDSU

- Cyber range operational
- Contained and secure experimental facility
- First of its kind in North Dakota
- Remotely accessible from anywhere in state
- Supports a wide range of experimental cybersecurity research
- 100+ experimenters can simultaneously use the Cyber Range
- Containment technology to avoid experiments running out of control
- Project on secure storage to ensure privacy of records is underway
- Support from Department of Defense, Cisco, NDSU ITD
Graduate Certificate in Cyber Security

- Collaboration with Minot State University, the University of North Dakota, and NDSU to provide a graduate certificate in cyber security
- Provides students a broad foundation of cyber security training
- Composed of three core courses, one at each of the collaborating institutions, and one elective course
- Designed for working practitioners or to be pursued concurrently with other graduate studies
NDSU UAS Projects

College of Agriculture, Food Systems, and Natural Resources, Experiment Station, and Extension Service

Remote sensing in precision agriculture
- Plant emergence and populations
- Nutrient management
- Weed and pest infestations
- Disease detection
- Livestock management

Department of Geosciences
Researchers use unmanned aircraft for survey of a rock glacier in Great Basin National Park

Department of Visual Arts
Aerial Photography Course Offered first time fall 2017

Department of Biological Sciences and USDA National Wildlife Research Center
Researchers studying use of UAS as a nonlethal hazing tool to disperse flocks of blackbirds from sunflower fields

Photograph by Dr. Page Klug
Nontraditional Funding Sources
Nontraditional Funding Sources

Integrated Corrosion Testing System

Development of amphiphilic, siloxane-based fouling release coatings

Gray water fouling research

High performance bio-based non-isocyanate polymer material systems
Faculty and Students
Graduate Student Research Achievements

Jackie Stenehjem’s research predicts mosquito breeding habitat areas

Pharmaceutical sciences graduate student Farnaz Fouladi wins Three Minute Thesis competition

Mihiri Mendis’ paper is one of the most viewed on the American Association of Cereal Chemists website

Maneka Malalgoda wins the 2017 Walter Bushuk Graduate Research Award in Cereal Protein Chemistry

Shelly Davis awarded Northwest Native American Research Centers for Health fellowship

2018 National Science Foundation Graduate Research Fellow Kurt Williams
Why Undergraduate Research?

- Promotes the development of critical thinking and problem solving skills
- Provides opportunities for networking and public speaking
- Offers a powerful career development opportunity
- NDSU undergraduates who engage in research report significantly higher levels of satisfaction with their overall academic experience, a better connection to faculty, and an increased feeling of being valued on campus
NDSU Explore

A program dedicated to promoting undergraduate research at NDSU

• Annual showcase of undergraduate research and creative activities
• Funding for undergraduate research projects
• Undergraduate research week filled with opportunities for professional development.
Undergraduate Research Projects
Undergraduate Research Space – JPL Research Management

- Project in conjunction with NASA JPL research staff
- NDSU students working to develop a prototype system that will help JPL provide research opportunities for students nationwide
- Multi-phase project
  - System research / design / development
  - Testing and benefit characterization
  - Refinement and repeat assessment
Engineering Grand Challenge Scholars Program

Goal: create the next generation of innovators and entrepreneurs

- Students recruited freshman year – an honors program
- Mentored by faculty though entire academic career
- Currently 15 scholars working on cutting edge research
- NDSU’s program is one of only 36 in country
Institutional Core Facilities
The NDSU Institutional Core Facilities provide centralized shared university resources including instruments, labs, and expertise to support research, education, and economic development.
Research Operations Recharge Center

- Microfabrication Laboratory
- Device Packaging Laboratory
- Reliability and Failure Analysis Laboratory
- Materials Characterization and Analysis Laboratory
- Device Testing Laboratory
- Materials Research Laboratory (Synthesis and Processing)

145 instruments in the Recharge Center

~ $30M of installed equipment
Research Operations Recharge Center Impact

- 9,960 Samples Processed
- 4,872+ Hours of Equipment Use
- 1200+ gallons synthesized in material scale-up reactors
- 75 Internal Users
  - 3 NDSU Colleges from 10 Departments
- 15 External Users Entities
  - 12 Private Sector, 3 Academic
- Lab Sessions Provided for 3 Academic Courses

July 2016 – June 2017

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Research Operations Recharge Center Projects

NDSU power electronics research group investigating ultra-efficient power delivery architectures for data centers and solar farms. Collaboration with Google.

High Density Power Delivery Prototype Assembled in cleanroom

NDSU researcher developing soy-based material for road dust control applications. Applied to segment of Cass County rural road for testing.

Scale-up reactor vessels to produce pilot project volumes.

Uniqarta Inc., a start-up company is developing innovative new electronic manufacturing technology for microLED display and other electronic markets. Licensed NDSU technology and utilize NDSU cleanroom on fee basis.

NDSU nanomaterials sensor research group developing sensor to quantify acetone in breath as an indicator of Type 1 diabetes.

Sensor prototype fabricated in cleanroom
Electron Microscopy Center

- Facility provides researchers electron microscopy services from project design to publishable data
- Imaging and analysis of a wide variety of samples types from biological to materials
- Only electron microscopes and x-ray MicroCT available to all institutions in the NDUS with expert Electron Microscopy support
- Most effective and efficient model for high-cost electron microscopy instrumentation
Economic Development
Economic Development

Engage with authenticity

Proceedings of a Workshop
IN BRIEF

MARCH 2018

Revitalizing the University-Industry-Government Partnership: Creating New Opportunities for the 21st Century
Proceedings of a Workshop—in Brief
Sponsored Research - Private

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Growth of research funding over time with individual companies

Company 1

Company 2

Company 3

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Invention Disclosures by Year
Contracting Models

**Traditional Model**
- Sponsor receives an option for an exclusive license that grants rights to commercialize any technology that is developed in the performance of the research
- Payment of patenting costs and royalties are negotiated after IP is developed

**Assessment NERF (Non-Exclusive Royalty-Free)**
- Sponsor receives a limited term (max 5 year) commercial, non-exclusive, royalty-free license in a defined field of use and also receives an option to extend the license at a commercially reasonable rate after the initial term. No sublicensing rights are granted to sponsor.

**Option NERF (Non-Exclusive Royalty-Free)**
- Sponsor receives a commercial, NERF license in a defined field of use for the life of the patent and has the option to an exclusive, royalty bearing license. Option must be exercised within six months of the initial disclosure of the invention. No sublicensing rights are granted to sponsor.
- Issue fee: 5% of total project costs ($7,500 minimum)

**Advance License**
- Sponsor will be entitled to an exclusive, sublicense-able, commercial license within a defined field of use.
- License is royalty-free until annual sales reach $20M, at which time a royalty rate of 1% on annual net sales will commence.
- Issue fee: 10% of total project costs ($15,000 minimum)
Research and Technology Park

Park Tenants
- Appareo
- John Deere Electronic Solutions
- Candlewood Suites
- NDSU R1, R1A, R2 Buildings

Support Companies
- Bank of ND
- Small Business Development Center
- MinnDak Computers

Anchor Tenant
- Bobcat

Software
- Omnibyte
- Harvest Profit
- MCP Networks
- Genesis Feed
- FarmQA

Drone Technology
- Field of View LLC
- Project Phoenix
- Flight Pros

Marketing
- OpGo
- Go/Do
- Probitas Promotions

Materials/Coatings
- Red Diamond Coatings
- Renuvix LLC
- Elinor Specialty Coatings

Technology
- Be More Colorful
- Intelligent Malt
- Summers Manufacturing
Research and Tech Park Economic Impact

Total Salaries: $85,158,744
Average Salary: $63,614

Research Park Employees

- NDSU Graduates 37%
- NDUS Graduates 15%
- Other 48%

Student Interns: 107
60% NDSU Students

Research Park Employment

- 2010:
  - NDSU Graduates: 286
  - Total Employment: 893

- 2015:
  - NDSU Graduates: 489
  - Total Employment: 1339

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Value-Added Services

• Coaching/Mentoring
• Student Employee Program
• Educational Events/Forums
• Access to Capital
• Relationships/Networking
• Innovation Challenge
• Innovate ND Entrepreneur Grants
The Innovation Challenge

- Annual contest for NDSU Students
- Three competitive tracks with three rounds of competition
  - $5,000/track, $20,500 total
- 5 student startup companies
- Current year
  - 2 definite company startups
  - 9 potential startups
  - Increase supported by new NDSU curriculum in entrepreneurship
Innovate ND Program

- Dept. of Commerce Program
- Administered by local Entrepreneur Centers
- Three phases of up to $24,000 for each startup company
- Dr. Jeff Stamp entrepreneurial training – online and in person boot camp
- Of 60 companies in Fargo in first biennium, roughly 2.3 jobs created per company.
- 182 companies, roughly 40% in Fargo region
- Statewide Funding
  - Total Entrepreneur Grants - $2.25 M (down from $3.25M)
June 2018 Incubator Graduates

**c2renew**
NDSU Faculty startup in renewable materials

**Discovery Express**
Innovation Challenge student winner instilling passion for STEM in elementary age children
Collaborations across the Country

Collaborations based on this slide deck
Thank you