Institute for Research on Innovation & Science (IRIS)

Jason Owen-Smith
IRIS/University of Michigan
jdos@umich.edu
Iris.isr.umich.edu
@IRIS_UMETRICS

EDITORIAL

Wanted: Better Benchmarks

How much should a nation spend on science? What kind of science? How much from private versus public sectors? Does demand for funding by potential science performers imply a shortage of funding or a surfeit of performers? These and related science policy questions tend to be asked and answered today in a highly visible advocacy context that makes assumptions that are deserving of closer scrutiny. A new "science of science policy" is emerging, and it may offer more compelling guidance for policy decisions and for more credible advocacy.

All developed and many developing nations today have accepted the need to support technical education and research as keys to future economic strength. Studies from the 1990s show that U.S. investment in R&D development led to greater economic productivity, and that information technology, in particular, has been a major factor in sustaining U.S. productivity growth. The question is not whether R&D investments are important, but what investment strategies are most effective in the rapidly changing global environment for science. Here, ideas diverge.

Take the issue of the technical workforce. Sharply differing opinions exist regarding the production of U.S. scientists to meet possible impending shortages.* The differences turn on the interpretation of "benchmark" data regarding the numbers of degree holders produced in the United States and other countries, particularly China and India. In the latter countries, the rates of growth in the numbers of scientists are high, although actual numbers are small relative to those in the United States. Advocates for increased production of U.S. scientists point to our low graduation rates, whereas critics emphasize limited short-term job opportunities for graduates and postdocs. Resolution of this issue requires a broader understanding of socioeconomic factors in a number of nations that would allow us to attach probabilities to different future scenarios. Optimal strategies for large mature economies such as that of the United States will doubtless differ from those for smaller or developing economies. Here, as elsewhere in policy debates, the benchmarks do not speak for themselves.

The data we choose to collect do say something about the framework in which we understand the relations among science, government, and society. Our customary reliance on historical trends in national data, however, creates an inertia that causes data categories to lag far behind changes in the dynamic socioeconomic framework, now evolving internationally. We know that there is a complex linkage between workforce issues and other economic variables. Technical workforces in different countries are increasingly interdependent in a way that makes single-country data unreliable for workforce forecasts.

Globalization and changing modes of science that have blurred disciplinary distinctions have undermined the value of traditional science and engineering data and their conventional interpretations. The old budget categories of basic and applied R&D, still tracked by the U.S. Office of Management and Budget, do not come close to capturing information about the highly interdisciplinary activities thought to fuel innovation. A 1995 U.S. National Research Council (NRC) committee chaired by Frank Press took a step toward data reform when it introduced the combined category of "federal science and technology," declaring that "the linear sequential view of innovation is simplistic and misleading." More attention, however, is needed to definitions and models that suit current needs of policy. A recent report from the NRC Committee on National Statistics found that "the structure of . . . data collection is tied to models of R&D performance that are increasingly unrepresentative of the whole of the R&D enterprise." Further, "It would be desirable to devise, test and, if possible, implement survey tools that more directly measure the economic output of R&D in terms of short-term and long-term innovation."†

Relating R&D to innovation in any but a general way is a tall order, but not a hopeless one. We need econometric models that encompass enough variables in a sufficient number of countries to produce reasonable simulations of the effect of specific policy choices. This need won't be satisfied by a few grants or workshops, but demands the attention of a specialist scholarly community. As more economists and social scientists turn to these issues, the effectiveness of science policy will grow, and of science advocacy too.

John H. Marburger III

John H. Marburger III is director of the Office of Science and Technology Policy, Executive Office of the President of the United States, in Washington, DC.

*D. Kennedy, J. Austin, K. Urquhart, C. Taylor, *Science* **303**, 1105 (2004). †*Measuring Research and Development Expenditures in the U.S. Economy*, L. D. Brown, T. J. Plewes, M. A. Gerstein, Eds. (National Academies Press, Washington, DC, 2005).

10.1126/science.1114801

In 2004, Jack Marburger issued a call for better ways to understand and measure the impact of science.

IRIS was founded in 2015 to answer that call

New information on three routes to economic impact

1. The careers of trained people
2. The purchase of goods and services
3. Entrepreneurship

Careers

Federal grants to 24 IRIS member campuses

- Paid nearly 122,000 people in FY 16
- Just over 47% of those were students or trainees
- 1 in 5 were faculty

When research trained students left 21 of those campuses

- 62% worked in the private sector
- After 3 years they made an average of nearly $92,000
- 43% stayed in the state where they were trained
- The rest spread across all 50 states

Vendor Purchases

In Fiscal 2016, 26 IRIS Member institutions

- Spent $2.5 billion from federal grants for goods and services to support research
- ~$600 million stayed in universities' home states
- Purchases from businesses in 1819 U.S. Counties and
- 435 congressional districts
- $5 million + purchases from businesses in 11 industries including:
  - Professional Scientific and Technical Services
  - Healthcare and Social Assistance
  - Information
  - Manufacturing
  - Construction

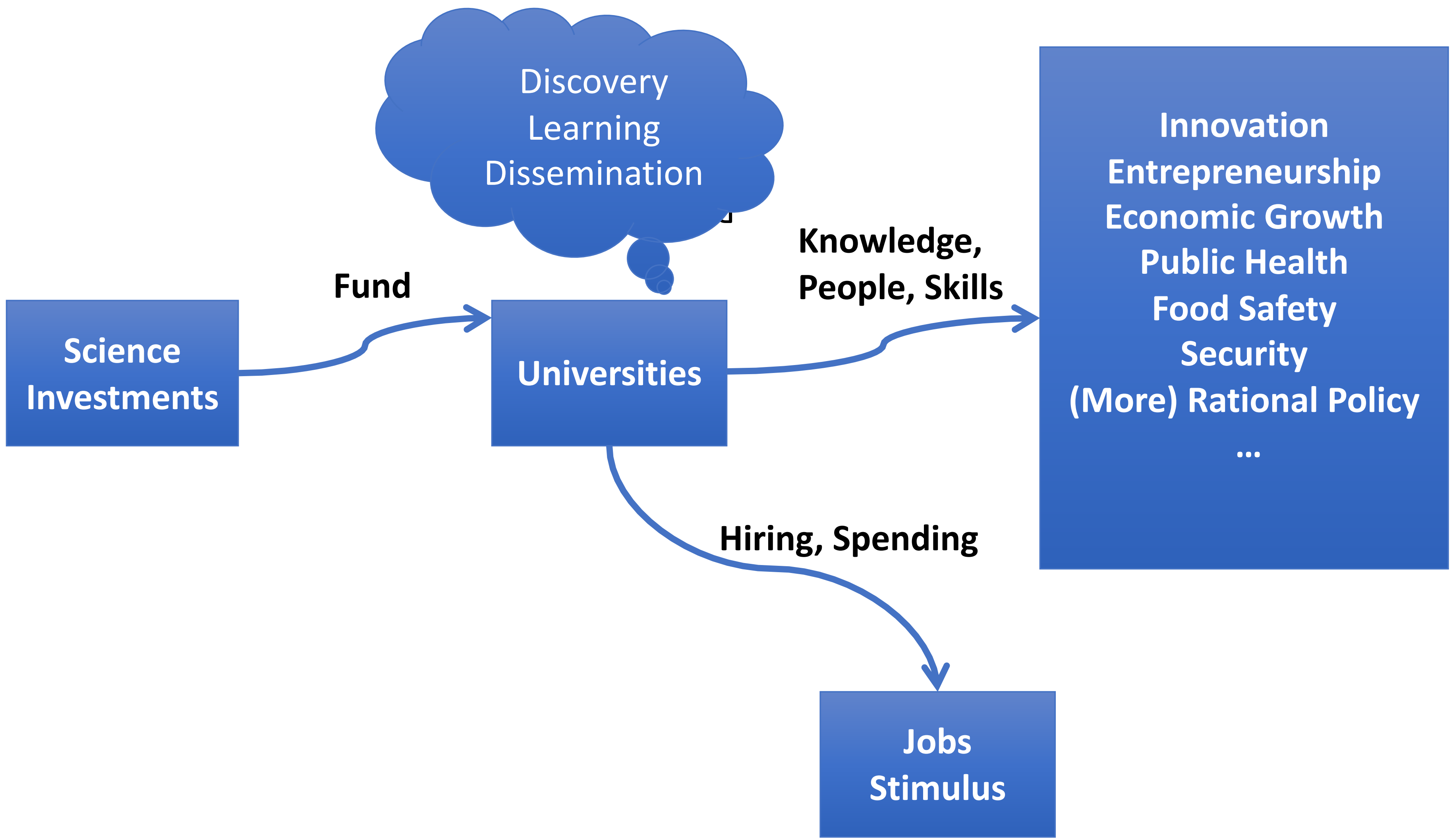
Entrepreneurship

University trained researchers hired by startups

- Were more likely to join High Tech ventures
- Particularly when funded by NSF, DOE and DOD grants
- Startups that hired university-trained researchers were significantly more likely to grow in terms of both employees and revenues
- Contributions of university trained researchers explains
  - ~40 % of variation in start-up patenting
  - ~11% of variation in start-up trademarking

How do we know?

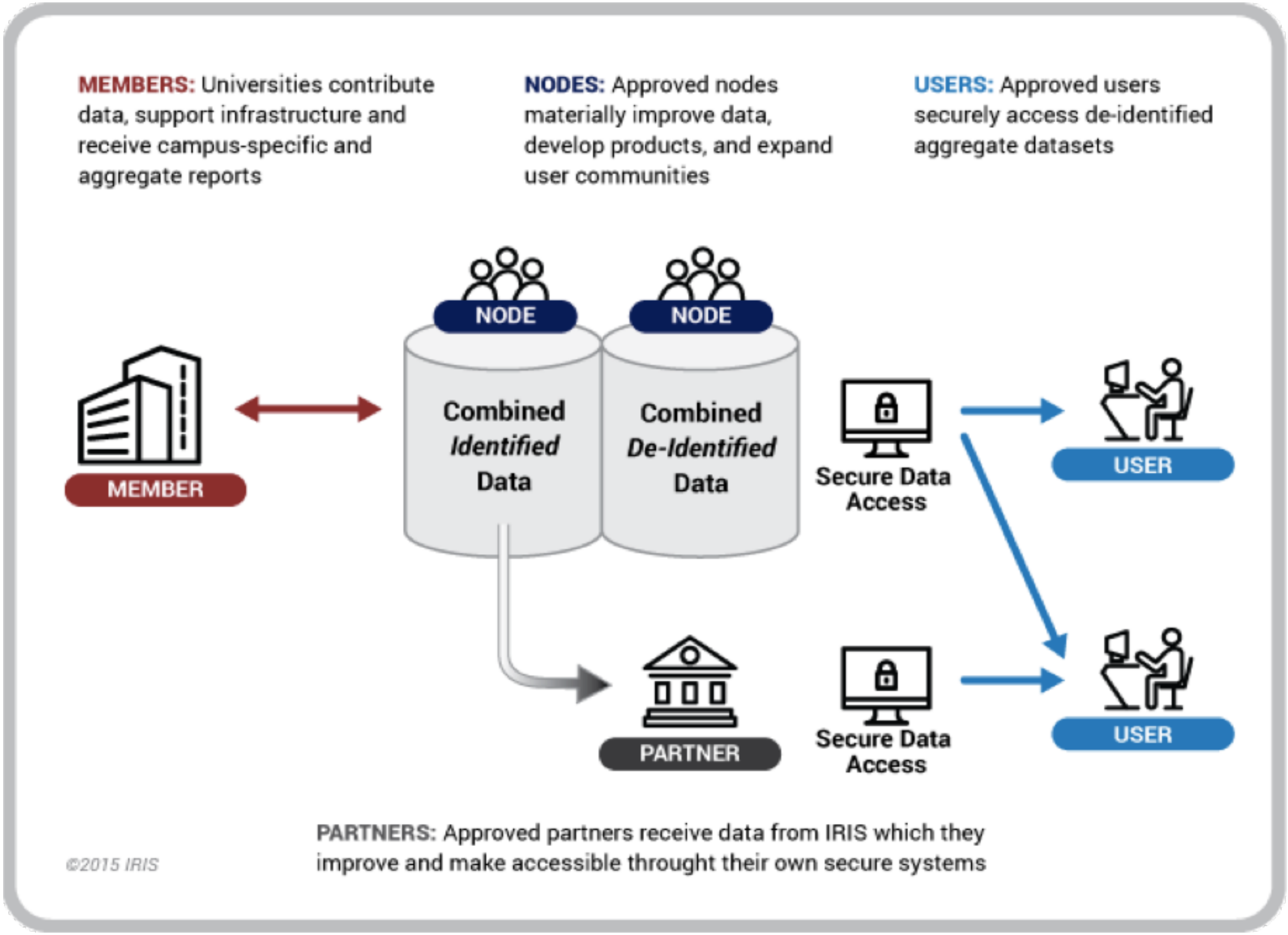
Framework

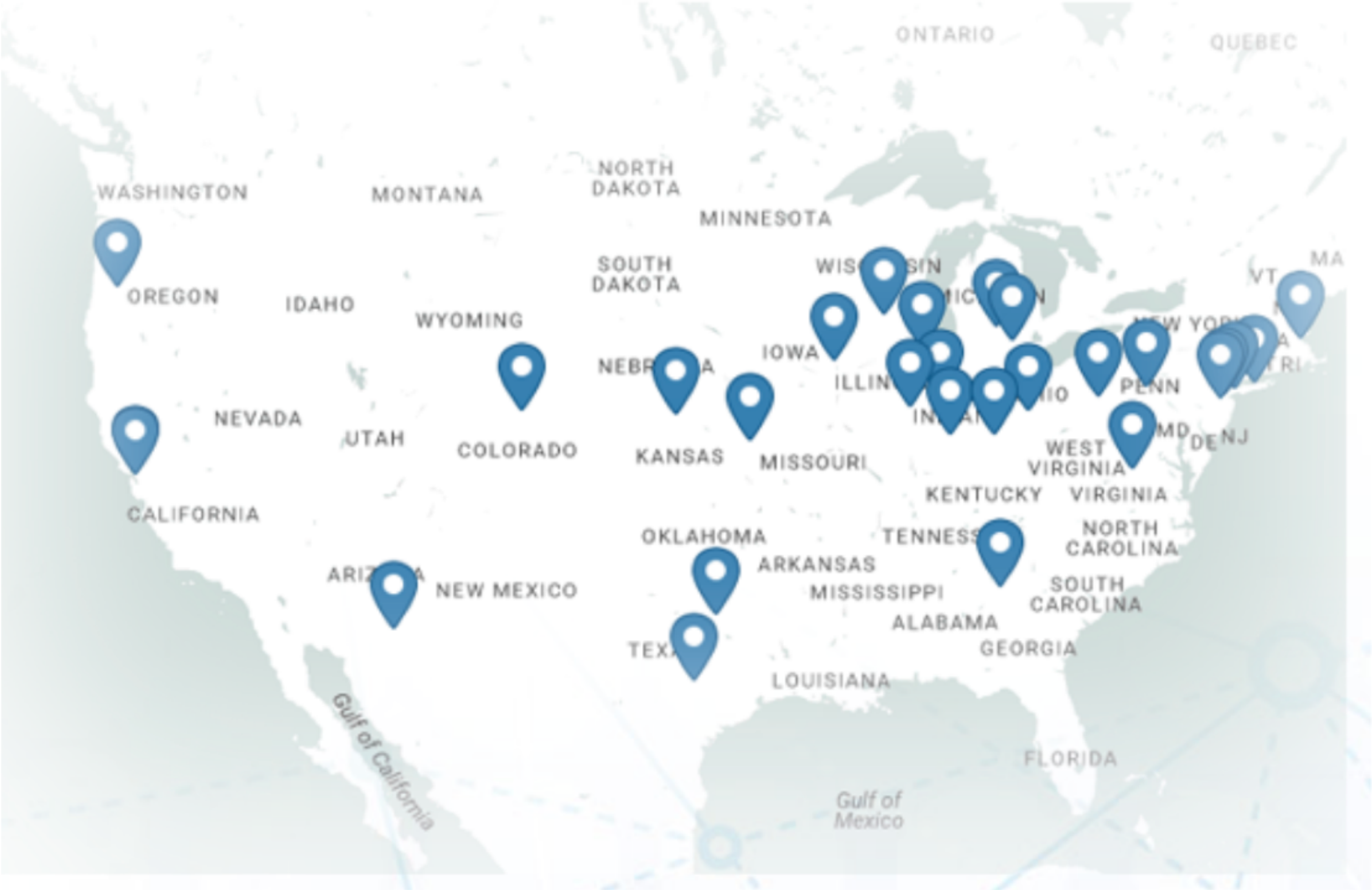

Discovery
Learning
Dissemination
Fund
Science
Investments
Universities
Knowledge,
People, Skills
Innovation
Entrepreneurship
Economic Growth
Public Health
Food Safety
Security
(More) Rational Policy
…
Hiring, Spending
Jobs
Stimulus

Background

- ➢ Recession & Stimulus
- ➢ Federal **STAR METRICS** (Level 1) Program
- ➢ **CIC/UMETRICS** Pilot Project
- ➢ **Institute for Research on Innovation and Science (IRIS)**
  - Founded 01/01/2015
  - Core facility at University of Michigan
  - 3 years seed funding for infrastructure from Sloan & Kauffman
  - 32 signed MOUs (26% federal R&D)
  - 40 more campuses in some stage of negotiation
  - Final goal = 150 (93% federal R&D)

PI Team: Julia Lane (NYU), Jason Owen-Smith (Michigan), Bruce Weinberg (Ohio State), Ron Jarmin (U.S. Census)


MEMBERS: Universities contribute data, support infrastructure and receive campus-specific and aggregate reports
NODES: Approved nodes materially improve data, develop products, and expand user communities
USERS: Approved users securely access de-identified aggregate datasets
NODE
NODE
MEMBER
Combined *Identified* Data
Combined *De-Identified* Data
Secure Data Access
USER
PARTNER
Secure Data Access
USER
PARTNERS: Approved partners receive data from IRIS which they improve and make accessible throught their own secure systems
©2015 IRIS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NEVADA
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KANSAS
MISSOURI
PENN
MD
DE
NJ
WEST VIRGINIA
KENTUCKY
VIRGINIA
CALIFORNIA
OKLAHOMA
NORTH CAROLINA
ARKANSAS
NEW MEXICO
MISSISSIPPI
SOUTH CAROLINA
ALABAMA
GEORGIA
LOUISIANA
Gulf of California
FLORIDA
Gulf of Mexico

What do IRIS members get?

- Three interactive, campus specific reports
- Benchmarking against selected aggregate groups
- Data access for affiliated researchers
- A role in governance
- A seat at the table to inform future products
- Inclusion in aggregate reporting
- A new opportunity to shape the national conversation about academic research

Reports

- Spending
- Employee Profile
- Vendor Profile

Governance

- Annual elections
- Members nominate and vote
- 6 university Directors

IRIS INSTITUTE FOR RESEARCH ON INNOVATION & SCIENCE

Mary Sue Coleman
President, Association of American Universities
(at-large member)

Kimberly Espy
Senior Vice President for Research & Chief Research Officer, University of Arizona
Term: April 1, 2017-March 31, 2020

Kimberly Griffin
Director for Electronic Research Administration, Northwestern University
Term: April 1, 2017-March 31, 2018

James Hilton
Vice Provost for Academic Innovation, University Librarian & Dean of Libraries, University of Michigan
Term: April 1, 2017-

Christopher Molloy
Senior Vice President, Office of Research & Economic Development, Rutgers University
Term: April 1, 2017-March 31, 2018

Daniel Reed
Vice President for Research and Economic Development, University of Iowa
Term: April 1, 2017-March 31, 2020

Neil Sharkey
Vice President for Research, Pennsylvania State University
Term: April 1, 2017-March 31, 2019

Caroline Whitacre
Senior Vice President for Research, Ohio State University
Term: April 1, 2017-March 31, 2019

Opportunities for Engagement

- BoD Elections/Nominations/Representatives
- Technical Advisory Group
- Quarterly Newsletter
- Annual Data Summit Meeting
- Policy and Outreach Advisory Committee

Research Access

- 38 research users in IRIS VDE
- From 14 institutions
- Pilot Grants with support from Sloan

http://iris.isr.umich.edu/research-data/grants/research-grants-awardees/

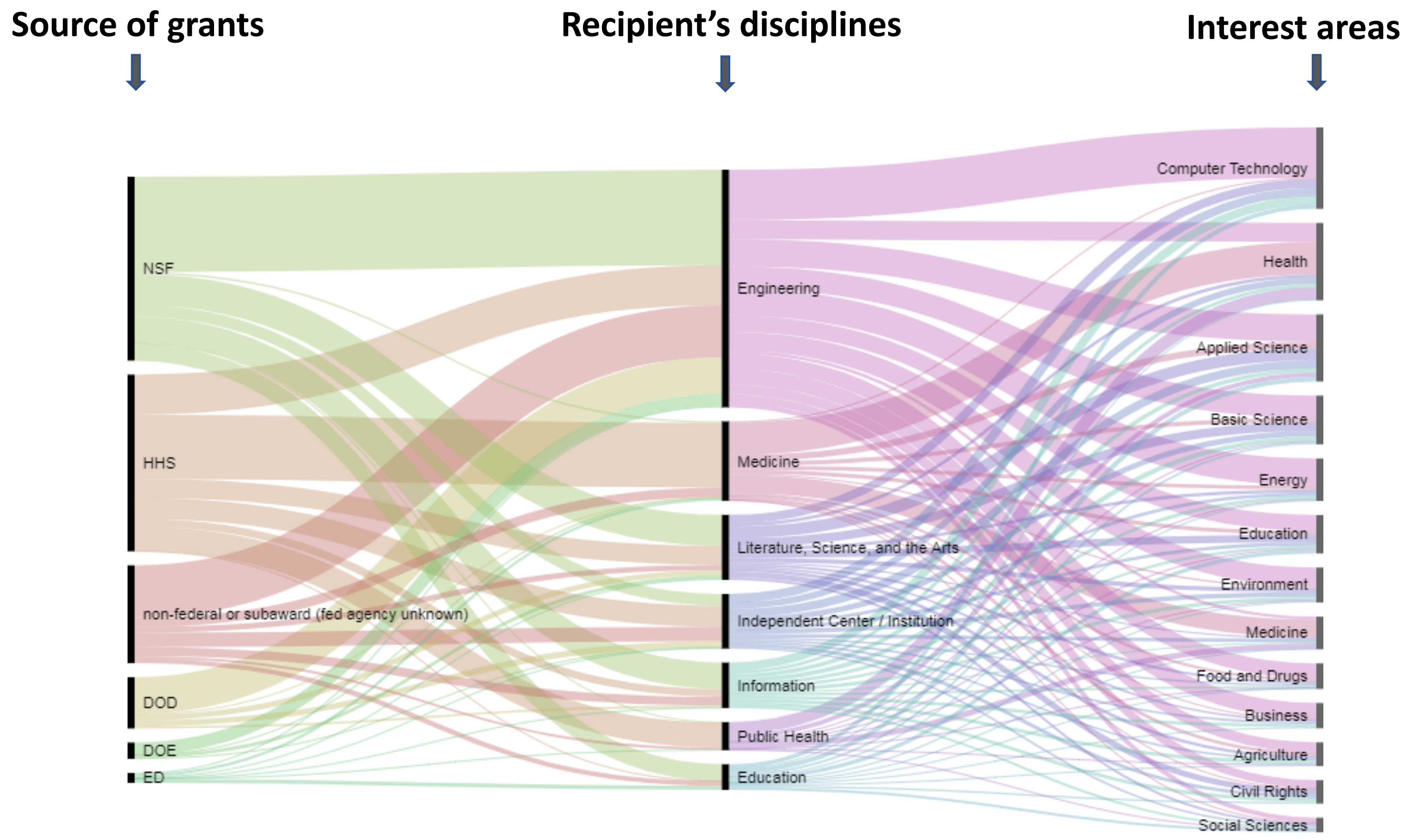
First Research Data Release (next in March 2018)

- 19 universities
  - $11B in 2014 federal R&D (16% of total)
- Transaction level data
  - 162,694 federal and non-federal sponsored projects
  - 333,565 individuals
    - 28,641 Post-Docs
    - 76,295 Grad Students
    - 87,195 Undergrads
  - $18.1B in vendor spending to ~81,000 establishments
  - $6B in subcontracts to other performers
- Links to abstracts etc for federal awards (NIH, NSF, USDA)
- Individual level links to dissertation information
- Title 13 crosswalks to LEHD, LBD, ACS, Decennial Census (available only through the FSRDC system)

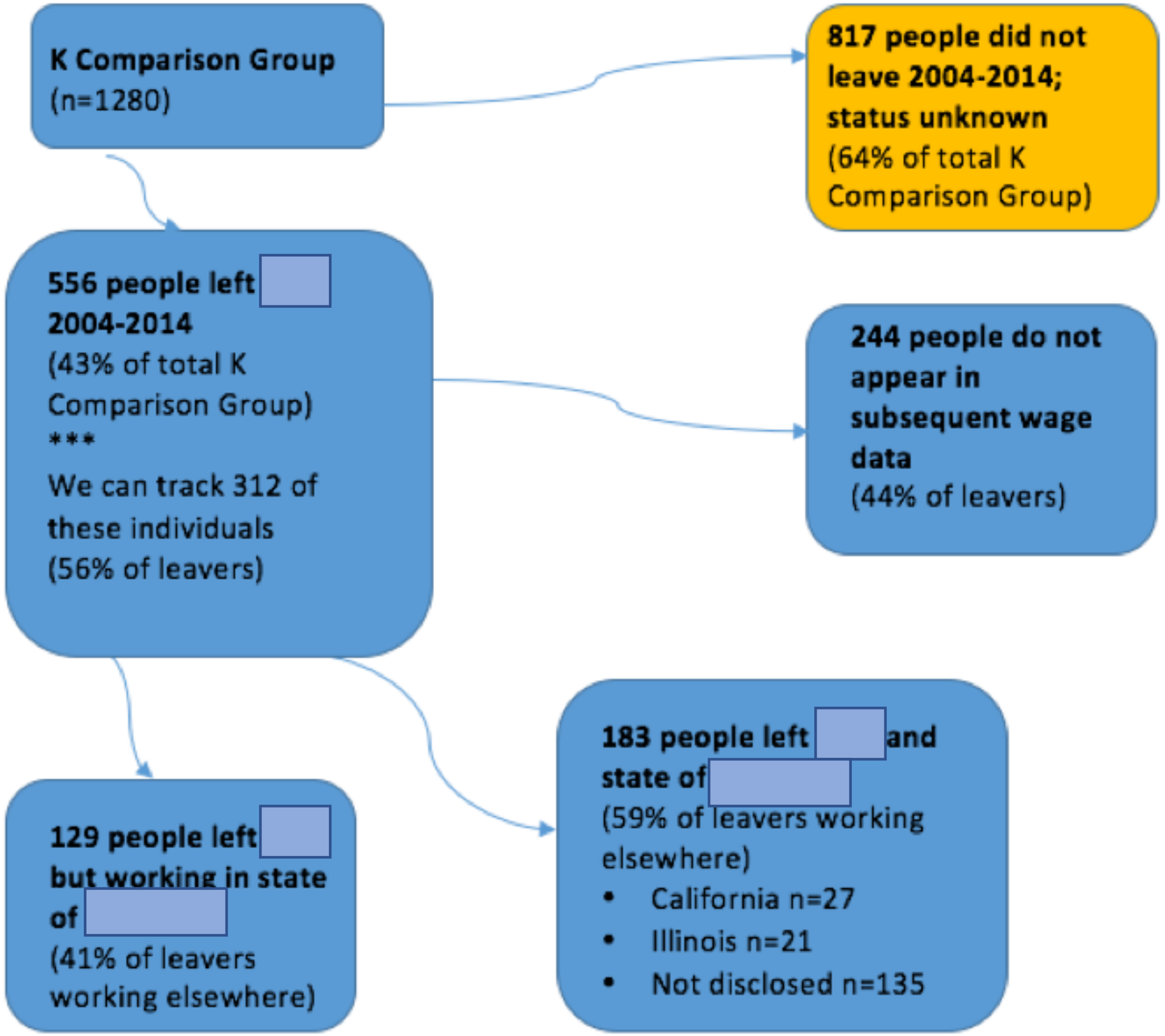
Future directions for reporting

- Federal Advisory Committee Service
- Collaboration Networks
- Large Scale Research Projects (CTSA & XSEDE)
- Post-Docs and Trainees
- Non-Federal sponsored projects

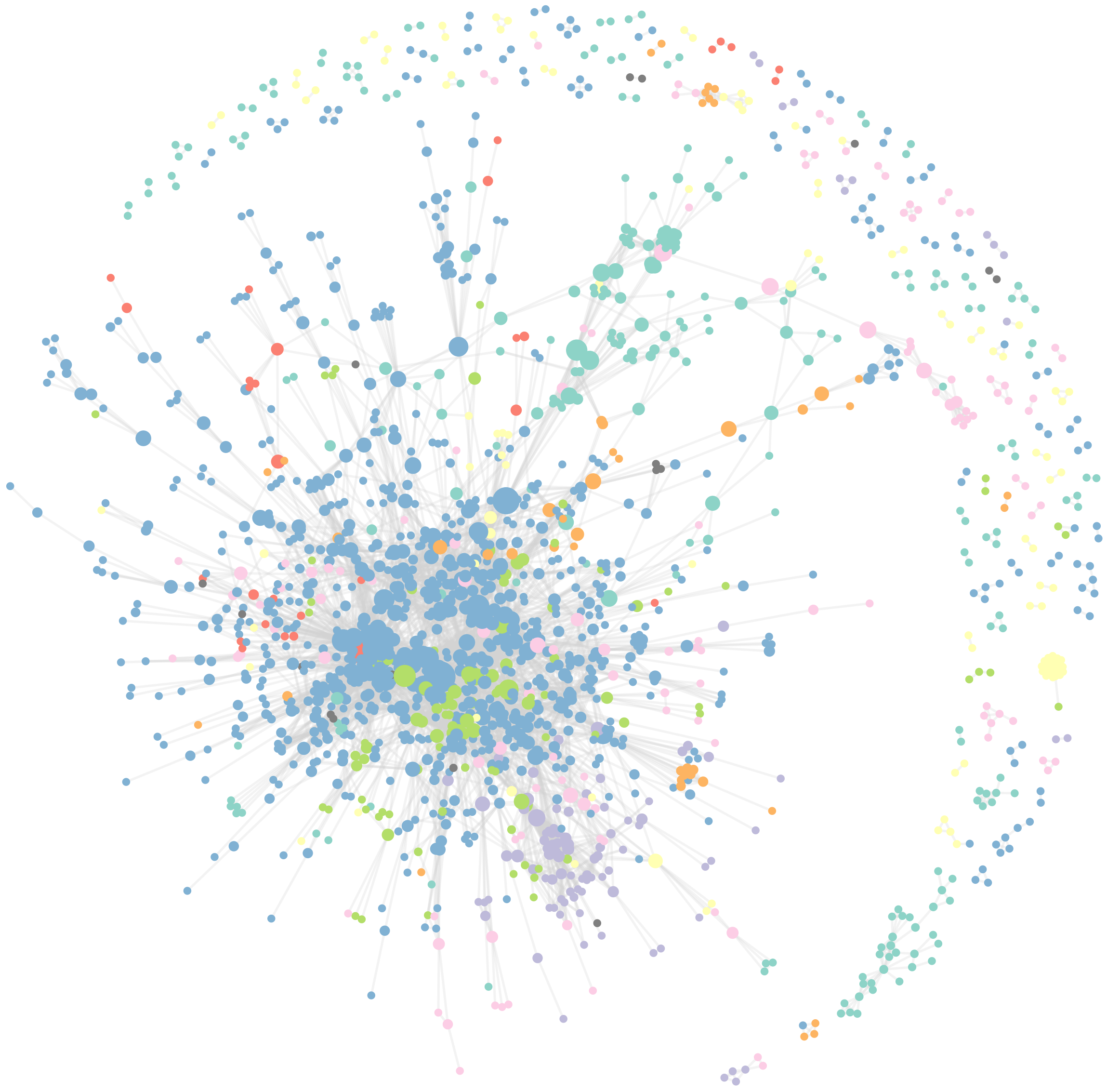
Funding and Federal Committee Service (One University)

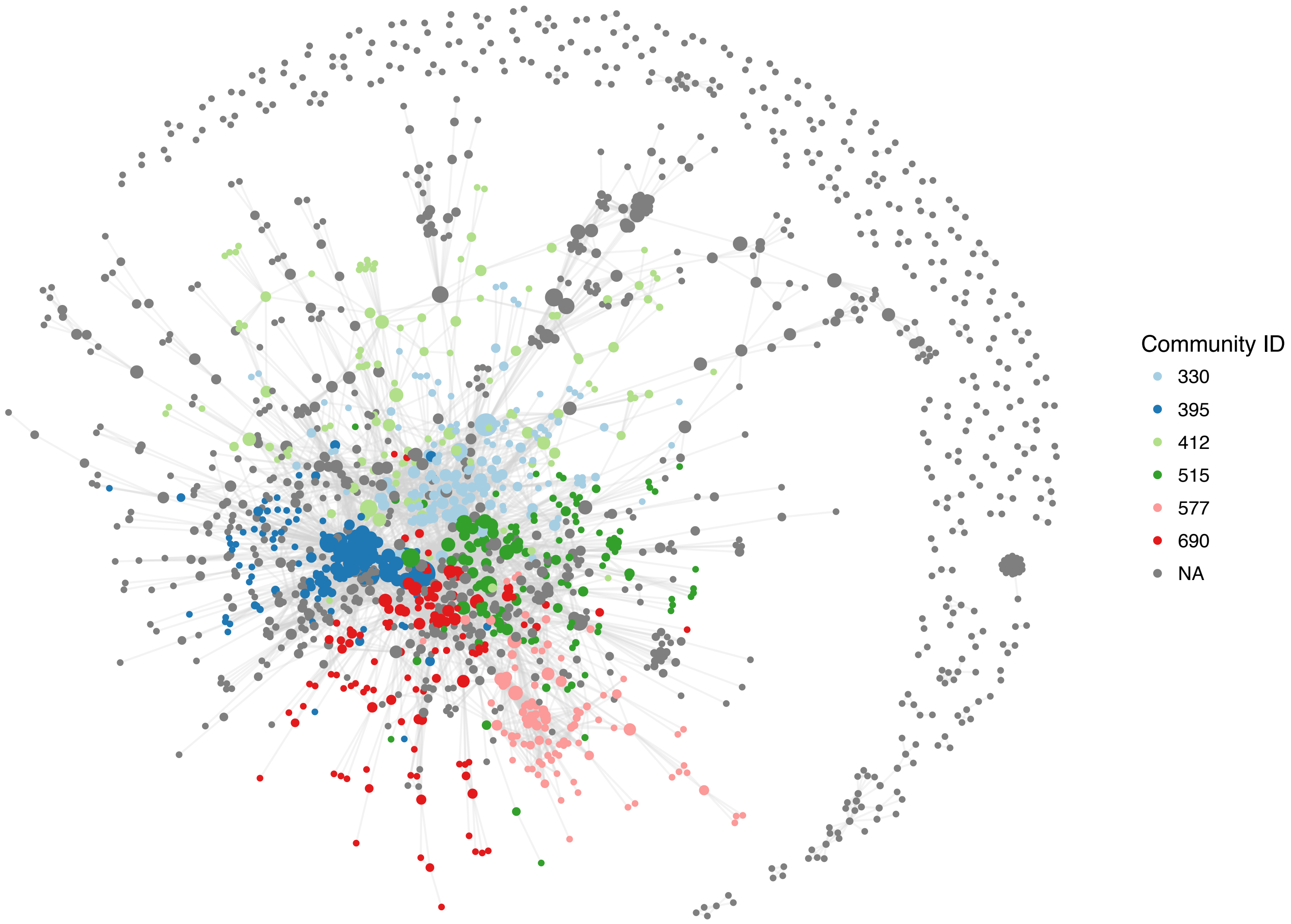


K Awardees (one university)



Networks

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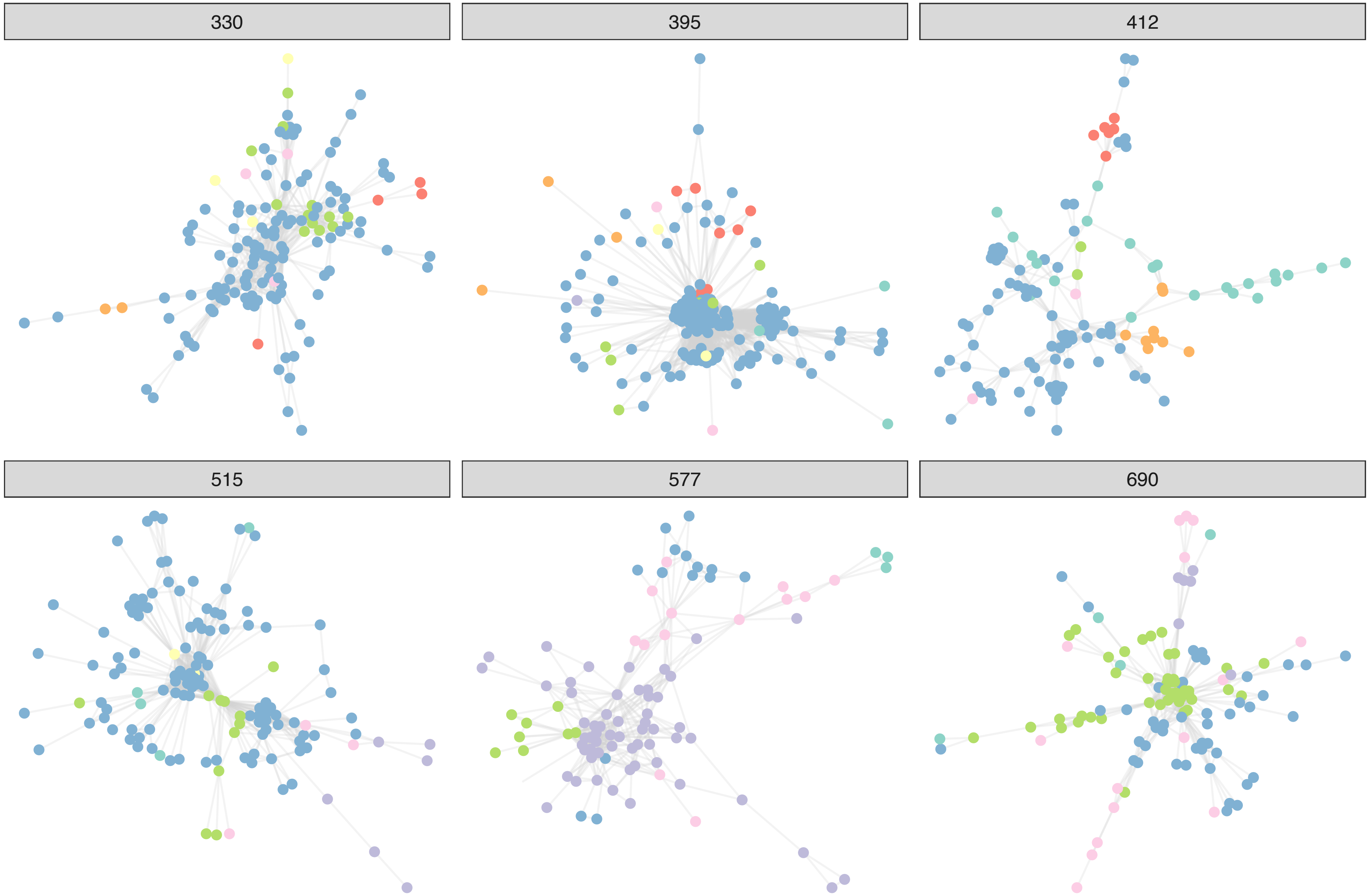
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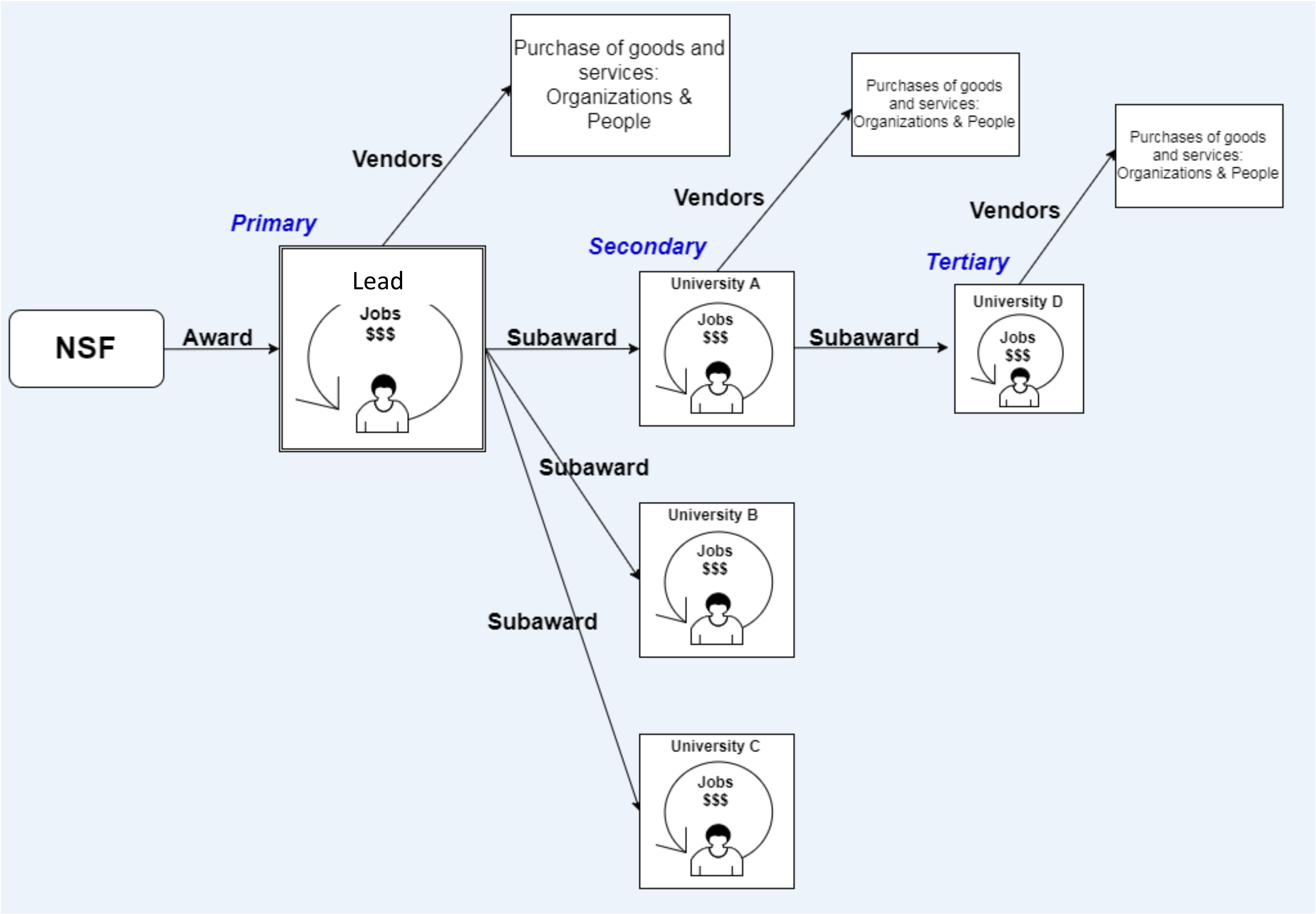
Subaward Tracing



What do IRIS members contribute?

- Data
- Contacts
- $25,000/year

What you can do

- Help IRIS grow by encouraging your university to participate
  - Current membership list - http://iris.isr.umich.edu/iris-members-map/
  - Contact me with questions and for details – jdos@umich.edu
- Spread the word to colleagues and students
- Use IRIS data your research
  - iris.isr.umich.edu/research-data/
  - Look for the next IRIS research grant call
- Help us conceptualize and develop new reports (POAC)

Thank You!