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
Problem Statement

• Losing status as innovation leader in manufacturing has severe and negative implications for U.S. economy
  – Jobs
  – R & D Expenditures
  – Growth

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
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
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)
• Implications:
  – Creativity ≠ Innovation
  – Innovation best done as part of a disciplined process that can be learned and taught

• 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:
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)

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 advantage (Zahra and George, 2002, p. 190)
  – $\eta$ 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)

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

Conceptual Foundations: Knowledge Acquisition in University-Industry Alliances

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

Sources:
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
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
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
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
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
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
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
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
Project Activity 2002/09

NPDC Projects
- Business Analysis (48)
- Marketing Communications (70)
- New Product Development (46)
Partners are critical to success!
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
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
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
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
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 management
• Communication/managing partnerships
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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