New IUCRC Evaluator Protocol
Incorporating Economic Impact Assessment
IUCRC Evaluator’s Meeting
June 6, 2013

Denis Gray
North Carolina State University
Purpose and Overview

• Review and debrief the implementation and success of the changes made in the evaluator protocol during 2012-13

• Make recommendations for continuing implementation
  – Need to move past pilot stage

Overview

– Part 1: Process Outcome Questionnaire Changes
  • Discussion

– Part 2: Interview-based Economic Impact Interviews
  • Discussion
Background

• Increasing expectation and pressure from Congress and oversight agencies to demonstrate quantitative impact estimates of STI programs
  – IUCRC no exception

• Completed *Measuring Economic Impacts of IUCRCs: Feasibility Study* (Gray & Rivers)
  – Documented economic impacts
  – Recommended changes to the IUCRC evaluation protocol
    • Changes to Industry Process Outcome Questionnaire (Part 1)
    • Interview-based economic impact assessment (Part 2)
IUCRC Economic Impact Model

How and when do quantifiable economic impacts show up?

Transfer in: product/process ideas & technologies

- R&D Efficiency
- 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 **$

- Start-ups on Center IP
- **$ Sales**

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IUCRC Portfolio

Firm R&D

--------------------- 5 yrs --------------------- 10 yrs --------------------- 15 yrs ---------------------

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June 2013

IUCRC Evaluation Team
Part 1: Process Outcome Changes
Recommendations

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

2. **Develop a standardized protocol and training system that facilitates collection of economic impact data by local evaluators.**

3. **Develop a simple and compelling methodology for reporting the impact data to important stakeholder groups.**

4. **Link the revised assessment activities with the efforts to periodically collect “technology breakthrough” cases.**
What is R&D Efficiency?

• Operational definitions are hard to find but…
  – *From this vantage point R&D capabilities can be recognized as connected with knowledge about how to search efficiently... Strong knowledge enhances efficiency both by enabling R&D to proceed on a generally better set of candidate projects, and by enabling the set worked upon to reflect more accurately particular demands and needs.* *(Nelson, 1983)*
  – *Therefore, the efficient usage of the scarce resources devoted to R&D becomes increasingly important, especially in a globalized world... Countries utilizing their R&D resources inefficiently will be penalized with a growth discount.* *(Cullmann et al, 2009)*
What is R&D Efficiency

- Companies can realize a 30% or greater increase in R&D efficiency—as measured by the return on invested R&D dollars—through proper planning processes and better allocation of resources. (Alix Parnters)
- Although the era of open innovation has begun for many firms, we still lack a clear understanding of the mechanisms, inside and outside of the organization, when and how to fully profit from the concept...However, only first approaches of measurement systems and key performance indicators are known, which makes it hard to evaluate open versus closed innovation approaches. (Enkel, Gassman, Chesbrough, 2009)
Calculation of Economic Impacts ($)

• Research amplification (Q1 & Q2a)
  – \( \text{Percent Rel.} \times \text{N of Center Proj.} \times \text{Scien. Months} \times \$/\text{Scien. Month} \) (Gray & Steenhuis, 2003)

• **Cost Avoidance** (Q2b & 2a)
  – \( \text{N of Proj. Avoid} \times \text{Scien. Months} \times \$/\text{Scien. Months} \) (Gray & Steenhuis, 2003)

• **R&D Cost Savings**

• Accelerated R&D savings (5a):
  – \$ saved by accelerated projects

• Avoided R&D (5b):
  – \$ avoided by not starting projects

• **Stimulated R&D** (5c):
  – \$ invested in new or revised R&D directions
Defining Research Efficiency Measures

Member Research

- Research Cost Avoidance
  - Project Activity
  - Project Activity
  - Project Activity

- Research Cost Savings
  - Project Activity
  - Project Activity
  - Project Activity

- Stimulated R&D (follow-on funding)
  - Future Project Activity
  - Future Project Activity
  - Future Project Activity

Center Research

- Proposed Project
- Project Activity
- Project Results

New Project Activity
Implementation

• Questionnaire Implementation
  – Some snafus
    • Several centers used the old questionnaires (N=61)
      – Oops vs. began collecting before questionnaires available
    • System of pre-coding questionnaires with N of Center projects needs to be re-worked.
  – Respondent compliance
    • Response rate consistent with previous years
    • Negligible missing data
    • Some feedback:
      – “Way too early to observe these impacts”
      – “Not sure I can make these estimates”

• Overall
  – No serious problems
Findings
Stimulated R&D (follow-on funding)

• What changed?
  – **Old:** Approximately how many **center-stimulated** research projects were supported by your organization (include internal projects and projects contracted to outside performers).
  – **New:** Access to Center research findings and outputs has **triggered the development** of new R&D projects at my organization, or significantly redirected current R&D. (Y/N) (5c)
Value of Center-Stimulated Projects: FY 2011-2012

49% Yes

Number of members

Dollars (in thousands)
Estimating IUCRC-Wide Center-Stimulated Funding

• Program-wide center-stimulated funding for 11-12 is $44.08 million

• There is a fundamental problem estimating both center and program-wide value of center stimulated projects
  – Response rate is running at ~40% of total population

• Our reported value is a VERY conservative estimate
  – Assumes none of the 60% non-responders invested in center stimulated projects

• Need to find a defensible approach to estimating
  – Non-responders
    • mean
    • median
    • 50% of median
Estimating IUCRC-Wide Follow-on Funding in Millions

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Reported (N=309)</th>
<th>Total Population Estimated (N=815)</th>
<th>Total Reported plus Non-respondents Estimated (N=506)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-12</td>
<td>$109.19</td>
<td>$94.68</td>
<td>$69.38</td>
</tr>
<tr>
<td></td>
<td>$44.08</td>
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</tr>
</tbody>
</table>

2011-12 (in Millions of Dollars)
Research Cost Savings

• New questions
  – Accelerated R&D savings (5a): Y/N
  – Avoided R&D (5b): Y/N
  – “If yes, taking into account personnel, facility and related costs how much would you estimate these accelerated AND/OR avoided project(s) would have cost your organization?”

• Industry perspective: “Some people do not realize how costly it is to not cut something off when your realize it is not going to work”. R&D Manager of Large Chemical Company
## Research Cost Savings

### B. Research & Development Benefits

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>5a. During the past year, access to Center research findings and outputs has helped accelerate the pace and/or completion of some R&amp;D projects already underway at the organization</td>
<td>199</td>
<td>111</td>
</tr>
<tr>
<td>5b. During the past year, access to Center research findings and outputs has helped the organization to decide against initiating a new project we otherwise would have conducted.</td>
<td>161</td>
<td>148</td>
</tr>
<tr>
<td>Yes to Either / No to Both</td>
<td>231</td>
<td>78</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>199</td>
<td>111</td>
</tr>
<tr>
<td>%</td>
<td>64.2</td>
<td>35.8</td>
</tr>
<tr>
<td>N</td>
<td>161</td>
<td>148</td>
</tr>
<tr>
<td>%</td>
<td>52.1</td>
<td>47.9</td>
</tr>
<tr>
<td>N</td>
<td>231</td>
<td>78</td>
</tr>
<tr>
<td>%</td>
<td>74.8</td>
<td>25.2</td>
</tr>
</tbody>
</table>
# Research Cost Savings

*If yes, taking into account personnel, facility and related costs how much would you estimate these accelerated AND/OR avoided project(s) would have cost your organization.*

<table>
<thead>
<tr>
<th>Member Level Scores</th>
<th>Mean</th>
<th>Median</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $ value of accelerated/avoided projects (thousands) per respondent org.</td>
<td>226.90</td>
<td>50.00</td>
<td>813.13</td>
</tr>
<tr>
<td>Sample: all respondents: N of respondents = 255 ; N of Centers= 39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Center Level Scores</th>
<th>Mean</th>
<th>Median</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. $ value of accelerated/avoided projects (thousands) per center</td>
<td>1483.59</td>
<td>850.00</td>
<td>2524.86</td>
</tr>
<tr>
<td>Sample: all respondents: N of respondents = 255 ; N of Centers= 39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Program Level Scores</th>
<th>Program Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. Total $ value of accelerated/avoided projects supported by respondent orgs.</td>
<td>$57,860,000</td>
</tr>
<tr>
<td>Sample: all respondents: N of respondents = 255 ; N of Centers= 39</td>
<td></td>
</tr>
</tbody>
</table>

*It is worth noting that since only 41.53% of all members completed the questionnaire; this is a very conservative estimate of the value of accelerated/avoided projects supported by members.*
Research Cost Avoidance

• Background
  – Based on previous research on IUCRC (Gray & Steenhuis, 2003)
  – Builds on prior research on estimating impact of government support of R&D
    • Link 1996: Production function approach: relative value exceeds alternative investments
    • Link and Scott, 1998: evaluation of cost structures for alternative ways to achieve the same output (counter factual evaluation model)
      – Demonstrate that relative value exceeds alternatives
Research Cost Avoidance

• Definition: *Research cost avoidance is savings a firm obtains by having “necessary” research projects performed by a center rather than performing them internally.*

• Example: If a firm reports that a particular “necessary” project would cost $100,000 to carry out internally (counterfactual estimate) but that project was actually carried out by a center to which they pay a $50,000 membership fee that firm has avoided $50,000 of R&D costs.
Member Evaluation of Center Projects

- Not relevant to a given member: 50%
- Relevant to a given member: 29%
- Relevant and high priority for a given member: 21%

RCA: Relevant but not high priority
Research Cost Avoidance

• Calculation:
  – \( RCA = \sum C_f - C_c \)
    - Firm cost \( (C_f) \) is calculated as follows: \( C_f = N_{\text{projects}} \times N_{\text{sm}} \times C_{\text{sm}} \).
  – \( N_{\text{projects}} \) = number of center projects a firm considers “high enough priority they would have conducted them internally or by contract” (Q1b)
  – \( N_{\text{sm}} \) = how many scientist months those projects would take to complete. (Q1c1)
  – \( C_{\text{sm}} \) = the cost of a scientist month (archival)
    - (Salary ($88.5k) + Fringe (35%) + indirect (50%)) / 12 = $14,939
  – \( C_c \) = average cost of center membership
RCA Findings

N of Projects Avoided

Average N of projects avoided = 2.29
N of months to complete a typical center project: FY 2011-2012

Average Months to complete = 13
### RCA Findings

#### Average Research Cost Avoidance (RCA)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Member Level Scores</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Average dollar value (in thousands) of avoided projects per respondent organization</td>
<td>487.55</td>
<td>243.91</td>
<td>847.55*</td>
</tr>
<tr>
<td>Av.RCA member = (N of projects * N of months * Average salary per month) – Primary Fee</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample: N of respondents = 287, N of centers = 41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Center Level Scores</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Average dollar value (in thousands) of avoided projects per respondent organization</td>
<td>4353.40</td>
<td>2897.37</td>
<td>5686.20</td>
</tr>
<tr>
<td>Sample: N of respondents = 287, N of centers = 41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Program Level Scores</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Total dollar value of avoided projects by respondent organizations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RCA program = Av. RCA member * N of members</td>
<td>$153,090,700</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample: N of respondents = 314 N of centers = 45</td>
<td></td>
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</tr>
</tbody>
</table>
## Summary of R&D Efficiency Impacts

<table>
<thead>
<tr>
<th></th>
<th>Member Level Mean</th>
<th>Center Level Mean</th>
<th>Program Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Cost Avoidance</td>
<td>$487,550</td>
<td>$4,353,400</td>
<td>$153,090,700</td>
</tr>
<tr>
<td>Research Cost Savings</td>
<td>$226,909</td>
<td>$1,483,590</td>
<td>$57,860,000</td>
</tr>
<tr>
<td>Stimulated Research Projects</td>
<td>$133,980</td>
<td>$1,001,820</td>
<td>$44,080,000</td>
</tr>
</tbody>
</table>

**Notes:**
- Since Research Cost Avoidance and Research Cost Savings are “savings” and Stimulated Research Projects involves “costs” indices should not be added.
- Since these data only involve feedback from about 40% of members they almost certainly underestimate impacts at both the Center and Program level.
Conclusions

• Implementation of the revised questionnaire went relatively well
  – Need 100% follow through in future
  – Need alternative method of obtaining total number of center projects
  – Members were able to complete the questions (little missing data)
    • “Too early to estimate”, only serious complaint
• Have expanded our ability to quantify “R&D Efficiency” beyond “Stimulated Projects” with impressive estimates
  – Cost Avoidance
  – Cost Savings
• Provides enhanced documentation of the IUCRC impact
• Evaluators may need a RCA excel app to insure accurate calculation
Issues for Discussion

• Where do we go from here? How can we insure we can defend these estimates?
• Are the labels for the indices accurate?
  – Cost avoidance; Cost savings; Follow-on funding?
• Is the wording of the questions demanding enough to defend the estimates?
• Do these estimates have face validity?
  – What do members say about these estimates? Would they be willing to use their firm-level estimates internally?
  – How much overlap might there be among the estimates?
  – How careful should we be in the time frame of these impacts (“During the last year”)

June 2013 IUCRC Evaluation Team
Part 2:
Economic Impact Assessment: Interview-based Economic Development Assessment

Denis Gray
North Carolina State University
Purpose and Overview

• Review and debrief the implementation in the evaluator protocol during 2012-13
• Make recommendations for continuing implementation

Overview

– Review the Implementation Plan
– Open Discussion of Evaluator Experience
Recommendations

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

2. Develop a standardized protocol and training system that facilitates collection of economic impact data by local evaluators.

3. Develop a simple and compelling methodology for reporting the impact data to important stakeholder groups.

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

• Impact data collection should become a higher priority for evaluators at centers as they become more mature with an emphasis on Phase 2 and 3 of NSF funding
• Assessment should emphasize data collection via personal interviews of targeted high impact beneficiaries
• Must allow respondent the option of the case and/or the economic estimate remaining confidential in reporting
• A method for logging reports of forecasted impacts will be developed so that the evaluator can conduct follow-up interviews with informants in order to validate these estimates.
• A method for documenting the causal impact of IUCRCs, particularly when other factors may be involved, should be developed
• Since centers graduate from the IUCRC program and these mature centers are likely to be promising sources of transfer-derived economic impact, provisions must be taken to include graduated centers in this procedure
Disclaimers for our new role

• After 30 years of IUCRC evaluation experience and involvement in the economic impact study …
  – Blockbuster impacts happen but they are few and far between
    • Expect a lot “we’re benefiting but nothing really big”
  – Many important center impacts cannot with all the nudging in the world be easily monetized
    • However, they can be documented and let the audience decide on their value

• There is no expectation or quota that every center will produce x breakthroughs or $Y of impact
Proposed economic impact assessment process

[monitor progress for economic impact]

No

Significant Economic impact event?

[typical routine year 1 to 5]

Interview director on emerging developments

Prepare "Success Story" Case in Evaluator Report

Yes

Significant Economic impact event?

Interview external beneficiaries

[typical routine year 6 to 15]

Submit for inclusion/follow up in Tech-Break Compendium?

[Gov't eval; no IRB]

Yes

IUCRC Eval Project reminds evaluator to begin impact assessment 60 days pre-report (150 days pre-grant)

[Confidential or not]

Prepare "Economic Impact" Case in Evaluator Report

No
Supporting Economic Impact Assessment:
www.ncsu.edu/iucrc

Resources for Evaluators > Tasks > Evaluator Report
> Economic Assessment

<table>
<thead>
<tr>
<th>Instrument/Procedure</th>
<th>When Collected</th>
<th>Data Sources</th>
<th>Reports</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluator’s Report</td>
<td>Ongoing including attendance at meetings, etc.</td>
<td>All Center participants, Center documents. Must include Semi-Annual Meeting</td>
<td>Written at end of planning grant, updated annually*</td>
<td>Full Report to Director for inclusion in IUCRC renewal application;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Best Practice Checklist, the Evaluator Report Cover Sheet, and</td>
<td></td>
<td>copy to NCSU, include cover sheet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Success Story of Impact Assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process/Outcome Questionnaire</td>
<td>Annually; August-November. Commence data collection</td>
<td>IAB Members, Faculty</td>
<td>Report for Center Director</td>
<td>Submit data to NCSU</td>
</tr>
<tr>
<td></td>
<td>after one year of operation (exclude planning grant)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meeting Summary Report</td>
<td>At any IAB meeting in which and NSF representative</td>
<td>Center Director, meeting materials, Evaluator observations</td>
<td>Send to NSF shortly after the meeting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>is not present</td>
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</table>

Section Updated: January 3, 2013

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1.2 REQUIRED AND OPTIONAL ACTIVITIES
3.7 Identifying and Documenting IUCRC Center Success Stories and Economic Impacts: Guidelines, Scheduling and Supporting Materials

In a recent report, the NCSU IUCRC Evaluation Team was able to demonstrate that they could document significant economic impacts in mature IUCRCs by engaging in a proactive assessment strategy that involved either face-to-face or telephone interview methodology and provision of confidentiality, if requested.

Supporting Materials:

The following materials and tools are intended to facilitate the collection of well documented success cases that include credible economic impacts.

- **EconImpact 1**: Guidelines for identifying beneficiary organizations
- **EconImpact 2**: Guide for first contact briefing with Center director
- **EconImpact 3**: Sample guide for interview with Center director
- **EconImpact 4**: Sample email from Center director to beneficiary
- **EconImpact 5**: Sample email from evaluator to beneficiary
- **EconImpact 6**: Guide for pre-screening interview with beneficiary
- **EconImpact 7**: Guide for interview with beneficiary
- **EconImpact 8**: Sample summary report of impacts
Coaching help for impact assessment

- NSF has provided travel and effort in the budget of the IUCRC Evaluation Project for telephonic and/or in person coaching for impact assessment interviews
  - Contact NCSU Evaluation Team
## Resources for conducting assessments

### Significance Economic Impact Event?
- **No**: Continue with typical routine year 1 to 5.
  - Contact director, informants on impacts

- **Yes**: Proceed with typical routine year 6 to 15.
  - Interview director on emerging developments
  - Interview external beneficiaries

### Monitoring Progress for Economic Impact
- **Yes**: Prepare “Success Story” Case in Evaluator Report
- **No**: Significance Economic Impact Event?

### Economic Impact Event?
- **Yes**: Submit for inclusion/follow up in Tech-Break Compendium?
  - [Confidential or not]
  - IUCRC Eval. Project reminds evaluator to begin impact assessment 60 days pre-report (150 days pre-grant)

- **No**: Prepare “Economic Impact” Case in Evaluator Report
  - [9,10,11]
How Evaluator Duties Change

- Begin exploring potential impacts earlier in reporting year
- Solicit nominations from multiple sources
- When warranted, engage in personal and/or telephonic interview with nominated beneficiary
  - Solicit help from IUCRC Evaluation Team on interviewing technique
  - Ask George Vermont what “SWAG” means
- Contact beneficiaries who are not members
- Engage in subsequent follow up interviews for early stage impacts that have forecasted economic value (document in Evaluator Report)
- Clarify whether case and/or economic impact must be kept confidential
- Prepare local and national report according to confidentiality understanding
Issues for discussion

- How did the reminder notification system work?
- Identifying potentially “high impact” beneficiaries?
  - Interviewing my director and others about possible beneficiaries
- Getting access to potential beneficiaries
- Usefulness of the tools on the website
- Conducting the beneficiary interview
  - To be or not to be confidential
  - How to get an economic impact estimate
- What and where of my success story/economic impact report
- What should be the frequency of this activity?
- How can and should this activity be integrated with other “economic impact” assessment activities
- General discussion: What else?