Methods for Evaluation of the National Science Foundation’s Experimental Program to Stimulate Competitive Research (EPSCoR): Qualitative Analyses/Enhanced Research Base

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Influence university, 
departmental policies 
and programs
Policy and program 
changes
Faculty hires
Faculty hires
Better funded research 
staff and research 
projects
Collaborations and 
academic-industry 
co-funding of research
New equipment and 
facilities research 
services
Research and 
innovation plans
STEM education 
programs; documents 
granted; graduates 
move to STEM careers
More spending and 
demographically 
broadened STEM 
workforce
More STEM workers 
and demographically 
broadened STEM 
workforce
State S&E funding 
programs created or 
expanded
Increased award 
success rates
Larger awards received
Stronger universities
Increased collaboration 
(cross-university, with 
industry, and within 
state)
More and higher quality 
research and 
publications
More faculty submit 
proposals
More awards received
New and existing 
faculty retained
Added incentives for 
research
Broader impact: 
decreased 
concentration of S&T 
funding
Legislative objective: 
competitiveness for 
Federal research 
funding increases

Legislative objective: state S&E research and education base increases
Broader impact: enhanced capabilities to support innovation/economic development

Resource Base
- Number of universities and colleges and quality of their S&T programs
- State-level policies and institutions supporting S&T
- Sociodemographic distribution of population in jurisdiction

Inputs/Context

Activities
- Influence university, departmental policies and programs
- Support faculty hiring
- Seed funding, student and post-doc support
- Support thematic/large-scale research
- Support research infrastructure/cyberinfrastructure
- Collaboration development
- State Committee plans and coordination
- Innovation activities and industry support
- Activities to broaden participation in STEM

Outputs
- Policy and program changes
- Faculty hires
- Better funded research staff and research projects
- Collaborations and academic-industry co-funding of research
- New equipment and facilities research services
- Research and innovation plans
- STEM education programs; documents granted; graduates move to STEM careers

Short-Term Outcomes
- Added incentives for research
- More faculty submit proposals
- More and higher quality research and publications
- Increased collaboration (cross-university, with industry, and within state)

Intermediate Outcomes
- New and existing faculty retained
- More awards received
- Increased award success rates
- Larger awards received
- Stronger universities

EPSCoR Eligibility Criteria

NSF EPSCoR Award Types
- Research capacity development (RII Track-1)
- Collaborative research support (RII Track-2)
- Cyberinfrastructure support (RII C2)
- E/O/D support (RII Track-3)
- Co-funding of other NSF single-investigator and small team awards

Congressional Objectives/ Broader Impacts

Sciences and Engineering
- Legislative objective: state S&E research and education base increases
- Broader impact: enhanced capabilities to support innovation/economic development

Science and Technology
- Legislative objective: competitiveness for Federal research funding increases
- Broader impact: decreased concentration of S&T funding

EPSCoR Logic Model
Analysis of Enhanced Research Base: Topics

- Institution-Building
- EPSCoR State Committees
- Education, Outreach, and Diversity (E/O/D)
- Academic Development
- Innovation

Separate database developed for each topic
Focused on activities and outputs—outcome data rarely available
DATA COLLECTION METHODS
Analysis of Enhanced Research Base: Methods

- Literature review on EPSCoR and research capacity development
- Developed EPSCoR logic model

**Qualitative data**
- Survey of EPSCoR jurisdictions
- Interviews of EPSCoR State Committee members
- Analysis of EPSCoR RII proposals and annual reports

**Quantitative data**
- Analysis of National Science Foundation (NSF) awards data
- Analysis of National Center for Science and Engineering Statistics (NCSES) survey data
- Information from journal articles with U.S. authors, as identified through the Thomson Reuters Web of Knowledge
- Analysis of EPSCoR eligibility criteria and NSF eligibility determinations
Jurisdiction Survey

- Two-pronged OMB cleared survey 6/2013 -
  - Life-of-program data template (1/jurisdiction, all years).
  - Faculty members hired through EPSCoR;
  - Graduate students and postdocs supported by EPSCoR;
  - Equipment purchased using EPSCoR funds;
  - EPSCoR-associated publications;
  - EPSCoR-associated patents, licenses, and startup companies;
  - Degree programs initiated - Web-based 34 question qualitative instrument (1/award, up to 8/jurisdiction)
  - Aspects of EPSCoR activities, outputs, and outcomes
State Committee Interviews

- OMB-cleared protocol conducted with the leaderships of State Committees between August and November 2013
- Covered State Committee composition, organization, roles, and activities and how these elements have evolved over time.
Analysis of Proposals and Annual Reports

• In fall 2011, NSF provided access to EPSCoR proposals and annual reports for RII awards 1997-2011 from its FastLane data system.
  – New RII awards made in FY 2012 and beyond were not included.

• Older awards: STPI researchers traveled to the National Archives repository in Kansas City, Missouri, to copy records from NSF’s historical EPSCoR files.
  – Documents were photographed and then compiled into PDF for analysis.

• To extract information from the documents, STPI researchers developed a coding framework that was implemented using the NVivo qualitative research analysis software package.
nVivo Snapshots

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IDA SCIENCE AND TECHNOLOGY POLICY INSTITUTE
THEMATIC CODING OF DATA
Institution-Building: Definition

• Activities coded as “institution building” are those intended to create capacity at the level of the institution, rather than at the level of the individual department (which is captured under “Academic Development”)

Institution-Building: Categories

• Faculty research and teaching policy
• Student and faculty recruitment/educational capabilities
• Creation of research-supporting offices and sustaining administrative workforce
• Technology transfer organizations
• Institutional structures for promoting diversity
• Laboratory management
• Renovation and new construction
Institution-Building: Supplementary/Comparative Analyses

• Internet searches of 47 lead universities in EPSCoR jurisdictions:
  – Whether the institution had a Vice President for Research (or equivalent),
  – Research was included in tenure and promotion criteria for faculty
  – Faculty policies provided for a percentage of tenure-track or tenured faculty time to be devoted to research
  – Number of credit hours of teaching expected of faculty members.

• Total laboratory space available at institutions ranked by the Carnegie Foundation as “Very High” or “High” Research Universities, using the results of the 2011 NSF Survey of Science and Engineering Facilities
EPSCoR State Committees: Questions

• Roles and Practices
  – Composition
  – Representation
  – Coordination (across universities, with private sector)
  – Development of State Science and Technology (S&T) Plan

• Themes in State S&T Plans

• State Research and Development (R&D)/S&T Programs
Education, Outreach, and Diversity: Definition

• Set of activities undertaken to expand participation in STEM, whether at K-12 or university level

• Four primary aspects analyzed
  – Activities undertaken
  – Level of education system influenced
  – Special populations
  – Leveraged funds
Education, Outreach, and Diversity: Activity Types and Levels

- Increased K–12 student motivation/interest in STEM.
- Enhanced science, mathematics, and engineering skills and knowledge for K–12 students.
- Community college/transition to four-year college.
- Undergraduates.
- Graduate student and postdoctoral researchers.
- Faculty.
- Capacity development at community colleges, tribal colleges, HBCUs, and PUIs.
- STEM planning activities.
Specific E/O/D Activities:
K-12 Example

• Student Research
• Science Camps
• Outreach
  – Classroom Kits/Visits
  – Museum Exhibits/Museum Visits
  – University/Laboratory Tours
  – Workshops/Meetings
  – Science Fairs
• Mentorship/Retention
• Teacher Research
• Teacher Training
• Support for Afterschool Programs
Education, Outreach, and Diversity: Sociodemographic Populations

• Underrepresented groups/generic.
  – Not feasible to code for African-American, Hispanic or Latino
• Women/girls.
• Native American/Native Hawaiian/Alaska Native/Pacific Islander
• Low income/first-generation college.
• Rural.
• People with disabilities.
• Immigrants.
Academic Development: Definition

• EPSCoR activities with departmental-level influences:
  – New courses/course modules
  – New minors or certification programs
  – New degree programs (Master’s, PhD)
  – New departments or schools
Innovation-Related Activities

• Collaborative research between EPSCoR-funded academics and industry
• Development or use of business incubators.
• Student internships/innovation training.
• SBIR Phase 0 programs.
Innovation-Related Outputs

• Patents
  – Match to USPTO data
• Startup Companies
• Results of SBIR Phase 0 Programs (where available)
Comparison of EPSCoR to non-EPSCoR Jurisdictions on Innovation Indicators

- Patenting (2012 USPTO data, number of utility patents)
- STEM workforce (NSF 13-330 analysis of Census data, percentage of workforce in STEM occupations)
- Receipt of SBIR/STTR awards (SBIR.gov database, 2012 data).
- Venture capital (National Venture Capital Association 2013 Yearbook, 2012 data)
Conclusions

• Analysis daunting, but feasible
  – Coding effort taxed capabilities of qualitative analysis software

• Required manual effort
  – Unstructured/messy text
  – Jurisdictions use different words for similar concepts and similar terminology for different contexts, making text mining infeasible

• Comparison between self-reported outputs/outcomes from EPSCoR jurisdictions and data from national surveys added context to analysis