PEARLS FROM THE PAST: USEFUL RESEARCH JEWELS

A cast of thousands
IUCRC Program
&
Psychology Department
North Carolina State University
Goal

• Provide a broad overview of some past IUCRC and IUCRC-related studies that might inform center operations and management
  • Will highlight I/UCRC work but there is relevant work on other programs by other authors
    • Santoro
    • Boardman
    • Bozeman
What you can do to maximize your membership investment
Evaluator Research on IAB Roles and Center Outcomes

IAB Behaviors as an External Boundary Spanner:

• Having discussions with Center faculty to develop new proposals that are consistent with the firm’s goals
• Contacting center investigators outside of Center meetings
• Proposing research ideas and topics for Center investigators to pursue
• Making recommendations to modify research projects already in progress

OUTCOMES
• R&D Benefits
• Commercialization
• Students Hired
• Follow on Research within Organization
• Research Relevance
• Networking

UNDERSTANDING THE ROAD TO LONG-TERM SUCCESS: EVIDENCE FROM SUSTAINED I/UCRCS

Lindsey McGowen, PhD
CChIPS Evaluator
North Carolina State University
November 20, 2013
Sustainability of IUCRCs

• 2009 Interviewed directors of all formerly funded IUCRCs - focused on documenting outcomes and transition strategies
• 2010-11 case studies of success strategies and failure cases
• 2012 survey of all formerly funded IUCRCs focused on changes in sustainability over time; longitudinal predictive

• Lots of data on what life after NSF is like, potholes to avoid, strategies for success
I/UCRC Status over time

<table>
<thead>
<tr>
<th>Status</th>
<th>2012 Status</th>
<th>2009 Status</th>
<th>1 Year post-NSF Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating</td>
<td>40.90%</td>
<td>37.10%</td>
<td>20.50%</td>
</tr>
<tr>
<td>Not Operating</td>
<td>59.10%</td>
<td>62.90%</td>
<td>79.50%</td>
</tr>
</tbody>
</table>

Legend:
- Green: Operating
- Red: Not Operating
Predictors of sustainability: Quick Quant List

- **Environment**
  - Strong industrial environment of R&D investment

- **Program**
  - Long term support from NSF – development and routinization
  - Industry hiring center students – S&T human capital, tech/knowledge transfer
  - Broad base of industry support
  - Strong impact for members
  - Dissemination of results via pubs
  - Diverse engagement models available

- **Individual/Director Role**
  - Directors spend time on networking, brainstorming, recruitment
  - Low director turnover
Potholes on the road to success: Lessons from 4 failed centers

- Mis-match between industry and center needs
  - IP exclusivity vs. consortial research
  - Ability to do pre-competitive research

- Competing funding opportunities for faculty
  - When research is a hot topic, faculty may focus winning on big $

- Membership composition issues
  - Economic setbacks for an entire industry
  - Excessive heterogeneity limits cohesive research
  - Need balance between shared interest and diversified support

- Structural weaknesses
  - Potential for reduced university support at Center transition points
  - New Univ. leadership may not understand value
  - All sites don’t pull their weight
  - PR problems

- Lack of leadership/ Botched succession planning
  - No successor/assigned successor; reduced resources/ops support; multiple transitions

*Context dependent potential for cascading failures*
Strategies for Long-term Success: Lessons from 4 sustained centers

- **Strategic** planning is KEY!
- Anticipate and adapt to changes in industry and national policy
  - Research maturation, globalization, consolidation, new policy initiatives/national priorities
- Deepen engagement with members by developing multiple center champions within the firms
- Plan for director transitions through mentoring and succession planning
- Proactive targeted member recruiting
- Facilities as resources for members AND the larger university/industry community
- Adopt an entrepreneurial approach to securing additional resources
- Partner with local/regional economic development initiatives
Strategies for Long-term Success: Lessons from 4 sustained centers

- Focus on outreach and inreach to highlight Center value and secure broad support
- Consider evolving the operating model to cope with scaling issues and enhance breadth of impact
  - Keep what is working – no need to reinvent the wheel!
  - Develop operational innovations
  - Topical interest clusters developed using planning grant model
  - Develop membership enhancement mechanisms – overhead-reduced contracts, scoping projects, short courses, access to equipment/facilities
    - Enhanced value for members and additional resources for the Center
REMBRANTS IN THE ATTIC: UNLOCKING THE HIDDEN POTENTIAL OF IUCRC EVALUATION STUDIES
SUPPLEMENTAL AND TARGETED STUDIES

- Faculty
- Directors/Leaders
- Industry
- Students
- Other/Structure
Faculty

• Describing faculty (process/outcome)
• Communication Networks Within IUCRCs (Eveland; Sonnenwald): social network analysis
• Changes in faculty perceptions over time
• Comparison of IUCRC and IU Project Faculty Perceptions and Goals
• Predicting Faculty Satisfaction (Coberly)
• Predicting Faculty Satisfaction and Organizational Commitment (Coberly)
• Faculty Leadership Roles and Impacts (Davis; Craig)
What’s the Best Way to Partner: IU Centers vs IU Projects*

- **Goal**: to understand the differences and similarities of two different types of partnerships
- **Why care**: Does partnership structure matter?
  - IU Projects: One-on-one cross sector scientific team
  - IU Centers: Multidisciplinary university-based industrial consortium
- **Method**: Questionnaire-based assessment with faculty and industry participants (N ~ 400) perceptions and outcomes
  - T-tests of project vs. center stakeholders

*Gray, Behrens & Johnson, 1986
Goal Importance for Industry Partners

- Patents
- New Products
- Enhance Stud.
- Training
- General Knowl.
- Expan.

IU Project
IU Center
Why on earth would faculty want to get involved in an I/U Center?

- **Goal**: understand what factors promote satisfaction and organizational commitment with center
- **Why care**: Faculty involvement is critical but participation is voluntary
- **Setting**: faculty involved in 30+ centers (IUCRCs + STC)
- **Method**: Cross-sectional; questionnaire-based multivariate causal model; N=200; DV= org. commitment

*Coberly, 2005*
Causal Model of Satisfaction & Commitment

- Funding per Faculty
- Intrinsic Rewards
- Extrinsic Rewards
- Leadership Versatility
- Years in Center

Factors affecting Satisfaction:
- E2 VAR?

Factors affecting Commitment:
- E3 VAR?

Relationships:
- Satisfaction → Commitment
- Satisfaction → E2 VAR?
- Commitment → E3 VAR?
Center Directors/Leaders

- How do directors recruit members
  - Descriptive and predictive
- What is the impact of serving as a center director (Rivers & Gray)
  - How does the center affect director’s careers (human capital)
  - Survey and cases
- What are the leadership dimensions of a director? (Craig)
  - How do leadership dimensions affect center performance?
- Director—Supervisor Influence Processes (Davis)
Employee (or Director) Lifecycle

- Avoid ‘bad’ hires (and associated costs)
- Maximize engagement
- Reduce time to performance
- Reduce attrition

*Particularly for those with unique and valuable skills

- Succession planning
- Sustainability

- Engagement
- Continuous improvement

- Faculty
- Universities

- Bootcamp & other training
- Mentoring

- Infrastructure support
- Policies
Alternative Career Path

“And then I was offered a dean position and then I went through with it because some friends asked me to look at it. I went through with it, I looked at it, and it really took me about half a day to say ‘no.’ And again I just am having fun. I think I am having a lot more impact; I think about the students that we are training, the industries that we are creating.”

- Center director, faculty member

1. Administrative/Managerial
   - Associate professor
   - Professor
   - Dept head
   - Dean
   - Provost

2. Scientific/Technical
   - Associate professor
   - Professor

3. Science- saturated administrative
   - Associate professor
   - Professor
   - Center director
   - (Open innovation champion)
EVALUATING LEADERSHIP DEVELOPMENT IN AN R&D CONTEXT: ASSESSING ALPHA, BETA, & GAMMA CHANGE

S. Bartholomew Craig
Clara E. Hess
Jennifer Lindberg McGinnis
North Carolina State University
Director
Performance Dimensions

- Interpersonal Skill
- Networking
- Embracing Ambiguity
- Broad Thinking
- Team Building & Maintenance
- Ambition & Productivity
- Ethics & Fairness

- Technical Expertise
- Obtaining Resources
- Navigating Bureaucracy
- Task Adaptability
- Balancing Competing Stakeholders
- Fostering Creativity

- Abrasiveness
- Disorganization
- Conflict Avoidance
Sample 360° Items

R&D Leadership Assessment

Instructions
The following items refer to aspects of your Center Director’s leadership. For each item, please indicate where your Director stands with regard to the behavior or characteristic described in the item.

52. Attends to political issues in the university
53. Attends to political issues in external organizations that are relevant to the Center’s work
54. Understands the legal and regulatory landscape of the industries relevant to the Center’s work
55. Operates within the budget

Fostering Creativity & Innovation

56. Willing to take risks with new ideas
57. Encourages “out-of-the-box” thinking—in self and others

Networking

36. Is well-networked in the industries relevant to the Center’s work
37. Seeks opportunities to build new relationships with industry members
38. Leverages professional relationships to benefit the Center’s work

Ambition & Personal Productivity

7. Sets high goals—attempt to get a lot accomplished
8. Encourages others to get a lot accomplished
General Model of Decision-making

1. Informal linkages are established in the research community
2. Potential projects or collaborations are identified and proposed to immediate manager
3. The opportunity is evaluated against organization needs by the gatekeeper, the manager, (and other researchers)
4. If accepted, then additional approvals may be required:
   • Budget approval
   • Legal review
   • Corporate oversight
   • Large firms tend to introduce additional decision points in the process
Industry

- Member benefits – descriptive; changes over time
- Predicting industry satisfaction
- Comparison of IUCRC members and IU project members
- Predicting industry intention to renew (w students)
- Estimating member cost-avoidance
- Assessment of industry gatekeepers (Tansik)
  - What roles to do they play
- Economic impact (Rivers and Gray)
- To join or not to join (Rivers)
Industry

- Predicting industry impacts from various IAB member roles and activities (Tarant)
- Member meeting evaluation (Blakely)
- Member expectations when joining centers (Levine)
- Why do firms join centers (Rivers; also Scarpello)
  - Interviews
  - Questionnaires
- Impact of center research on members (Scott)
  - Technology breakthroughs
- Impact of center research on members (Gray & Rivers)
  - Selected high impact members
- SBIR members on supplements and how they benefit
- Other authors: Santoro
MEASURING THE ECONOMIC IMPACT OF THE NSF INDUSTRY/UNIVERSITY COOPERATIVE RESEARCH CENTER PROGRAM:
A FEASIBILITY STUDY

Denis O. Gray, Ph.D.
Drew Rivers, Ph.D.
with
George Vermont, Ph.D., NSF Expert, IIP

IUCRC Evaluators’ Meeting, Arlington, VA, June 9-10, 2011
IUCRC Econ Impact Model

IUCRC Portfolio

Proof of concept

Center IP

Start-ups on Center IP

$$ Sales

Transfer in: product/ process ideas & technologies

Firm R&D

R&D Efficiency $$

R&D Efficiency $$

R&D Efficiency $$

R&D Efficiency $$

R&D Efficiency $$

R&D Efficiency $$

Process improvements $$ Savings

New or improved products $$ Sales

Customer & supplier spillovers $$

5 yrs 10 yrs 15 yrs
Aggregate Cases

- Retrospective impacts total nearly $1.27B, with a net present value of $1.25B.
- Each dollar invested by NSF-I/UCRC generated an estimated 64.7 dollars in impacts.

<table>
<thead>
<tr>
<th>IUCRC investments &amp; Impacts</th>
<th>TOTAL</th>
<th>IMS</th>
<th>BSAC</th>
<th>IUCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated impacts (present value)</td>
<td>$1267.1M</td>
<td>$846,738,946</td>
<td>$410,727,849</td>
<td>$9,638,633</td>
</tr>
<tr>
<td>Total investments (present value)</td>
<td>$19.6M</td>
<td>$3,133,857</td>
<td>$13,250,712</td>
<td>$3,203,057</td>
</tr>
<tr>
<td>Benefit:Cost Ratio</td>
<td>64.7:1</td>
<td>270.2:1</td>
<td>31.2:1</td>
<td>3.0:1</td>
</tr>
<tr>
<td>Net Present Value</td>
<td>$1247.5M</td>
<td>$843,605,090</td>
<td>$397,477,137</td>
<td>$6,435,577</td>
</tr>
</tbody>
</table>
Students

- Impact on Center Alumni (Scott 1,2,3)
  - Description of impacts; comparison group
  - Assessment of alumni by their supervisor
- Unintended consequences for students (Behrens)
  - Comparison of center and non-center students
- Predictors of student satisfaction and impacts (Schneider)
  - Examination of processes (teams, interdisciplinary, etc.)
Does industry sponsorship and center mode affect academic freedom among students?

- **Goal**: Empirical test for unintended consequences
- **Why care**: Some observers claim that the sky is falling!!
- **Methodology**
  - Cross sectional “known groups” design: students supported by industry vs. other students
  - DV: various; climate for academic freedom
  - N: universities = 6; N: students = 500

Behrens & Gray, 2002
Findings Unintended Consequences

• No differences on “Climate for Academic Freedom” scale
  • Equally free to choose topic and methods and to whom one communicates
• Low climate for academic freedom for those doing applied research and non-U.S. students
A MULTIVARIATE STUDY OF GRADUATE STUDENT SATISFACTION AND OTHER OUTCOMES WITHIN COOPERATIVE RESEARCH CENTERS

Thesis Research
by
Jennifer S. Schneider
& Denis O. Gray
North Carolina State University
## Predicting Satisfaction for Students

R Square = .44

<table>
<thead>
<tr>
<th>Satisfaction</th>
<th>B</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (0 = Female, 1 = Male)</td>
<td>-0.15</td>
<td>0.01</td>
</tr>
<tr>
<td>Interactions: Advisor</td>
<td>0.20</td>
<td>0.00</td>
</tr>
<tr>
<td>Interactions: Industry Members</td>
<td>0.16</td>
<td>0.01</td>
</tr>
<tr>
<td>Technical Project Involvement</td>
<td>0.12</td>
<td>0.03</td>
</tr>
<tr>
<td>Multidisciplinary Center Experiences</td>
<td>0.22</td>
<td>0.01</td>
</tr>
<tr>
<td>Experiential Center Experiences</td>
<td>0.27</td>
<td>0.00</td>
</tr>
</tbody>
</table>
Other Levels of Analysis

- Center performance (structural information)
- Center case studies
- Center self-sufficiency? (McGowen)
- Outcome of multi-center “tie” projects
- Human and social capital analysis (Rivers)
- Strategic planning processes in centers (w Steenhuis)
  - Descriptive
- Space of innovation (Toker)
  - Predictive
- Performance of consortial and “one-on-one” centers?
• 4 failure cases + 1 sustained from interviews
• Cases:
  – Two failed within 1-4 years
  – Two failed within 5+ years
• Conclusions
  – Structural weaknesses: no doctoral programs
  – External factors: industry with exclusive IP interests; lack of absorptive capacity in firms
  – Lack of institutional support especially during transitions
  – Lack of leadership/ Botched succession planning
  – Multiple flaws
• IUCRCs fail for a number of different reasons, and they succeed for a number of different reasons in a variety of forms
• The following cases illustrate the diverse paths to program sustainability for IUCRCs
Does office and laboratory space affect collaboration and innovation?

- **Goal**: understand the extent to which the physical workspace layout of university centers affects collaboration & innovation

- **Why care**: Big investments in the physical plant for “team science”

- **Setting**: 6 large scale university-based centers from across the country

- **Methods**: Mixed method: Questionnaire; Activity Log; Floor Plans; Multiple case

* Toker & Gray, 2008
Collaborative Consultations

Space syntax methodology
Space of TS Findings

- Scientists prefer and utilize face-to-face technical consultations
- Individuals who occupied more “accessible” spaces had more consultations
- Centers that had better workspace designs (intelligibility; common spaces) had more consultations
- Centers that had better workspace designs had higher subjective and objective innovation outcomes
QUESTIONS, SUGGESTIONS, NEXT STEPS