Research and Economic Development Committee Agenda
November 17, 2021
Time: 3:00 PM – 5:00 PM

1. Welcome – Trustee Fall/Diana Hulme
2. Faculty Research/Business (Resono) presentation - Dr. Jonathan Naughton
3. WIP ARP Funding update – Steve Farkas
4. Carnegie Classification discussion – Provost Kevin Carman
Small Business Development at the University of Wyoming

Jonathan W. Naughton
Professor, Mechanical Engineering
Director, Wind Energy Research Center
CEO, Resono Pressure Systems

Pourya Nikoueeyan
CTO, Resono Pressure Systems
Outline

• Origins of Tech Companies at a University
• The University of Wyoming Aeronautical Laboratories
• Product Origin - Challenge and the Solution
• Resono’s Product History
• The Product
• Resono Today
• Support from UW and the State of Wyoming
• Ideas to Further Encourage Economic Development

The ideas discussed in this presentation are our personal opinions and should not be considered to represent the official positions of the ME Department, CEAS, or UW.
Origins of Technology Companies at Universities

• Technology companies come from ideas generated primarily in the Sciences and Engineering
  • There are other examples, but they are small in number

• The ideas result from a vigorous Research Enterprise
  • Although not all research generates the ideas that will be the foundation of a company, a subset of the research can generate those ideas
The University of Wyoming Aeronautical Laboratories

• Established 1997

• Areas of Research
  • Experimental Aerodynamics
  • Instrumentation
  • Analysis Methods

• Applications
  • Drag Reduction
  • Helicopter Blade Flows
  • Wind Turbine Blade Flows
  • Instrumentation Development
The University of Wyoming Aeronautical Laboratories

**Funding**
- **Primary sources**
  - Department of Energy
  - Department of Defense
    - Air Force
    - Army
  - NASA
- **Amount (Past 3 years)**
  - Total ~$2 million, Naughton ~$700k
- Funding has come from traditional grants, and more recently SBIR and STTR contracts awarded to companies

**Students/Visitors/Employees**
- **PhDs** – 7 (3)
- **MS (thesis)** – 20 (3)
- **Undergrad Researchers – 20**
- **Engineers** – 3
- **Visiting Researchers** – 3 (All International)
- **Post-Doctoral Researchers** – 3 (1)
• Oscillating airfoils have been used as an “ideal case” for unsteady airfoil research
  • Dynamic stall

• Application Areas
  • Helicopters in forward flight
  • Wind turbines at off-design conditions

• Importance
  • Increased lift followed by stall
  • Repeated load changes lead to fatigue
The University of Wyoming Aeronautical Laboratories
Example Research – Oscillating Airfoils
The University of Wyoming Aeronautical Laboratories
Example Research – Oscillating Airfoils

• First documented discovery of “preferred paths” in cycle-to-cycle variations
Product Origin - The Challenge – Unsteady Pressure Measurement

- Robust
- Cost Effective ($300/ch)
- Reusable
- Convenient

- Fragile
- Expensive ($1000/ch)
- Single-use
- Inconvenient
Product Origin - The Solution – Unsteady Pressure Measurement
Resono’s Product History

• Motivated by unsteady airfoil research in the mid 2000’s (airplane application - flutter)
  • Needed a way to practically measure unsteady pressure at many points on an airfoil
  • Broke available sensors due to moving airfoil tested in the wind tunnel
• Airfoil research resumed in the late 2000s (wind turbine aerodynamics)
  • Developed method for measuring unsteady pressure using pressure scanners using approach of Whitmore and Wilson
Resono’s Product History

• Throughout the 2010s, the approach was refined
  • Contracts from DOE and Army provided sustained funding
• We started getting questions about how we were making the unsteady pressure measurements
• First considered commercializing in early 2010s
• Real work toward developing commercial application when Pourya Nikoueeyan indicated interest
Resono’s Product History

- **Resono Pressure Systems Founded in 2016**
  - Fisher Innovation Challenge 2016
  - DOE Phase I STTR
  - Air Force Research Labs STTR
    - Phase I
    - Phase II
  - WBC Match through ENDOW
  - NASA- Langley Demonstration
The Product

• **Resono is a Software Company**
  - Software provides means to determine unsteady pressures using conventional hardware

• **Software Requires Hardware**
  - Hand-Held Pressure Characterization Device
  - Data-Acquisition System

• **Price Point is ~$200K depending on the configuration**
Resono Today - The Team

Jonathan Naughton  
PhD, Mechanical Eng., Penn State  
Chief Executive Officer

Pourya Nikoueeyan  
PhD, Mechanical Eng., U. Wyoming  
Chief Technology Officer

John Strike  
MSc, Mechanical Eng., U. Wyoming  
Hardware Design

Michael Hind  
MSc, Mechanical Eng., U. Wyoming  
Algorithms

Stephen Whitmore  
PhD, Aerospace Eng., UCLA  
Technology Adviser

Marvin Perry  
MSc, Mechanical Eng., U. Wyoming  
System Integration

Leann Naughton  
MSc, Biochemistry, Colorado State U.  
Business Manager

Benjamin Wimpenny  
BS, Mechanical Eng., U. Wyoming  
System Development
Resono Today - Facilities

Our office and laboratory located in IMPACT 307 building in Laramie, Wyoming

We have expanded and improved our in-house system design and development capabilities.
Resono Today – Current Activities

• **Phase II Small Business Innovative Research (SBIR) with Air Force**
  • Delivering 2 systems in December

• **Demonstration Test at NASA-Langley on the Space Launch System**
  • Carried out in July ‘21
  • Presenting results at a conference in June ’22
    • 2 joint publications with NASA

• **Working on Next Projects**
  • First sales of a Beta commercial system
  • Additional grant-supported research for new applications
    • NASA- Langley, NASA-Armstrong
    • Arnold Engineering Development Center
  • **Exploring Service-Based Product**
    • System design
    • Fee-based testing
Support from University of Wyoming and the State of Wyoming

- **Engineering Tier I Initiative**
  - Supported Pourya Nikoueeyan during PhD studies
  - Part of his time was used to start Resono

- **Entrepreneurship Competitions**
  - Fisher Innovation Challenge 2016
    - Among 6 teams selected for development
  - Ellbogen $50k Competition 2020
    - First Place Winner ($30k)

- **Impact 307 Office Space and Support**
  - Small office in 2017
  - Moved into larger space in Summer 2020
  - Coaching from Impact 307 Personnel

- **Wyoming Business Council Support**
  - Phase I STTR Matching Grant
    - $100k
  - Phase II STTR Matching Grant
    - $200k

*This Support has Directly Impacted Resono’s Ability to Develop*
Ideas to Further Encourage Economic Development

• **Support the Research Enterprise**
  • This is contracting due to reduced budgets
    • Less research, fewer ideas

• **Provide Faculty the Incentives and Support to Develop Their Ideas**
  • Faculty are busy already
  • Little credit is given to faculty for this work (this is something the academic side needs to address)
  • Assisting faculty in the process can be the difference between an idea being pursued or not

• **Make Economic Development Support a 1-Stop Shop**
  • Over the time Resono has existed, have seen the organization of these activities vary
  • The support structure is scattered
    • Business College
    • Engineering and Applied Science
    • Impact 307

• **Encourage Faculty/Student Collaboration**
  • It is rare that a student has the background or experience necessary
  • Faculty typically lack time
  • Most economic development will grow out of the graduate programs
    • More emphasis is needed here
Questions
Carnegie R1 Classification

Kevin Carman
July 17, 2021
Why does a “R1” designation matter?

• Recruitment of outstanding graduate and undergraduate students
• Recruitment and retention of outstanding faculty
• Reputation among peer universities
• Credibility with funding agencies
• Enhanced opportunities to contribute to state economic development
• Prestige with employers and alumni
Who determines Carnegie research classification?

- Carnegie Foundation for the Advancement of Teaching
  - Indiana University
- Last reclassification in 2018
  - 130 R1
  - 131 R2
- Next assessment in December of 2021
Carnegie Metrics

- Doctoral degrees
  - Humanities
  - Social Sciences
  - STEM
  - Other Professional

- Non-Faculty PhD Research Staff (e.g., postdocs)

- Research Expenditures
  - Science & Engineering (S&E)
  - Non-S&E

- Each metric ranked (261-1)
## Aggregate vs. Per Capita Indexes

<table>
<thead>
<tr>
<th>Aggregate Research</th>
<th>Weight</th>
<th>Per Capita Research</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEM Doctorates</td>
<td>.909</td>
<td>STEM Expenditures</td>
<td>.935</td>
</tr>
<tr>
<td>STEM Expenditures</td>
<td>.899</td>
<td>Research Staff</td>
<td>.930</td>
</tr>
<tr>
<td>Research Staff</td>
<td>.894</td>
<td>Non-STEM Expenditures</td>
<td>.619</td>
</tr>
<tr>
<td>Doctorates: Social Sciences</td>
<td>.864</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doctorates Humanities</td>
<td>.839</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-STEM Expenditures</td>
<td>.817</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doctorates: Other Fields</td>
<td>.621</td>
<td></td>
<td></td>
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</tbody>
</table>
Combined weighted ranks are converted to standardized scores
Standardized Per Capita Index Score and Standardized Aggregate Index Score

The graph shows the standardized per capita index score and standardized aggregate index score for various universities.

- CSU
- ISU
- KSU
- MSU
- NMSU
- NDSU
- ORSU
- WSU
- UNL
- UA
- UNLV
- UNR
- UNM
- UW
- USU

The x-axis represents the standardized aggregate index score, while the y-axis represents the standardized per capita index score.
How do we compare to R1 and R2 universities?

<table>
<thead>
<tr>
<th></th>
<th>STEM Expenditures (1000s)</th>
<th>Non-STEM Expenditures (1000s)</th>
<th>S&amp;E Research Staff</th>
<th>Doctorates: Humanities</th>
<th>Doctorates: Social Sciences</th>
<th>Doctorates: STEM</th>
<th>Doctorates: Other Fields</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1 Median</td>
<td>295,776</td>
<td>18,986</td>
<td>346</td>
<td>36</td>
<td>37</td>
<td>160</td>
<td>65</td>
</tr>
<tr>
<td>R2 Median</td>
<td>25,644</td>
<td>2,191</td>
<td>23</td>
<td>0</td>
<td>4</td>
<td>23</td>
<td>24</td>
</tr>
<tr>
<td>UW</td>
<td>121,927</td>
<td><strong>3,105</strong></td>
<td><strong>83</strong></td>
<td><strong>0</strong></td>
<td><strong>7</strong></td>
<td>70</td>
<td>29</td>
</tr>
</tbody>
</table>
How do we compare to R1 and R2 universities?

<table>
<thead>
<tr>
<th></th>
<th>Per-capita STEM Expenditures (1000s)</th>
<th>Per-capita Non-STEM Expenditures (1000s)</th>
<th>Per-capita S&amp;E Research Staff</th>
<th>Number of Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1 Median</td>
<td>232</td>
<td>15.0</td>
<td>0.27</td>
<td>1263</td>
</tr>
<tr>
<td>R2 Median</td>
<td>63</td>
<td>4.7</td>
<td>0.05</td>
<td>469</td>
</tr>
<tr>
<td>UW</td>
<td>229</td>
<td>5.8</td>
<td>0.16</td>
<td>530</td>
</tr>
</tbody>
</table>
The Need for Faculty in PhD programs

<table>
<thead>
<tr>
<th></th>
<th>Utah</th>
<th>New Mexico</th>
<th>UW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total faculty</td>
<td>992</td>
<td>894</td>
<td>530</td>
</tr>
<tr>
<td>Faculty in PhD Programs</td>
<td>853</td>
<td>737</td>
<td>347</td>
</tr>
<tr>
<td>% in PhD Programs</td>
<td>86%</td>
<td>82%</td>
<td>65%</td>
</tr>
</tbody>
</table>
Doctoral Graduates

Year | Number of Graduates
---|---
2011-12 | 72
2012-13 | 113
2013-14 | 93
2014-15 | 60
2015-16 | 70
2016-17 | 80
2017-18 | 110
2018-19 | 93
2019-20 | 72
2020-21 | 93
Doctorate Enrollment

- Fall 2011: 667
- Fall 2012: 744
- Fall 2013: 630
- Fall 2014: 600
- Fall 2015: 550
- Fall 2016: 500
- Fall 2017: 650
- Fall 2018: 700
- Fall 2019: 630
- Fall 2020: 630
- Fall 2021: 744
Research Personnel

Post Doc, Research Prof, & Research Scientists with PhD
Strategic next steps

• Assure we are getting full credit
  • Postdocs and research faculty
  • Faculty salaries/HERD reporting

• Strategic investments
  • ORED
  • Faculty in doctoral programs
  • Doctoral programs in humanities/social sciences
  • Graduate assistantships
  • Graduate stipends