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 Evaluator’s Meeting, Arlington, VA, June 9-10, 2011
Overview

• IUCRC Program Goals
• Project Objectives
• Findings from Phase 1, Current Evaluation--Strengths and Weakness
• Findings from Phase 2, Economic Impact Assessment
• Recommendations and Implications for Evaluation Strategy
I/UCRC Program Goals

Program Goals

1. promote research programs of mutual interest [to industry and university]
2. contribute to the Nation's research infrastructure base
3. enhance the intellectual capacity of the engineering or science workforce through the integration of research and education
4. as appropriate, NSF encourages international collaborations that advance these goals within the global context

Achieved through

• Contributing to the nation's research enterprise by developing long-term partnerships among industry, academe, and government;
• Leveraging NSF funds with industry to support graduate students performing industrially relevant research;
• Expanding the innovation capacity of our nation's competitive workforce through partnerships between industries and universities; and
• Encouraging the nation's research enterprise to remain competitive through active engagement with academic and industrial leaders throughout the world.

IUCRC → Capacity Building
Capacity Building --------> Economic Impact
Research Objectives

1. To assess the strengths and weaknesses of the current impact assessment strategy

   *The objective was addressed during Phase 1 of our project and involved analysis of existing IUCRC impact evaluation data.*

2. To assess the feasibility of improving the program’s ability to obtain credible and persuasive quantitative estimates economic of impact

   *This objective was addressed during Phase 2 of our project and involved collecting additional impact data via a more targeted and interview-based format.*

3. Based on these findings, to make recommendations for a strategy for routinizing the collection of such impact data on an ongoing basis
Project Implementation

**Phase I: Strengths & weaknesses of current assessment strategy**
- IUCRC structural data
  - Funding & leverage
  - Publications
- Process/Outcome data
  - Ratings on benefits/outcomes
  - Open reports of benefits
- Compendium of Technology Breakthroughs (CTB)
  - Coding of vignettes

**Phase II: Impact assessment of targeted centers and beneficiaries**
- Pilot with 2 centers
  - CAPPS
  - CIPM
- Assessment of 3 centers
  - IMS
  - BSAC
  - IUCS
Strengths & weaknesses of current assessment strategy

PHASE I
Relevant Features of Current Evaluation

• **Core Evaluation Activities**
  - Data collected by IUCRC Evaluation Team at NCSU and/or local evaluator at every center
  - Impact data collected annually directly from all firms and faculty PIs via questionnaire
    • Most impact questions ask: “During the last year…”
    • ~ 40% response rate

• **Compendium of Technology Breakthroughs**
  - Targeted Assessment; all centers, some beneficiaries
  - Longer time frame (any thing significant happen)
  - Data collected periodically (3 times in last ten years) from firms by interview
    • Have you received any significant benefit? Please describe. Emphasis on the “story”.

9 June 2011

IUCRC Evaluation Team
I/U CRC Structural data

In the 2009-2010 program year, $9.9M of NSF- I/U CRC investments generated $29.2M from industry and $62.7M from industry and other sources combined.

Industry funding has historically been 3x or more the NSF-I/U CRC investment; combined industry and other sources has been 6x or more.

I/U CRC Program Funding, by Major Source
Past three years (in millions)

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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>NSF-I/U CRC</td>
<td>$9.9</td>
<td>$8.5</td>
<td>$7.7</td>
</tr>
<tr>
<td>Industry</td>
<td>$29.2</td>
<td>$26.0</td>
<td>$28.8</td>
</tr>
<tr>
<td>Industry + Other</td>
<td>$62.7</td>
<td>$54.3</td>
<td>$75.6</td>
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I/U CRC Program Leveraging
Past three years

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>Program to Industry</td>
<td>2.9</td>
<td>3.1</td>
<td>3.8</td>
</tr>
<tr>
<td>Program to Industry + Other</td>
<td>6.3</td>
<td>6.4</td>
<td>9.9</td>
</tr>
</tbody>
</table>
32% of respondents reported a High or Very High impact on R&D, compared to 8% on Commercialization.

43% reported a High or Very impact on their professional networking.
One in three respondents offered an open comment on IUCRC benefits.
70% reported R&D-related benefits, while 10% reported commercial benefits (product or process impacts).
Other benefits included networking, recruiting, and consulting.

**Percentage reporting different benefits from IUCRC participation**

Process/Outcome, open comments (2008-2009, n=91)

- 5% reported a financial impact value
- 31% reported a potentially quantifiable impact
Estimating IUCRC-Wide “Follow-on Funding” ($ firms invested in center triggered research)

Follow-on R&D funding among IUCRC members: Reported and estimated amounts
Reported (n=234); Estimated (n=636)

- Reported, $87
- Estimated (mean), $242
- Estimated (median), $112
- Estimated (50% median), $99

$ millions
CTB example

Ceramic and Composite Materials Center (CCMC)

- Rutgers University, Richard Haber, Director, 732.445.4931, rhaber1@erebus.rutgers.edu
- University of New Mexico, Plamen Atanassov, 505.277.2640, plamen@unm.edu
- Pennsylvania State, James Adair, 814.863.6047x6156, jadair@psu.edu
- Center website: http://ccmc.rutgers.edu/

Ambient Pressure Technology

The Ceramic and Composite Materials Center (CCMC) has developed an ambient pressure process for making aerogels and xerogels. Previously these materials had to be made under critical conditions, a commercially unattractive process. This breakthrough technology spawned a spin-of company, NanoPore, which has developed into a multimillion dollar operation. The ambient pressure technology was patented and licensed to NanoPore, Hoechst, and Texas Instruments. Hoechst used it to develop a multimillion-dollar insulation manufacturing business that subsequently was sold to Cabot. Texas Instruments, TI, used the technology to develop insulation for microelectronic parts. Recently, TI reported copper wire interconnects protected with xerogel insulation for microelectronic devices. TI claims this to be a breakthrough technology that will enable copper wire interconnects to replace aluminum wire interconnects, the current industry standard. For more information, contact Professor William Koenke, 505.277.6824, vonder@unm.edu.

Source: CTB, 2009 (p 39)
CTB: Stages of development

Cases in the *Compendium of Technology Breakthroughs* were coded according type of impact, stage of development, beneficiaries, and economic impacts.

- New products were the least likely to be found (about 10% of cases), while 42% reported a new process, tool, device, or algorithm.
- About one in four cases (28%) included a commercialized technology (chart below).
- About one in three cases (34%) specifically name a current or potential adopter(s).
- Just 5% of cases provided specific economic impact data.

**Percentage of CTB cases at different stages of development and commercialization**

- Undetermined: 17%
- Basic principles: 15%
- POC- experimental: 17%
- POC- relevant envrn: 8%
- Implementation phase: 15%
- Commercialized: 28%
## Conclusions

<table>
<thead>
<tr>
<th>Source</th>
<th>Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Structural data</td>
<td>• documents IUCRC leveraging and outputs measures and supports the establishment of valuable partnerships</td>
</tr>
<tr>
<td>2 Process/ Outcome data</td>
<td>• provides substantial documentation of relatively immediately realized R&amp;D impacts...</td>
</tr>
<tr>
<td></td>
<td>• ...but much less evidence of and information about commercialization outcomes</td>
</tr>
<tr>
<td></td>
<td>• most informants were unwilling or unable to provide economic impact estimates for R&amp;D and commercialization outcomes</td>
</tr>
<tr>
<td>3 Compendium of Technology Breakthroughs</td>
<td>• many of these breakthroughs were still in their early stages</td>
</tr>
<tr>
<td></td>
<td>• respondents were frequently unwilling or unable to provide economic impacts--in only 5% of the cases do informants provide an impact estimate</td>
</tr>
<tr>
<td></td>
<td>• some impacts may be very significant</td>
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IUCRC Evaluation Team
Overarching Questions

• Does the lack of evidence on commercialization outcomes suggest the program does not produce these kinds of benefits?

• Do these commercialization findings (or lack thereof) have more to do with our methodology?
Impact assessment of targeted centers and beneficiaries

PHASE II
PHASE II

Methodology

1. Planning: develop, pilot, and refine the study protocol
2. Implementation: Select target centers and identify beneficiaries
3. Data collection: Interview beneficiaries
4. Reporting: Analyze interview data and prepare report
**Framework: Benefit:Cost Analysis**

- Analysis recommended by Office of Management & Budget
- We leveraged published reports from the Advanced Technology Program (ATP)
- Criticism: does not reflect the complexity of the innovation process

<table>
<thead>
<tr>
<th>Metric</th>
<th>Utility</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefit-Cost Ratio (BCR)</td>
<td>Good for comparisons among different “projects”</td>
<td>The ratio of the present value of estimated benefits to the present value of costs. Both benefits and costs are inflation-adjusted to the initial operating year of the center. Real benefit and cost dollars are brought forward to present values using a 7% discount rate. A BCR greater than 1 indicates a project that performed above a breakeven threshold.</td>
</tr>
<tr>
<td>Net Present Value (NPV)</td>
<td>Considered the most (theoretically) accurate measure of economic value (Tassey, 2003). Result depends on the selected discount rate.</td>
<td>This is the net benefit of the investment in the center or program. We use the same information from the BCR calculation to calculate the NPV. The present value of costs is subtracted from the present value of estimated benefits.</td>
</tr>
</tbody>
</table>
| Internal Rate of Return (IRR) | Good for assessing project returns against a benchmark rate; is biased toward projects that begin generating returns quickly (i.e., process innovations) | This is the discount rate that makes the NPV = 0 or BCR = 1; in other words, this is the opportunity cost of capital that would make the investment a breakeven venture. The IRR can be compared against the recommended 7% discount rate applied to NPV and BCR calculations: an IRR that exceeds 7% could represent a worthwhile investment. 

**NOTE:** Since the IRR requires streams of costs and benefits, we were unable to calculate an IRR.
Study Assumptions

Assumptions

1. It may take years for IUCRCs to conduct research that influences firm R&D and then produce economically significant impacts.

2. Evidence suggests a disproportionate percentage of the total economic impact from centers is attributable to a small number of “high impact findings/inventions.”

3. Some impacts are more readily quantified than others.

4. Some impacts may already be realized in commercial products or processes; others may yet to be realized but could be forecasted.

5. Since firms that report benefiting from IUCRCs often do not volunteer quantitative economic impacts,

Data collection should...

1. …Concentrate on a few relatively mature and/or graduated centers

2. …Target high impact beneficiaries.

3. …Focus on R&D cost savings; cost savings from process and product improvements; sales and job creation from new processes and products; and spillover benefits to users and adopters of center technology.

4. …Distinguish between retrospective and prospective impacts.

5. …Utilize a more interactive interview-based methodology and should provide all informants with complete confidentiality about the impacts they report.
Interviewing Beneficiaries

• The director’s relationship with the beneficiaries was pivotal for scheduling interviews
  – Identifying the most likely beneficiaries
  – Establishing a level of trust necessary to share information with the research team

Getting to beneficiaries

Team contacted director

Director identified beneficiaries

Director made email introduction

Team scheduled an interview time

Interview Coverage

How has your firm benefited from involvement in the center?

Have these ideas/technologies reached commercial application? If so, when?

Would you be willing to provide estimates of their economic impact?
Can we obtain estimates of economic impact?
PHASE II

Case: IMS (Center for Intelligent Maintenance Systems)

- Director: Jay Lee
- Launched in 2001
- Multi-site center focused on process monitoring and prognostics
- Market addressed: mature, largely incremental innovations
- 6 interviews: NPV of $843.6M with prospective benefits through 2015 of roughly $1.4B.

Table: IMS economic metrics

<table>
<thead>
<tr>
<th>IUCRC investments &amp; Impacts</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated impacts (present value)</td>
<td>$846,738,946</td>
</tr>
<tr>
<td>Total investments (present value)</td>
<td>$3,133,857</td>
</tr>
<tr>
<td>Benefit:Cost Ratio</td>
<td>270.2:1</td>
</tr>
<tr>
<td>Net Present Value</td>
<td>$843,605,090</td>
</tr>
</tbody>
</table>

Table: Typical and outlier cases for IMS

<table>
<thead>
<tr>
<th>Case</th>
<th>Impacts</th>
<th>Short description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$0.4M</td>
<td>The company discovered the IMS center through a university relationship involving the company’s core technology. Five years later the company is applying IMS technology to predict and prevent machine failures and improve operational efficiencies.</td>
</tr>
<tr>
<td>E</td>
<td>$500.0M</td>
<td>This company is deploying IMS-based knowledge and technology throughout its global network of manufacturing facilities. Improvements in predictive maintenance and machine performance have resulted in an estimated several million per plant in savings, or about half a billion dollars annually.</td>
</tr>
</tbody>
</table>
This (and other) informant described the center as an enabler or catalyst. In this case, the firm engaged in a multi-year collaboration effort with a supplier to bring the technology to commercial application.

- Member asks for a consult
- In-house development
  - The firm independently pursued the solution proposed by the director
- Collaboration with supplier
  - The firm engaged in collaboration with a supplier to further develop the technology
- Filed patent
  - The firm and supplier jointly filed for patent
- Branded/ sold by supplier
  - The supplier now sells the technology as a branded product

An IMS director provided consultation on a manufacturing process problem

5 to 7 years
PHASE II

Case: BSAC  (Berkeley Sensor and Actuator Center)

- Director: John Huggins
- Launched in 1986
- Multi-site center focused advanced integrated circuit technologies
- Market addressed: emerging, potentially explosive
- 5 interviews: NPV of $397.5M (forecasted benefits too uncertain to estimate)

### Table: BSAC economic metrics

<table>
<thead>
<tr>
<th>IUCRC investments &amp; Impacts</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated impacts (present value)</td>
<td>$410,727,849</td>
</tr>
<tr>
<td>Total investments (present value)</td>
<td>$13,250,712</td>
</tr>
<tr>
<td>Benefit:Cost Ratio</td>
<td>31.2:1</td>
</tr>
<tr>
<td>Net Present Value</td>
<td>$397,477,137</td>
</tr>
</tbody>
</table>

### Table: Typical and outlier cases for BSAC

<table>
<thead>
<tr>
<th>Case</th>
<th>Impacts</th>
<th>Short description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>$11.0M</td>
<td>The company launched a successful spin-off company based in part on technology linking back to BSAC. Revenues are estimated at over $10M. Further a former BSAC student and now current employee of the company has developed a new technology for the vehicle safety market. If successful, the new technology could generate several hundred million in revenue for the company in the next 5 years.</td>
</tr>
<tr>
<td>D</td>
<td>$85.0M</td>
<td>This start-up company was founded by a former BSAC student. A recently landed large contract with a global consumer brand accelerated the company's growth, with revenues nearing $100M mark. Double-digital growth rates are expected in the coming years.</td>
</tr>
</tbody>
</table>
BSAC: Attribution Event Example

- In this case, the informant argued the technology would not have been developed without BSAC, citing the unique, leading-edge expertise in MEMS technologies present in the BSAC center.
Case: IUCS (Industry-University Center for Surfactants)

- Director: P. “Som” Somasundaran
- Launched in 1998
- Multi-site center focused on environment-friendly surfactants and particulates
- Market addressed: transitioning into green chemistry in manufacturing
- 6 interviews: NPV of $6.4M (forecasted benefits too uncertain to estimate)

Table: IUCS economic metrics

<table>
<thead>
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<tbody>
<tr>
<td>Estimated impacts (present value)</td>
<td>$9,638,633</td>
</tr>
<tr>
<td>Total investments (present value)</td>
<td>$3,203,057</td>
</tr>
<tr>
<td>Benefit:Cost Ratio</td>
<td>3.0:1</td>
</tr>
<tr>
<td>Net Present Value</td>
<td>$6,435,577</td>
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</tbody>
</table>

Table: Typical and outlier cases for IUCS

<table>
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<tbody>
<tr>
<td>E</td>
<td>$0.4M</td>
<td>This multi-national corporation takes advantage of the center's facilities and expertise in surfactants. The company now employs several center graduates, and also benefits from applying center knowledge toward the enhancement of existing product lines. These product benefits could not be quantified.</td>
</tr>
<tr>
<td>F</td>
<td>$4.0M</td>
<td>This relatively new member of IUCS applies center knowledge and technology toward reducing production costs. The impacts are pervasive, but the informant estimates about $3M from improved product performance, and about 0.5M in saved research costs per year.</td>
</tr>
</tbody>
</table>
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>
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<td>Estimated impacts (present value)</td>
<td>$1267.1M</td>
<td>$846,738,946</td>
<td>$410,727,849</td>
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<td>Total investments (present value)</td>
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<td>Benefit:Cost Ratio</td>
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<td>270.2:1</td>
<td>31.2:1</td>
<td>3.0:1</td>
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<tr>
<td>Net Present Value</td>
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<td>$843,605,090</td>
<td>$397,477,137</td>
<td>$6,435,577</td>
</tr>
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</table>
Pilot Case Attribution Example
CAPPS: Attribution Event Example

- Director reported the commercialization was directly and strongly tied to center research even though the commercializers were not members and the events spanned nearly two decades.

9 June 2011

IUCRC Evaluation Team
Attribution in general

Paraphrasing informants’ responses to attribution:

• *Impacts on our company probably would have taken longer to realize without the center, but its difficult to say for sure.*

• *Without the center we would not be in the market position we are in today. There are other, similar centers but this one offers benefits that others do not (like proximity, other members, accelerated learning).*

• *We would not have pursued this line of technology had we not been introduced to the center.*

• *We would not have been able to do this ourselves... however, the center would not have been able to do this without us. A collaborative effort was the best approach.*

• *The center sparks the idea but we develop and implement it into our operations.*

• *Without the center’s technology, we would have been delayed by two years.*
Proposed Impacts Model

Where do quantitative impacts come from?

- R&D Efficiency
- Process improvements
- New or improved products
- Customer & supplier spillovers

5 yrs
10 yrs
15 yrs
Conclusions: Data Collection & Methodology

- Targeting Mature IUCRCs
- Gaining Cooperation of Center Directors and Staff
- Gaining Cooperation of Nominated Beneficiaries
- Obtaining Impact Estimates with Confidentiality
- Collecting Data via Phone Interviews
- Targeting “Outlier” Beneficiaries
- Validity and Credibility of Information provided
Summary of Findings

- Current evaluation approach does a good job addressing the program’s explicit partnership and capacity building goals.

- However, current evaluation approach does not offer accurate documentation of the economic value of center activities.
  - R&D impacts but some commercialization and few economic estimates

- Pilot data collection resulted in economic valuation following a benefit:cost analysis framework proved successful in obtaining credible quantitative estimates of economic value of specific impacts:
  - Improved R&D efficiencies
  - Improved or new processes
  - Improved or new products
  - Spillover benefits to technology adopters

- Results from three mature IUCRCs show a total present value of realized impacts of $1.27B, and a net present value of $1.25B.

- The IUCRC program (and at least some individual centers) is having a significant and measurable economic impact on member companies and other beneficiaries.

- Methodological challenges were discovered, like causal connection, that should be overcome prior to implementing the assessment program-wide.
Recommendations for Evaluation Effort

Caution: If recommendations are accepted, methodology will be developed over next couple of months with input from evaluators
Recommendation 1

- Continue the existing IUCRC evaluation effort but **modify the responsibilities of on-site evaluators to include collection of economic impact data.**

  - **Assumption:** Current evaluation is providing value but falling short on documenting economic impact

  - **Changes:**
    
    - Eliminate Exit Interview from evaluator responsibilities
    
    - Some changes in Process/Outcome Questionnaire
    
    - As center matures, increasing responsibility to conduct follow-up economic impact interviews with nominated beneficiaries at your center.
Recommendation 2

- Modify the Process/Outcome Questionnaire to **emphasize relatively proximate quantitative economic impacts**.

- **Assumption**: In open-ended answers to “how did you benefit… please quantify”, many IAB provided estimates of specific R&D efficiencies that could be captured more reliably (Gray & Steenhuis, 2003; *Scientometrics*)
  - “cost avoidance”: research they would have done any way but didn’t have to because of center research
  - “research amplification”: projects they would like to do but couldn’t justify but got benefit of because of center research
  - “cost savings”: ongoing projects that reached closure quicker because of center research
  - Other impacts …

- **Methodology**:
  - Forced choice categorization of projects
  - Get scientist months of effort and calculate savings
Recommendation 3

- Develop a standardized protocol and training system that facilitates collection of the kind of economic impact data collected in this assessment by local evaluators.

- **Assumption:** Evaluators are in a better position than we were to collect economic data because they know center research, know beneficiaries, have opportunity for face-to-face interviews.

- **Methodology:** Will be based on our assessment but is a work in progress…
  - Increased emphasis later in center life cycle
    - Must pursue leads but no expectation of a “homerun” (every year or ever)
  - Nominations from director, faculty and members
  - Broadened list of beneficiaries: current members; past members; licensees; spin-outs; ex-students
Recommendation 3 (continued)

- Telephone or face-to-face interview methodology
  - Interview guide with instructions
  - Discussion and training at evaluator meetings
  - On-site consultation from member of evaluation team

- Issues to address
  - Scheduled follow-up for emergent technologies or forecasted impacts
  - Clarify and obtain IRB/OMB approval
  - Maintaining confidentiality at local level
Center Impacts

Quantitative estimates come in the form of:

1. R&D cost savings and efficiencies
2. New and improved processes
3. New and improved products
4. Spillover impacts for technology adopters

Other impacts are likely quite significant but non-quantifiable (e.g., influence on R&D, networking)
Recommendation 4

- Develop a simple and **compelling methodology for reporting the impact data** to important stakeholder groups (e.g., dashboard +)

- **Assumption**: NSF needs compelling evidence of center impacts

- **Methodology**:
  - Program level-of-analysis
    - Aggregate program impacts (e.g., total leveraging; total students)
    - Economic impacts based on extreme beneficiaries
      - Portfolio approach: could justify whole program based on a couple of highly successful breakthroughs
  - Center level-of-analysis
    - Need to be cautious that a capacity building program doesn’t expect blockbusters quickly or from every center
    - Could attempt a more concise dashboard approach especially at renewal points
Dashboard Example

Center for Center Evaluation (CCE)

<table>
<thead>
<tr>
<th>Metric</th>
<th>CCE</th>
<th>IUCRC</th>
<th>(avgs)</th>
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<tbody>
<tr>
<td><strong>Inputs</strong></td>
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<td></td>
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<tr>
<td>PhD Students</td>
<td>12</td>
<td>16.1</td>
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<tr>
<td>Faculty</td>
<td>20</td>
<td>14.7</td>
<td></td>
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<tr>
<td>Members</td>
<td>14</td>
<td>18.1</td>
<td></td>
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<tr>
<td>Total fees</td>
<td>$750k</td>
<td>$626k</td>
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<tr>
<td>Total funding</td>
<td>$1.72M</td>
<td>1.73M</td>
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<tr>
<td>Mtg attendance</td>
<td>60%</td>
<td>85%</td>
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<tr>
<td><strong>Leveraging</strong></td>
<td></td>
<td></td>
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<tr>
<td>to Industry</td>
<td>2.8:1</td>
<td>2.9:1</td>
<td></td>
</tr>
<tr>
<td>to Total funding</td>
<td>4.4:1</td>
<td>4.6:1</td>
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<tr>
<td><strong>Outcomes</strong></td>
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<td>Publications</td>
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<tr>
<td>Patents</td>
<td>0</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Presentations</td>
<td>45</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>Mbr satisfaction</td>
<td>75%</td>
<td>75%</td>
<td></td>
</tr>
<tr>
<td><strong>Economic impacts</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cost avoidance</td>
<td>$100k</td>
<td>$100k</td>
<td></td>
</tr>
<tr>
<td>cost savings</td>
<td>$75k</td>
<td>$250k</td>
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<tr>
<td>follow-on funding</td>
<td>$1.2M</td>
<td>$2.5M</td>
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</table>

**CCE history & assessment**

The CCE center is engaged in research on multi-disciplinary R&D collaboration and innovation outcomes. The center launched as a single site CRC in 2004 with 6 members. In 2006 the center integrated two additional university sites and expanded its members to 14. Member churn has been relatively high, in some years losing 25% of its member base. Faculty involvement remains strong, though student participation and graduation rates fall short of program averages. Member satisfaction is in line with program averages, though meeting attendance and follow-on funding has been decreasing since 2007. Data suggest…
Recommendation 5

• Link the revised assessment activities with the efforts to periodically collect “technology breakthrough” cases.

  • Assumptions: Many stakeholder groups may want “success stories” and interesting pictures as much or more than disembodied economic impact estimates; should try to get both but confidentiality promises may require economic impacts and stories to be produced separately.

• Methodology: work in progress
  
  • Some informants may not require complete confidentiality
  
  • Report cases and economic totals completely separately
  
  • Coordinate Technology Breakthrough Compendia with identification of “successes”
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Contacts:
Denis O. Gray, Ph.D.                               Drew Rivers, Ph.D.
North Carolina State University                 North Carolina State University
Ph: 919-515-1721                                  Ph: 919-515-3237
Email: denis_gray@ncsu.edu                        Email: dcrivers@ncsu.edu

QUESTIONS?