Multidisciplinary Innovation Teams: the New Product Development Center (NPDC) at Oklahoma State University (OSU)

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Seminar Outline

- Problem Statement
- NPDC Role and Scope
- Conceptual/Theoretical Foundations
  - Innovation
  - Best New Product Development Practices
  - Absorptive Capacity, University/Industry Interactions
  - Experiential Learning
  - Model of University Industry Bidirectional Technology Transfer
- Implications for Research, Teaching, Outreach
- Empirical Examples
- Impact Measurement
- Funding
- Partnerships
- Opportunities/Challenges
- Discussion/Questions

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Problem Statement

- **Losing status as innovation leader in manufacturing has severe and negative implications for U.S. economy**
  - **Jobs**
  - **R & D Expenditures**
  - **Growth**
  - **Soruce: Popkin, Joel and Kobe, Kathryn. (2006). U. S. Manufacturing at Risk, Report produced by Joel Popkin and Associates for the Council of Manufacturing Associations and The Manufacturing Institute, February.**

NPDC Mission

- The NPDC mission is to help Oklahoma manufacturers' and inventors' transform unique, new ideas into manufactured goods. Our goals are to:
  - Create/retain jobs
  - Increase revenues
  - Reduce costs
  - Sustain the advantage

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Types of Projects

- **New Product/Process Development – Design, build, test, and deliver (under licensing agreements) working prototypes to manufacturers or inventors and provide them with implementation assistance**
- **Business Analysis – Analyze and report the business case for new products/processes and create practical, implementable marketing plans**
- **Marketing Communications – Design and deliver electronic and hard copy files of marketing materials to small manufacturers or inventors**
- **Grant writing – Identify opportunities and assist with writing, partnership creation, and submission**

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Conceptual Foundations: Innovation

- Creativity: generation of new ideas and concepts
- Innovation: "…the successful creation and delivery of a new product or service in the marketplace." (Carlson and Wilmot, 2006, p. 4)
- Innovation: "Bringing new ideas to life." (Tucker, 2002, p. 18)
- Implications:
  - Creativity ≠ Innovation
  - Innovation best done as part of a disciplined process that can be learned and taught

Conceptual Foundations: New Product Development Best Practices

- Six Dimensions (Conclusions):
  - Strategy: strategic, long-term orientations toward NPD
  - Portfolio Management: formalized management process
  - Process: formal NPD process and discipline to adhere to the process (perhaps Stage-Gate®)
  - Market Research: proactive market research program
  - People: use cross-functional teams
  - Metrics and Performance Evaluations: standardized criteria and metrics

  - Sources:
    - Kahn, Kenneth B, Barczak, Gloria, and Moss, Roberta (2006). PERSPECTIVE: Establishing an NPD Best Practices Framework. *J. of Product Innovation Management* 23(2):106-116. (Five rejoinders are also published in the same issue.
    - Cooper, Robert G. 2008. Perspective: The Stage-Gate® Idea-to-Launch Process—Update, What's New, and NexGen Systems. *J. of Product Innovation Management* 25: 213-232. Accessed on-line at http://www.prod-dev.com/research_articles.php . Accessed Sept. 25, 2009.

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Conceptual Foundations: Enhancing Absorptive Capacity

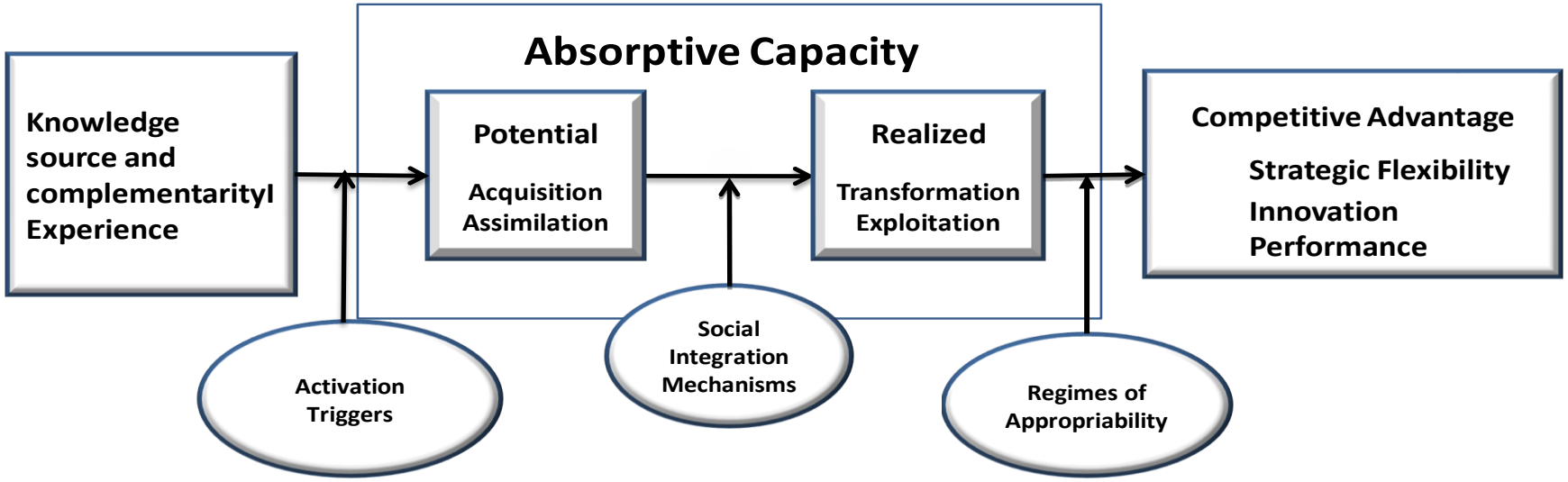
- **Absorptive Capacity: "…a dynamic capability pertaining to knowledge creation and utilization that enhances a firm's ability to gain and sustain a competitive advantage." (Zahra and George, 2002, p. 185)**
- **"Organizational routines and processes by which firms acquire, assimilate, transform and exploit knowledge to produce a dynamic organizational capability." (Zahra and George, 2002, p. 186)**
  - **Source: Zahra, S.A. and George, G. (2002). Absorptive Capacity: A Review, Reconceptualization, and Extension. *Academy of Management Review* 27:185–203.**

Conceptual Foundations: Enhancing Absorptive Capacity

- **Two Components:**
  - **Potential Absorptive Capacity (PACAP): acquisition and assimilation of knowledge (Zahra and George, 2002, p. 190)**
  - **Realized Absorptive Capacity (RACAP): transformation and exploitation of knowledge to create a competitive (Zahra and George, 2002, p. 190)**
  - **η is RACAP/PACAP is defined as the efficiency factor which is the percentage of the potential that is realized (Zahra and George, 2002, p. 193)**

  - **Source: Zahra, S.A. and George, G. (2002). Absorptive Capacity: A Review, Reconceptualization, and Extension. *Academy of Management Review* 27:185–203.**

Figure 1. A Model of ACAP
Source: Zahra and George, 2002, p. 192



– Source: Zahra, S.A. and George, G. (2002). Absorptive Capacity: A Review, Reconceptualization, and Extension. *Academy of Management Review* 27:185–203.

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Conceptual Foundations: Knowledge Acquisition in University-Industry Alliances

- Important problem
- Most literature focuses on one-way transfer
- Feedback and learning deserve more attention

❖ Sources:

❖Agrawal, A. (2001). University-to-Industry Knowledge Transfer: Literature Review and Unanswered Questions. *International Journal of Management Reviews* 3 (4):285–302.

❖Sherwood, A.L., and Covin, Jeffrey G. (2008). Knowledge acquisition in university-industry alliances: An empirical investigation from a learning perspective. *Journal of Product Innovation Management.* 25:162-179.

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Conceptual Foundations: Experiential Learning

- **Concept: Students and faculty learn from working on projects for real companies**
  - **Recruitment/cooperation/preparation of client companies**
  - **Assignment of multidisciplinary student teams to companies and projects**
  - **Evaluation of project outcomes involving representatives from client companies and review panels of faculty**

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Conceptual Contributions

- Industry assistant teams involve students/faculty/staff/partner agencies from multiple disciplines
- Focus on existing small- and medium-sized manufacturers
- Knowledge transfer is bi-directional
- Partnership focus
- Adaptable approaches

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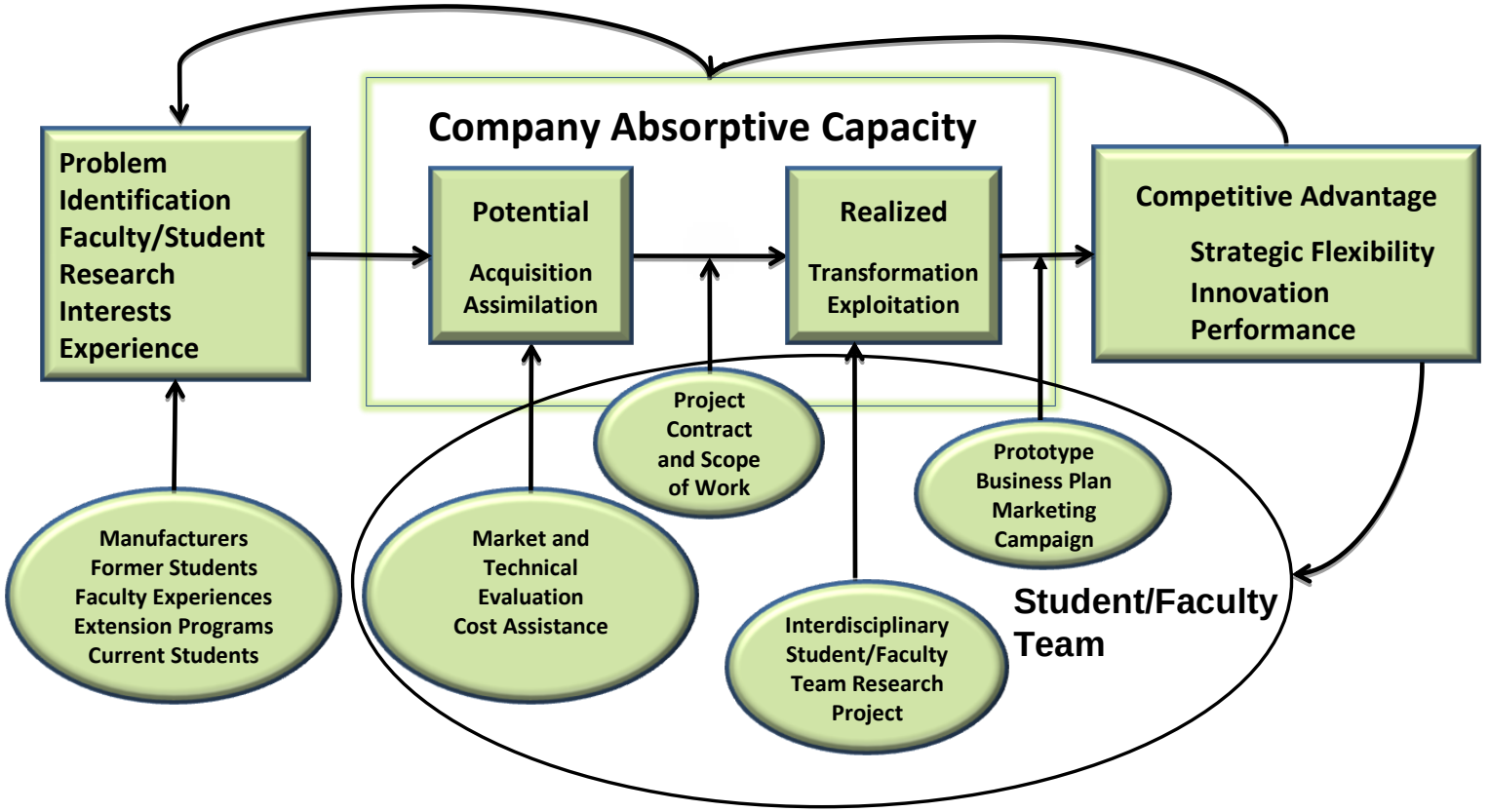
Figure 1.
Increasing Agribusiness Manufacturers' Potential and Realized Absorptive Capacity With Student/Faculty Senior Design/Capstone Projects



Source: Tilley, et al., 2009, Using Student/Faculty Projects to Increase the Potential and Realized Innovation Capacity of Small- and Medium-Sized Manufacturers, in review.

Emphasis on Appropriable Rent

- **Multidisciplinary team deliverables include:**
  - **Working prototypes**
  - **Business plans for implementation**
  - **Marketing and communications strategies and materials**
  - **Participants may be students in classes or NPDC interns**
  - **Graduate and undergraduate students are involved**

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Implications for Teaching, Research, and Outreach

- Model is integrated with teaching, research, and outreach components
- Model focuses on experiential/service learning that emphasizes higher level learning
- Student teams are valuable resources that can produce useful results
- Client companies need to be open to interaction with the students

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Implications for Teaching, Research, and Outreach

- **Model is being applied at OSU, Cal Poly, and UNL**
  - **Three semester sequence is probably too long**
  - **Disciplinary differences can be overcome**
  - **Student responses to experiential learning vary**
  - **Company interactions with students have been positive**
  - **Teamwork requires communications**

Implications: Model is Fundable

- Oklahoma Department of Commerce
- Oklahoma Center for the Advancement of Science and Technology (OCAST)
- USDA Challenge Grant
- NSF-Partnerships for Innovation
- Economic Development Administration
- Small Business Administration
- USDA SBIR Programs
- NASA
- OCAST competitive grants
- Technology Business Assessment Group

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Empirical Examples: 3C Cattle Feeders, Mill Creek, Ok

- **Controlled Access to Cattle Feeders**
  - USDA SBIR Phase I $80,000
  - OCAST Phase II Support $25,000
  - SBIR Phase II Proposal Funded, $350,000
  - Ning Wang, BAE
  - Chris Richards, Animal Science
  - Dan Tilley, Ag. Econ.
  - Tyler Campbell, USDA Field Station, Kingsville, TX
  - Dayton Hancock, MAG, Agribusiness, now Marketing Manager, Walco International, Fort Worth was employed as a graduate student on this project

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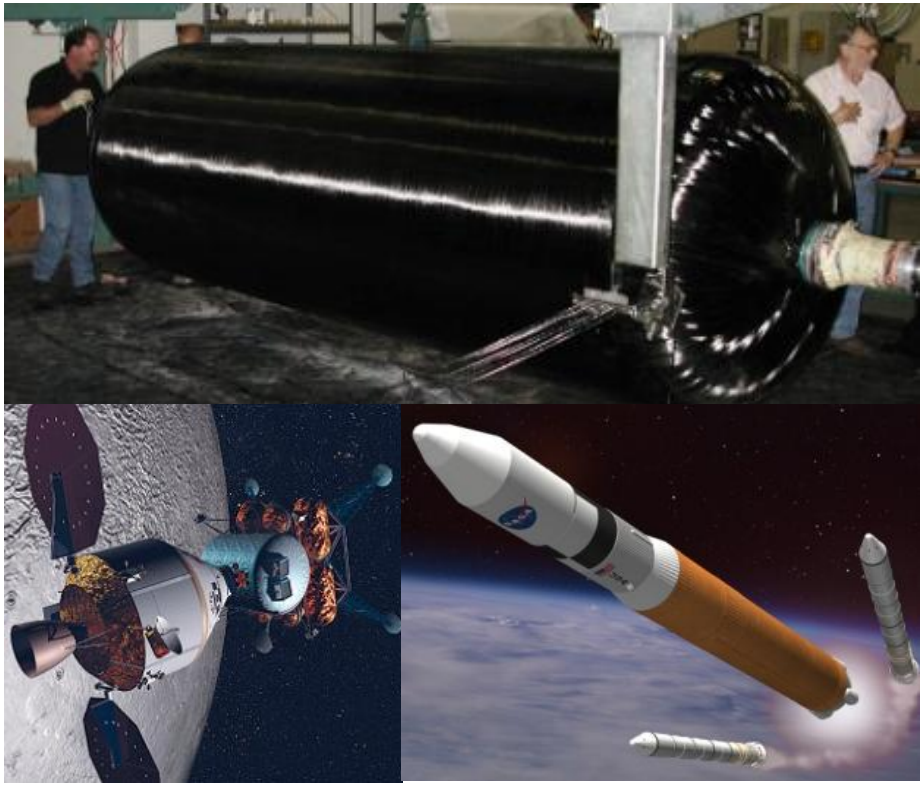
Empirical Example: Wilco Machine and Tool, Marlow

- Wilco Machine and Tool, Marlow--Nano Technology-based composite materials for high pressure storage tanks
- NASA Marshall, Johnson, Glenn and Langley
- NASA EPSCOR $750K
- ONAP $500K
  - Raman Singh, MAE
  - Kevin Ausman, Chemistry
  - Kan Kalkaan, MAE
  - Ranji Vaidyanathan, GE
  - Dan Tilley, AGEC



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Empirical Examples: Licensing Agreement Progress

- Airgo, Guthrie, Completed agreement
- AFC, Bartlesville, completed this week, millions in bids
- BRB, final product in process
- Stolhand Heating and Air Conditioning – final testing in progress

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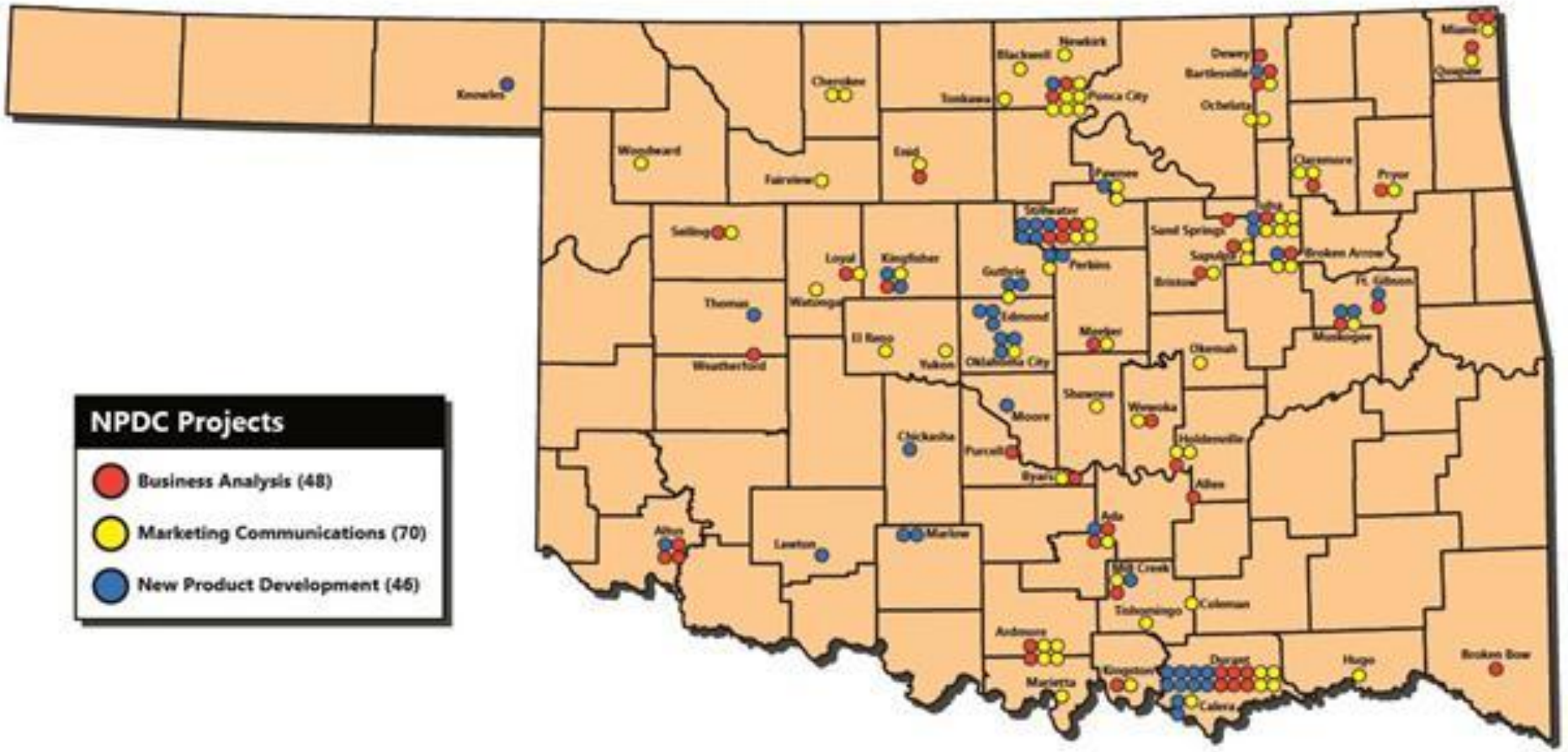
Project Activity 2002/09



Partners are critical to success!

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Partnership Strengthening

- OK Manufacturing Alliance
  - 20 Manufacturing Extension Agents
- OSU/Alliance Partnership
  - 6 Applications Engineers
- OSU Faculty and Students (DASNR, CEAT, A&S, ED, BUS)
- CIED Staff
- Numerous companies
- OCAST
  - SBIR and IAS Programs
- REI
- Technology Centers
- State Chamber & Members
- Local Economic Development Agencies
- I2e

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Partnership Growth

- Murray State College
- Center for Emerging Technology and Entrepreneurial Studies, CETES, Cameron University
- OSU Department of Entrepreneurship
- Oklahoma Association of Business Incubators
- OSU Kerr Center for Food and Agricultural Products
- California Polytechnic State University
- University of Nebraska, Lincoln
- OSU Riata Center for Entrepreneurship
- NASA Centers
- USDA
- Oklahoma Department of Agriculture
- SBDCs
- Technology Centers
- Oklahoma Department of Transportation
- University of Oklahoma
- University of Tulsa

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Manufacturing Innovation and Revitalization Partnerships: Universities, Manufacturers, and K-12 Teachers

- NSF Partnership for Innovation Program (NSF-PFI) $600 K for three years
  - Manufacturing Innovation Leadership Program
  - Presidential Innovation and Creativity Scholars Program
  - K-12 Innovation in the Classroom Program
  - Faculty: Dan Tilley, Ranji Vaidyanathan, Steve McKeever, Susan Stansberry, Arun Tilak (Cameron University), others from OSU may be added
- Cleared for award

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Impact Measurement

- **Measured by Manufacturing Extension Agent Survey which are spot checked by National Institute of Standards and Technology**
  - **Cost Savings**
  - **Revenue Gains**
  - **Jobs created or saved**
  - **$20 million short-run impact in 2008/09 alone**
  - **Approximately $3.0 million in active grants with manufacturing partners**

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Opportunities and Challenges

- Make a real difference in rural businesses
- Disciplinary recognition for multi-disciplinary work
- Product Innovation Interns (11 today)
- Strengthening university-industry-government partnerships
- Grant and contract managment
- Communication/managing partnerships

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Opportunities and Challenges

- State funding
- Addition of Inventor's Assistance Service activities
- Must have a high acceptance rate on grant applications or process is very inefficient
- Disciplinary differences and compromises
- Sustainability of faculty interest
- Measuring the long-run impact

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