NDSU NORTH DAKOTA STATE UNIVERSITY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

ANNUAL REPORT
2018-19

A MESSAGE FROM THE CHAIR

As I pass the one-year anniversary of serving as the Chair for the IME department at NDSU I am overwhelmed with happiness. The staff, faculty and students have been outstanding in helping with the transition and have made me feel welcome. Despite the challenges of student enrollment, the department has seen the rewards of student recruitment in the fact that the enrollment for IME is growing. Thanks goes to the college for their help with student recruitment as well as faculty and students. The department recently purchased a series of banners and now have booths at the leading industry conferences and tradeshows, in which faculty and students volunteered their time for "booth duty". With the addition of resources for grantsmanship, the department has seen a growth in awarded grants, including a National Science Foundation grant for an Industry/University Cooperative Research Center on sustainable materials (CB^2, Center for Bioplastics and Biocomposites).

This past year the department also gained an outstanding new Assistant Professor, Dr. Trung Le (Tim). Tim has been very busy and wasted no time preparing successful grants and recently built a state of the art sleep study laboratory for his research on sleep and work place wellness. I am happy to see the entire junior faculty showing great progress in grantsmanship. Proposals for research in areas typically not related to IME are being submitted and awarded. For example, Dr. Nita Yodo was a co-PI on a grant from the North Dakota Corn Council, where she will be using her skills on Life Cycle Assessment (LCA) and Techno-Economical Analysis (TEA) to assure product acceptance of novel sustainable materials derived from North Dakota grown corn. I am delighted by the progress of our junior faculty.

We have also hired a Business Development Coordinator, Ben Deetz, who is not only supporting proposal development but also growing CB^2. He has been a corner stone in the department by supporting industry engagement, proposal development and budgeting. His addition, Ben has helped THE one person that keeps the department functioning, Beth Dahl. While she has been at NDSU for less than two years, she is everyone's go to person. I welcome all to stop by and say "hi" to Beth, Ben and I as well as all of us.

We look forward to the challenges of the upcoming new academic year and are excited to see new students coming into the department as well as seeing our seniors graduate and move onto highly successful careers. The success of our students speaks volumes to the dedication of staff and faculty. I feel extremely grateful and have realized just how fortunate I am to be working in a department that is so welcoming and where the faculty and staff are overwhelmingly passionate about what they do.

David Grewell
Professor/Department Chair/CB^2 Center Director

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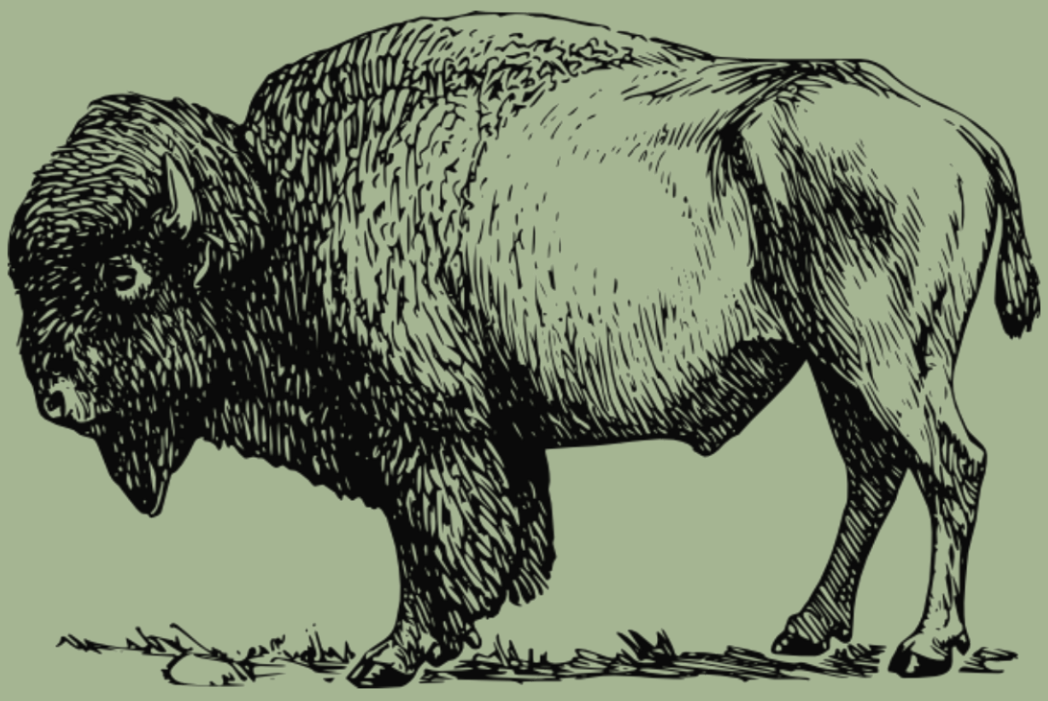
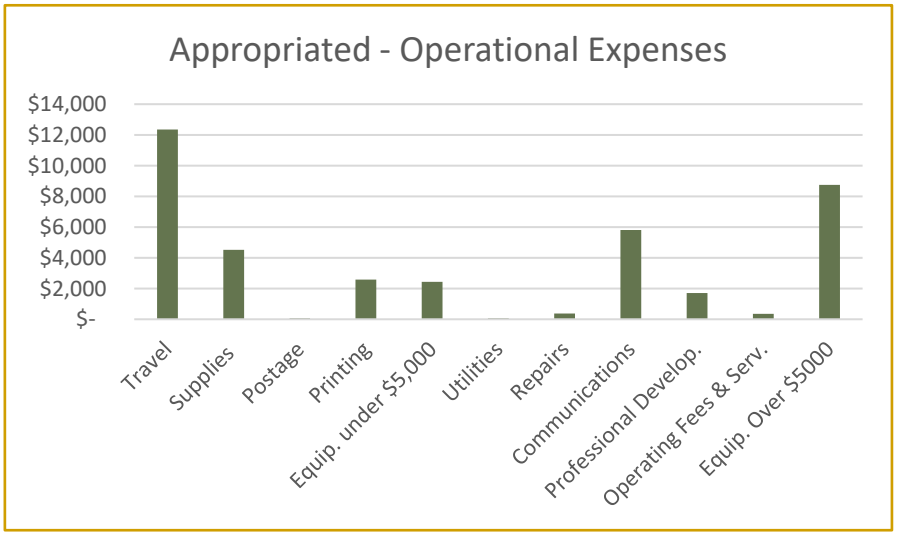


DEPARTMENTAL BUDGET

Financial Report as of June 30, 2019

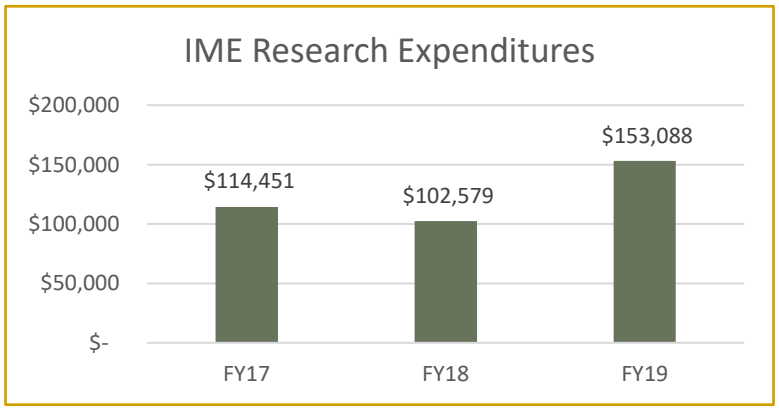
PS Fund	Title	Beginning Balance as of 7/1/2018	YTD Revenue	YTD Expense	Ending Balanc as of 6/30/2019
30134	Appropriated - Operations	$ 45,085.00		$43,982.80	$ 1,102.20
30312	Differential Tuition - Operations	$ 24,760.14		$9,493.73	$ 15,266.41
30540	Provost fund in lieu of lab fees	$ 4,211.00		$4,211.00	$ -
30922	Summer School allocation from 2018	$ 4,000.00		$1,557.35	$ 2,442.65
18052	IME General Fund	$ 1,991.52	$26,935.29	$1,400.00	$ 27,526.81
18337	Indirects	$ 45,063.96	$16,389.69	$11,461.09	$ 49,992.56
18428	Capstone	$ 52,953.66	$5,000.00	$15,607.84	$ 42,345.82
18837	CB² - Grewell & Dean	$ -	$5,400.00	$4,512.50	$ 887.50
19173	IME QRME - Yadav	$ 78,791.86	$13,294.90	$7,581.51	$ 84,505.25
Total Appropriated and Local Funds:		**$256,857.14**	**$67,019.88**	**$99,807.82**	**$224,069.20**
22110	Machine Shop	$20,543.84	$11,843.27	$8,991.82	$ 23,395.29
Total for Machine Shop:		**$20,543.84**	**$11,843.27**	**$8,991.82**	**$23,395.29**
79787	Marvin Windows (restricted for student use)	$ 17,410.50	$5,000.00	$0.00	$ 22,410.50
Total Restricted Gift Funds:		**$17,410.50**	**$5,000.00**	**$0.00**	**$22,410.50**
30081	IME Department Fund	**$36,784.37**	**$8,978.01**	**$2,157.91**	$ 43,604.47
30143	Robotics & Control Lab	**$2,437.20**	**$0.00**	**$0.00**	$ 2,437.20
30144	IME Labs	**$6,113.79**	**$0.00**	**$0.00**	$ 6,113.79
30216	IME Scholars Fund	**$0.00**	**$0.00**	**$0.00**	$ -
30491	Heller, Robert & Diane CQRME Fund	**$95,095.00**	**$0.00**	**$0.00**	$ 95,095.00
30512	Vettel Family IME Fellowship	**$0.00**	**$31,578.95**	**$1,578.95**	$ 30,000.00
40135	Vettel, IME Department Endowment Fund	**$2,312.00**	**$773.00**	**$0.00**	$ 3,085.00
Total Spendable IME Founadation Funds:		**$142,742.36**	**$41,329.96**	**$3,736.86**	**$180,335.46**
Total FY19 Revenue/Expenditures		**$420,143.34**	**$120,193.11**	**$112,536.50**	**$427,799.95**



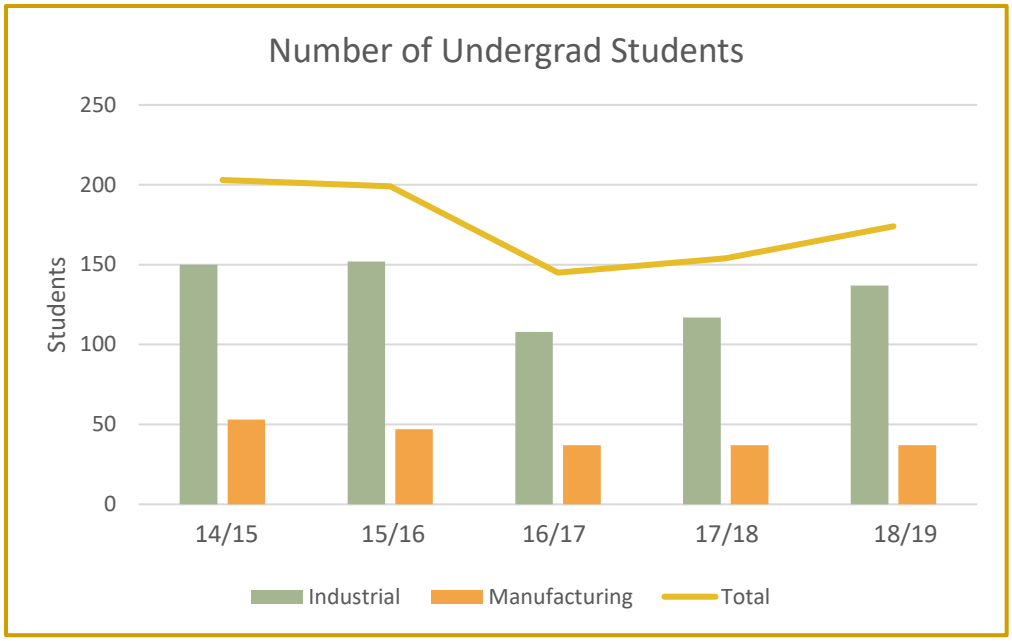
FACULTY STATISTICS (2018 Calendar Year)

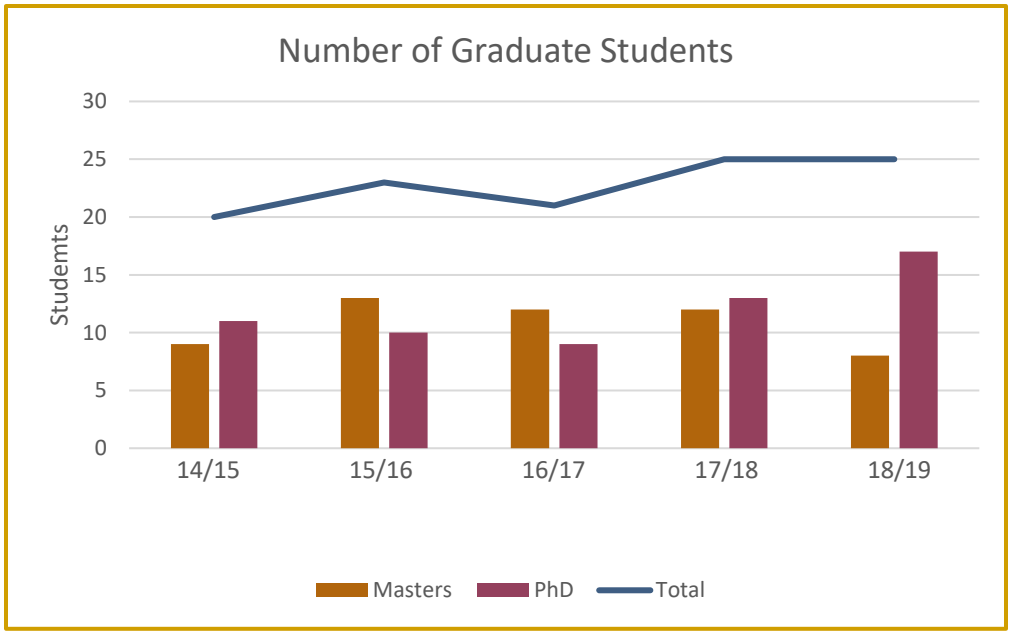
Faculty Statistics for Calendar Year 2018

Scholarly Activities	Total
Peer reviewed journal papers appearing in print this calendar year	16
Journal papers in review	11
Conference papers appearing in print	28
Books appearing in print	3
Patents issued	1
Annual research reports completed and submitted	8
Plenary, invited or keynote lectures given	15
Conference Leadership roles	7
Total:	**89**
Teaching and Advising	
Direct Instruction	14
PhD students supervised	19
PhD as a committee member	20
MS students supervised	6
MS as a committee member	9
Undergraduate students advised	177
Student Organization advising	
Total:	**231**
Project Proposals	
Submitted proposals	22
Awarded proposals	8
Total funds on submitted proposals	$ 7,927,701.00
Total awarded amount	**$ 579,283.00**

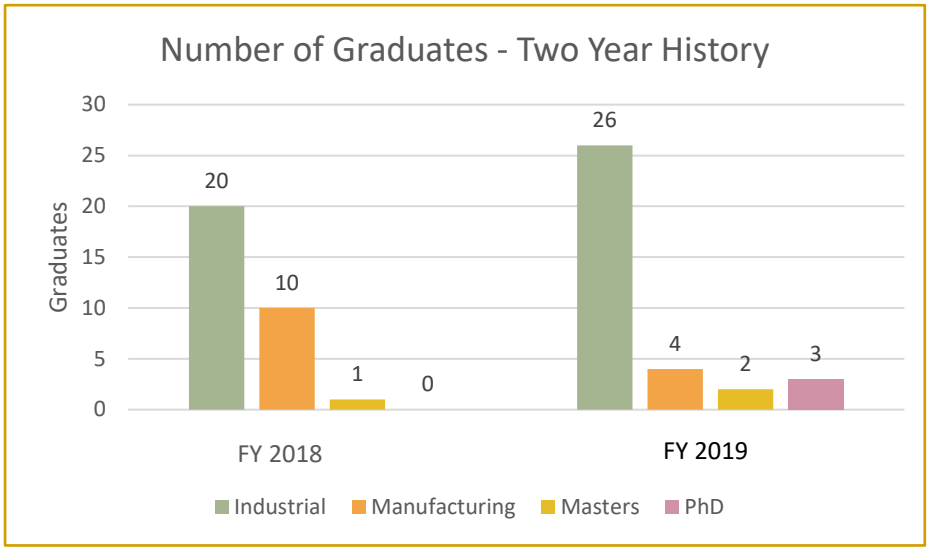


ENROLLMENT NUMBERS



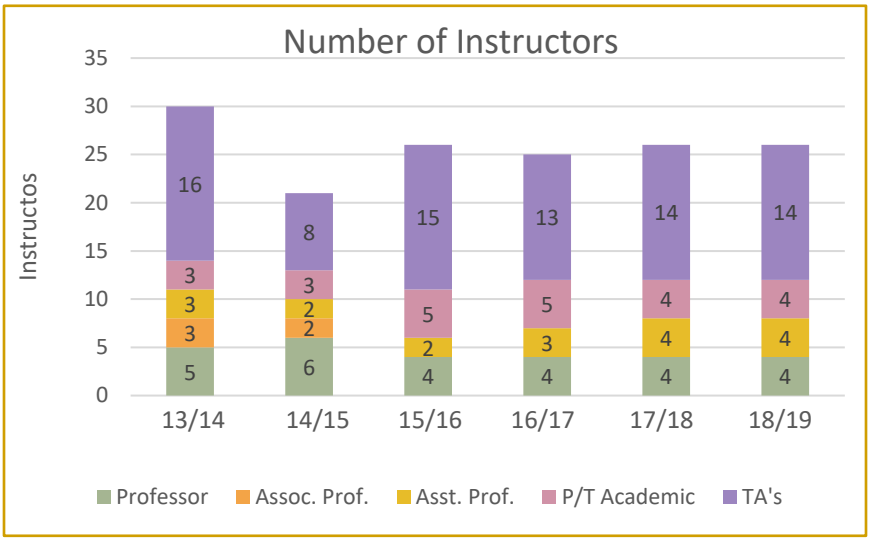


GRADUATES



NAME	DEGREE YEAR	TITLE	DEGREE TYPE
AMM NAZMUL AHSAN	2019	Form and Functionality of Additively Manufactured Parts with Internal Structure	Ph.D.
MAHMOUD MOSTAFA	2019	ISO 9001: 2015 Quality System Manual Development and Implementation for Business and Commerce with Expanded Emphasis on Risk Management	M.S.
AHASAN HABIB	2019	Designing Bio-Ink for Extrusion-Based Bio printing Process	Ph.D.
SHAH LIMON	2019	Assessing Reliability of Highly Reliable Products Using Accelerated Degradation Test Design, Modeling, and Bayesian Inference	Ph.D.
TANZINA AFRIN	2019	Resilience Assessment for Complex Networks Based on Recovery Strategies	M.S.

PERSONNEL



Staff	
Charles Choate	Laboratory Supervisor/Instructor
Beth Dahl	Assistant to Department Chair
Ben Deetz	Business Develop. Coord. (CB^2)
Armon Myrick	Laboratory Supervisor/Instructor

Part-time Academic – Courses Taught	
Maisha Asha	On-line Engr. Economy
Jim Misialek	Intro to IME & Project Mgmt.
Connie Rokke	Total Quality
Dennis Steinman	Senior Capstone

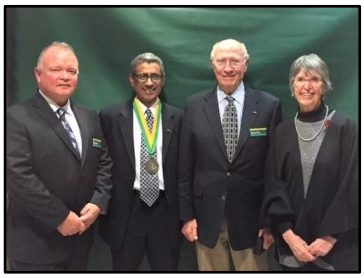
Faculty	
David Grewell	Department Chair, Professor
Canan Bilen-Green	Professor, Vice Provost of Faculty Affairs
Kambiz Farahmand	Professor
Bashir Khoda	Assistant Professor
Trung (Tim) Le	Assistant Professor
Val Marinov	Professor
Yiwen Xu	Assistant Professor
Om Prakash Yadav	Professor
Nita Yodo	Assistant Professor

AWARDS

Dr. Grewell Awarded Walter B. Booth Distinguished Professorship

David Grewell was awarded a Walter B. Booth Distinguished Professorship.

Dr. Om Yadav Appointed Duin Endowed Fellow



Om Yadav was named the inaugural holder of the Spencer G. and Carol A. Duin Endowed Fellowship during a ceremony at the NDSU McGovern Alumni Center. NDSU benefactors who establish faculty fellowships provide a minimum of $30,000 in annual funding for at least five years. The money is used by faculty to advance research, provide students transformational learning experiences and enhance academic programs.

Beth Dahl Receives Staff Recognition Award

Beth Dahl received the NDSU 2019 Staff Recognition award. NDSU President Dean Bresciani presented her with the award at the Staff Recognition social in May.

Ameneh Shahraki Awarded SRE Scholarship Award

IME PhD student, Ameneh Shahraki, received a scholarship from SRE (Society of Reliability Engineers). As a part of the award, SRE covered the entire expense for Ameneh to attend the Reliability & Maintainability Symposium (RAMS) and present her paper.

Ameneh Shahraki Receives the Glomoski Best Paper Award

IME PhD student, Ameneh Shahraki received the Glomoski Best Paper Award for her collaborative work on a paper with Dr. Om Yadav. They presented their paper titled “Selective Maintenance Optimization for Multi-state Systems Operating in Dynamic Environments.”

Satpal Wadhwa Awarded Best Agricultural Transportation Paper Award

IME Ph.D. student, Satpal Wadwha, received the Best Ag Transportation Paper Award. His paper, "An Agent Based Simulation Model for Inland Hard Red Spring Wheat to Determine the Impact of Market Factors on Wheat Flows" described research that explored the impact that market factors, such as rail rates and farm storage costs, have on market flows.

2019 SENIOR CAPSTONE PROJECTS

Company	Project	Students
Fast Manufacturing	Machine Design and Process Improvement	Sopan Seth, Hassan Farah, Jake Gerecke and Matthew Schiroo
D&M Industries	Facility Layout Improvement	Bailey Kemper, Tiahna Burian, Lauren Kopel and Mitchell Roberts
SUPERVALU Distribution	Facility 5S Analysis and Implementation	Jason Cary, Reid Groninger, Tristan Benson, Jacob Riebel, and Camron Roehl
TSR Parts	R&D Manufactured	Timothy Straus, George Lagat, Samuel Andrusick and Taylor Farber
BTD Manufacturing	Material Handling Productivity Improvement Analysis	Andrew Roth, Lucas Bobier, Jason Spano, Mohammed Bin Jadnan and Hassan Almuzel
Felling Trailers	Decal Printing In-House Analytics	Ethan Lochner, Nathan Maciej, Theodore Zipoy, Jacob Crosby and Morteza Khavari
BSE Supply Chain Solutions	Warehouse Inventory Slotting System Analysis	Macensie Lange, Olivia Gravel, Lucas Johnson, Anna Bieganek, and Joseph Garty
Action Fabrication	ROI Analysis on New Equipment Purchase	Matthew Pavlicek, William Spaulding, Luke Selken, Shi Ho and Taylor Waln

1st Place – Border States

2nd Place – TSR Parts

3rd Place – D&M Industries

RESEARCH FOCUS AREAS - OVERVIEW

Advanced System Engineering Laboratory

ASEL focuses on the multidisciplinary development of theories, methodologies, and applications in designing safer, more resilient, sustainable (longer-lasting), and lower-cost engineered systems.

Current research thrusts in ASEL include:

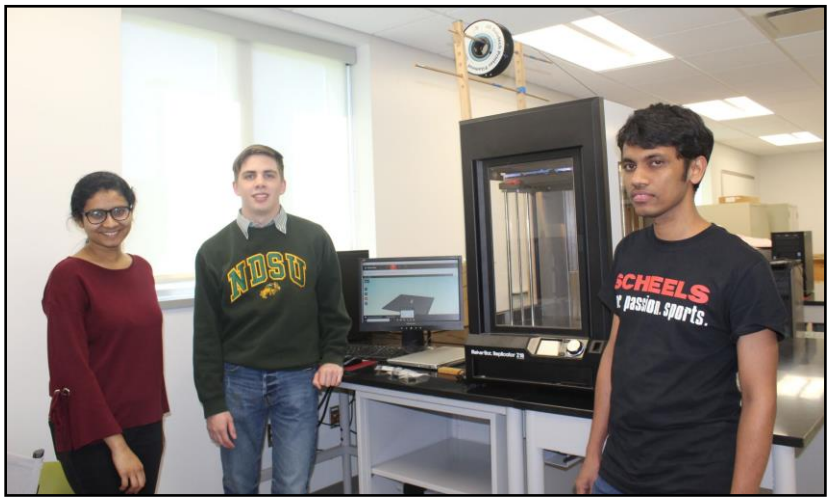
- Modeling and optimization of complex networked systems
- Predictive failure analysis and failure recovery schemes
- Development of data-driven decision making processes under uncertainties
- Process parameter optimization for additive manufacturing
- Reliability and resilience assessment in cyber-physical systems

Principal Investigator	Nita Yodo
Graduate Students	Arup Dey (Ph.D. Student), & Tanzina Afrin
Undergraduate Students	David Hoffman (B.S. in IME)

Research Grant: ND EPSCoR Seed Grant award of $10,000

The long-term goal of the research done using the seed grant was to develop an innovative data-driven approach to resolve problems that prevent additive manufacturing (AM) from achieving very accurate and replicable three dimensional (3D) printed products.

The objective of this seed grant was to collect initial process parameters and develop a database for critical process parameters.



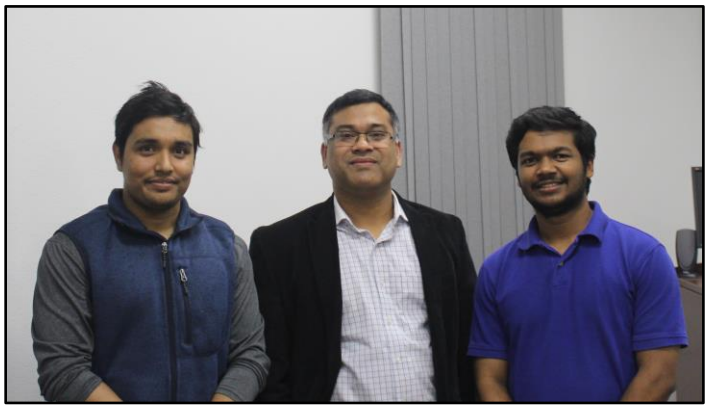
RESEARCH OVERVIEW CONTINUED

Tissue engineering is a vital means to mimic the *in-vivo* counterpart due to the insufficiency of animal models. The synthetic tissue produced in this technique can have a significant impact on predicting the applicability of drug and other physiological behavior. 3D bioprinting is an emerging technology to reproduce the living tissue with scaffold through the controlled allocation of biomaterial and cell. A wide range of materials can be printed on the XY plane following a vectorized tool-path, and the subsequent z-axis movement ensures the progressive 3D build height of the scaffold construct. Dispensing materials, often defined as bio-ink used in this technique, requires suitable viscosity and density as well as the shape-retaining capability along with bio-compatibility in the form of high cell viability during and after printing. Currently, the selection of bio-ink is an empirical decision backed by a 'trial and error' technique which can become a very exhaustive process with little repeatability.

Principal Investigator	Bashir Khoda
Graduate Students	AMM Nazmul Ahsan and Ahsan Habib
Undergraduate Students	Triston Ihrke and Zelin Zang

The goal of this work is to develop a bio-ink assessment protocol to determine the intrinsic and extrinsic properties that are suitable for extrusion-based bio printing processes.

Outcome: A set of systematic qualitative and quantitative characterization tests were proposed and conducted to validate printability, shape fidelity of the identified hybrid hydrogel. Following the protocol, hybrid hydrogel-based bio-ink is designed, and 3D intricate scaffold structures were fabricated. About 90% of cell survivability is reported in the designed bio-ink with multiple cell lines e.g. BxPC3 (pancreatic cancer cell), human embryonic kidney cell (HEK 293), prostate stem cancer cell and Porc1 (functional cell) at the post-printing stage i.e. incubation period.



RESEARCH OVERVIEW CONTINUED

Center for Quality, Reliability, and Maintainability Engineering (CQRME)

The CQRME was established in 2013 with the support of local companies and agencies who focus on advancing the research in the area of quality and reliability engineering. The current focus of the center is in the area of degradation modeling of physical engineering systems to understand and model the failure behavior and subsequently use this understanding to assess system reliability, remaining useful life (URL), develop maintenance strategies, and design spare parts inventory systems.

The CQRME is also advancing research in the area of big data analytics, machine learning, and IoT areas to model large infrastructure networks such as energy, communication, transportation, and techno-social networks to provide real-time condition monitoring of these critical networks. The use of big data and machine learning in large infrastructure networks will help not only assess the reliability of these critical systems but also to design and develop resilience and robustness into these critical systems to manage and prepare for catastrophic failures.

Director	Om Prakash Yadav
Graduate Students	Shah Limon, Ameneh Forouzandeh, Anunay Gupta, Alex Davila Frias, and Abdulsalam Alqarni

The CQRME research team has been working on following FUNDED research projects:

- Design and Development of Accelerated Degradation Test Methodology for Hydrostatic System (**Funded Research ND and Bobcat**)
- Accelerated testing and Reliability Assessment of Flexible Hybrid electronics (FHE) (**Funded By SBIR NSF through Uniqarta**)
- Implementing QMS and Process Improvement Tools (**D&M Industries**)
- Reliability Oriented Design for DC-Link Capacitors in Power Electronic Converters (**Funded by CQRME**)
- Prognostics and Maintenance Planning of Complex Systems in Dynamic Environmental/Operational Conditions (**Funded by CQRME**)
- Reliability Assessment of Cyber Physical Systems (**Funded by CQRME**)

DEPARTMENT SCHOLARSHIPS

Frank E. Biltonen Scholarship
- Cody Beaulieu, Plymouth, MN

Gordon Heller Scholarship
- Olivia Gravel, West Fargo, ND
- Alexis Sumers, West Fargo, ND

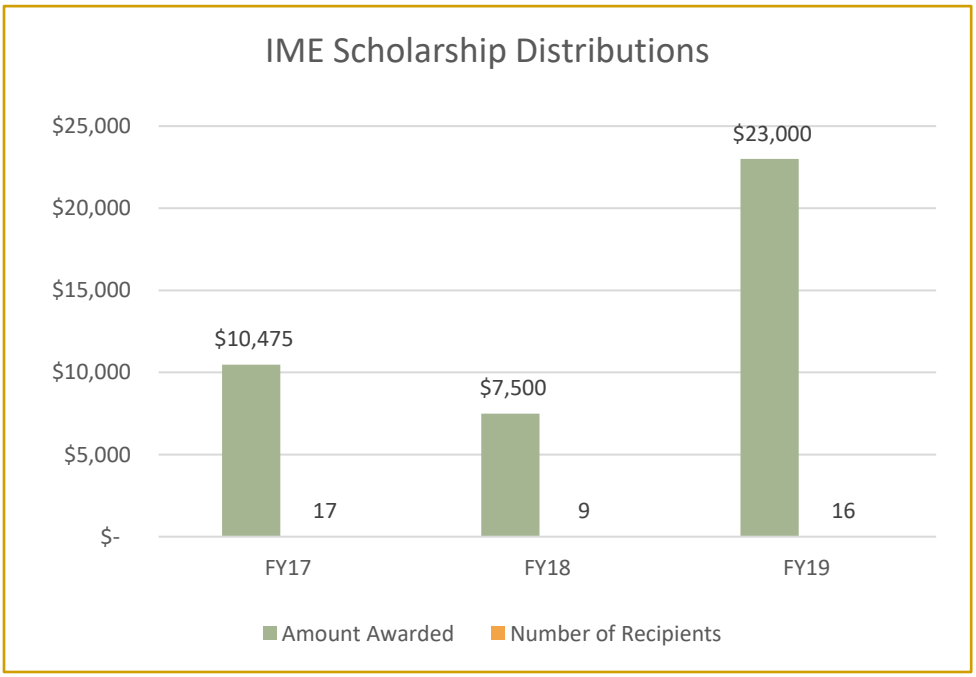
IME Chair's Scholarship
- Payton Hanzal, Chandler, AZ

Industrial and Manufacturing Engineering Scholarship
- Anne Bundy, Champlin, MN

Paul and Sharon Madson Industrial Engineering Scholarship
- Megan Chromy, Callaway, MN
  Megan Chromy, Callaway, MN
- David Hoffman, Fargo, ND
- Elena Pearce, Fessenden, ND
- Kaija Rizzo, Eau Claire, WI
- Dustin Stedman, West Fargo, ND
- Rachel Stiles, Pipestone, MN
- Trevor Walderon, Hastings, MN

Philip W. Ruud Scholarship
- Tristan Schettler, Carpio, ND

Vettel Family IME Scholarship
- Emily Runsvold, Fargo, ND
- Jakob Vircks, Eau Claire, WI



ADVISORY BOARD

NAME	JOB TITLE	COMPANY
JASON ADAM	Project Manager	NASA
SCOTT BADER	Senior product engineer	Teel Plastics, Inc.
CHRIS BARTA	Director of operations	Tecton Products, LLC
RAY BERRY	President and CEO	OmniByte Technology
JAMES ENGELSTAD	Project Manager, Supply Chain	Sanford Health
JODY FEMRITE	Industrial Engineer	Sparton Corp
ADITYA GARG	Plant Manager	CNH Industrial
JOHN HANSMANN	Vice President, Professional Services	Health Catalyst
KIM HEINLE NELSON	Senior Manager, Operational Excellence	Digi-Key Electronics
ROBERT HELLER	President	Heller Capital, Inc.
AL HENDERSON	Brigadier General	Retired
VERDALE HERMAN	Manufacturing Scheduler	CNH Industrial America LLC
DAN HOEFS	President	Padgett Business Services
DEREK HOLT	CT Business Analyst	Doosan Bobcat
BRIAN JOHNSON	Vice President of Operations	Marvin Companies
MICHAEL KIERNAN	Retired	Case New Holland (CNH)
DAVID N. LONG	Retired	SJE-Rhombus
DAVID S. LONG	Principal Systems Engineer Professor of Systems Engineering	CENTUARI University of Dayton
PAUL MADSON	Retired	Border States Electric
DAVID MALM	Retired	
MICHAEL MATHERS	Sourcing Specialist Sr.	Doosan Bobcat North America
TODD MEESTER	Regional Sales Director	Datalink
JIM MISIALEK	Project Manager	Marvin Companies
BRIAN POPOFF	Principal	Capgemini Consulting
CLINT ROSSLAND	Health Systems Engineer	Sanford Health
MICHAEL SCHNEPF	Data Analytics Manager	Border States Electric
PETER SEDGEMAN	Director	Social Services of Polk, County, MN
DENNIS STEINMAN	General Manager	SuperValu
CHRISTY STRONG	Director	Global Enterprise-Boston Scientific
EMMY VAREBERG	Vice President	Vareberg Engineering, Ltd.
BRETT WINKELMAN	President	Fargo Assembly Co.

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Thank You!

We are very grateful for the support of our generous alumni, faculty, staff and friends.

Your Donation Helps…

- Fund student scholarships
- Support student clubs and activities
- Support research/education through laboratory and classroom improvements
- Support faculty through endowed chairs and professorships

Ways to Contribute:

- Contact one of the Directors of Development for the College of Engineering:
  - Andy Dahl: andy@ndsualumni.com or PH: 701.934.0856
  - Lisa Otterson: Lisa.otterson@ndsualumni.com or 701.561.8591
- Online gifts can be made at the NDSU Development Foundation: https://www.ndsualumni.com/contribute
- NDSU Giving Day, December 3rd, 2019; https://www.ndsugivingday.com

NDSU GIVING DAY

The Herd

Now this is the law of the prairie
As old and as true as the sky
And the Bison that keep it will prosper
And the Bison that break it will die
As the creeper that girdles
the tree trunk
This law is the final word:
For the strength of the Herd
is the Bison
And the strength of the Bison
is the Herd.

NDSU | INDUSTRIAL AND MANUFACTURING ENGINEERING

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