



# Got Data? Building a Data Ecosystem to Drive 21<sup>st</sup> Century Research

**Dr. Francine Berman**

Chair, Research Data Alliance / US

Hamilton Distinguished Professor in Computer Science, Rensselaer Polytechnic Institute

# The Information Age: Data-enabled Everything



**Physical  
Infrastructure**



**Communication  
/ Community**



**Commerce**



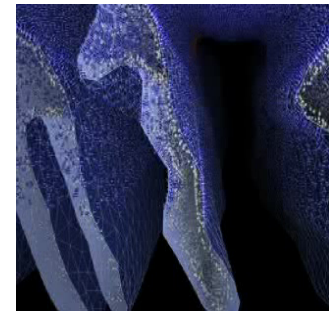
**Education**



**Entertainment**

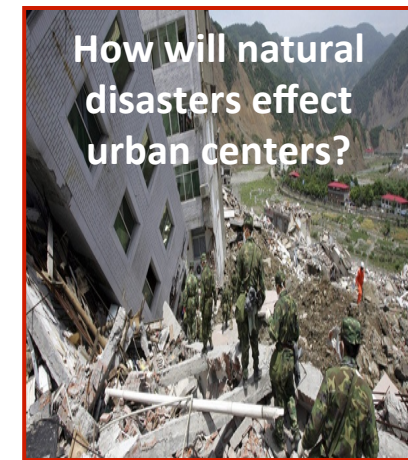


**Health**



**Research**

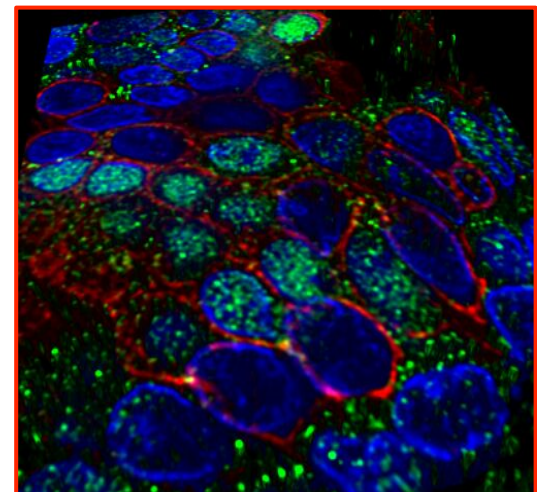
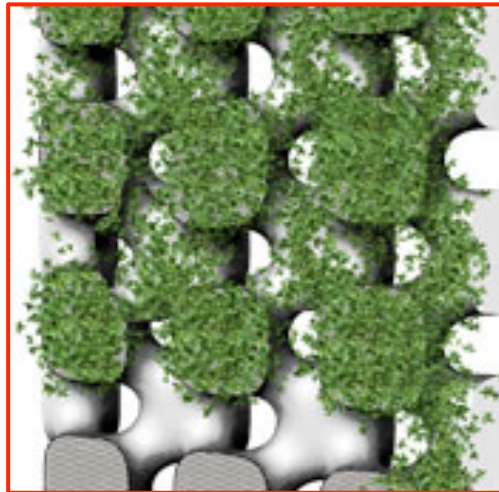
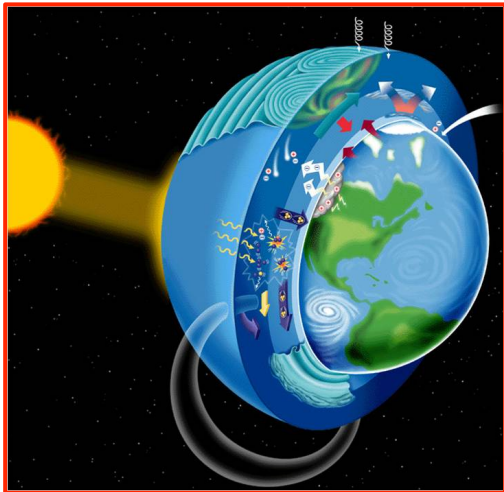
# Digital research data driving our ability to address science and societal challenges



# Today's Presentation

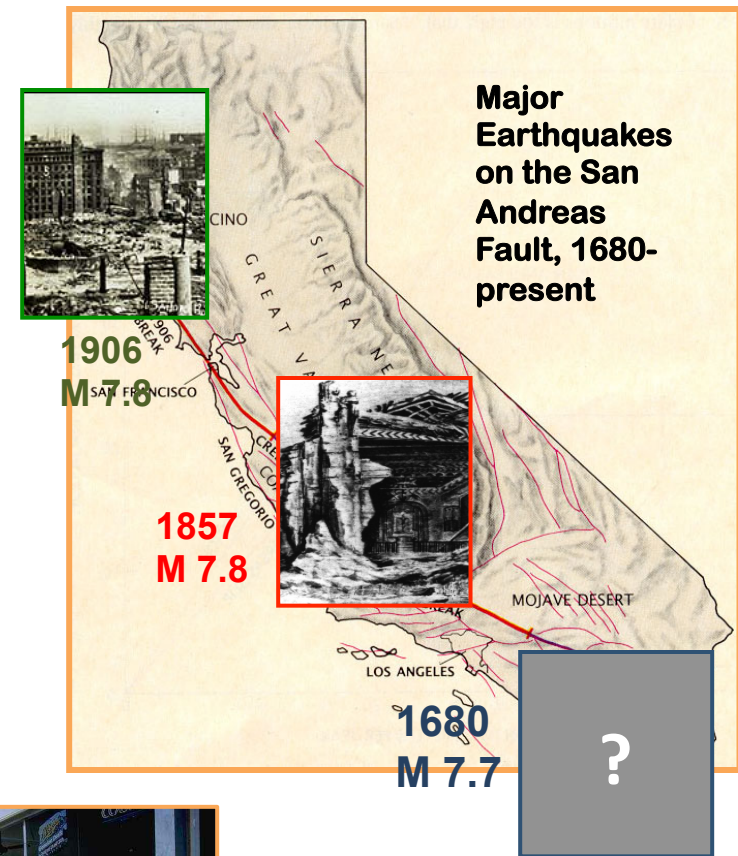
- **Data-driven Research**
- **Supporting Digital Research Data – Research Cyberinfrastructure**
- **Supporting the Research Data Ecosystem – Who's Paying the Data Bill?**
- **It takes a Village: Community Efforts to Build Coordinated Global Data Infrastructure**

# Data-Driven Research



# Data-Driven Geoscience – What is the impact of a large-scale earthquake on the San Andreas Fault?

- Earthquake simulations provide critical scientific information enabling better
  - *Estimation of seismic risk*
  - *Emergency preparation, response and planning*
  - *Design of next generation of earthquake-resistant structures*
- Simulations combine large-scale data collections, high-resolution models, supercomputer runs



*6.7 M earthquake in Northridge California, 1964, earthquake brought estimated \$20B damage*

**Fran Berman**

# Earthquake Simulation

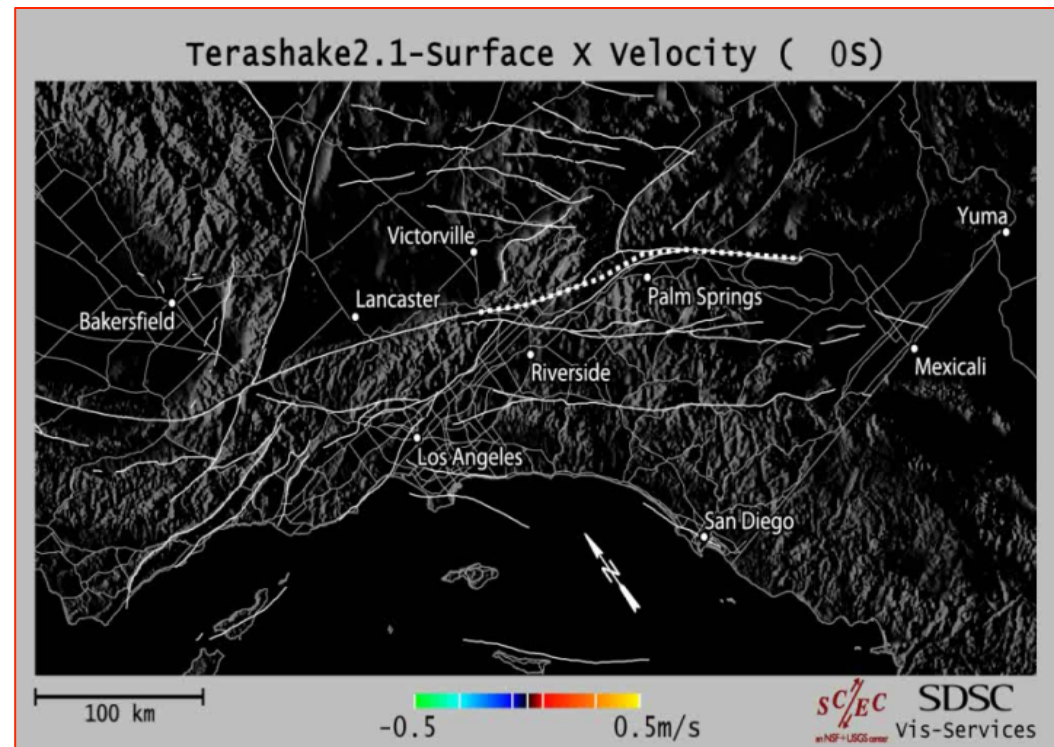
- **Input for supercomputer simulation:**

- Model of 7.7 earthquake targeted to lower San Andreas fault
- 10 years of sensor data on southern CA terrain

- **Post simulation**

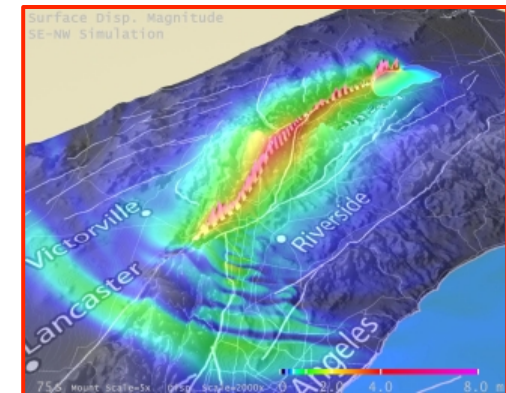
- Additional computation (80,000+ CPU hours) used for visualization of seismic wave propagation and analysis
- Derived data products (velocity magnitude, displacement vector field, cumulative peak maps, statistics, etc.) included in SCEC digital library (>168 TB).

- **Results used for better science and a safer society (better building codes, more informed disaster response planning)**



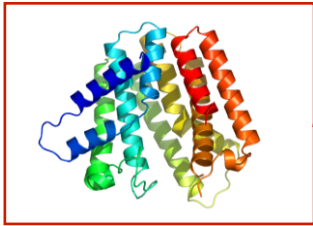
# Better Prediction Accuracy Involves “Bigger” Data

<i>Estimated figures for simulated 240 second period, 100 hour run-time</i>	TeraShake domain (600x300x80 km <sup>3</sup> )	PetaShake domain (800x400x100 km <sup>3</sup> )
<b>Fault system interaction</b>	NO	YES
<b>Inner Scale</b>	200m	25m
<b>Resolution of terrain grid</b>	1.8 billion mesh points	2.0 trillion mesh points
<b>Magnitude of Earthquake</b>	7.7	8.1
<b>Time steps</b>	20,000 (.012 sec/step)	160,000 (.0015 sec/step)
<b>Surface data</b>	1.1 TB	1.2 PB
<b>Volume data</b>	43 TB	4.9 PB





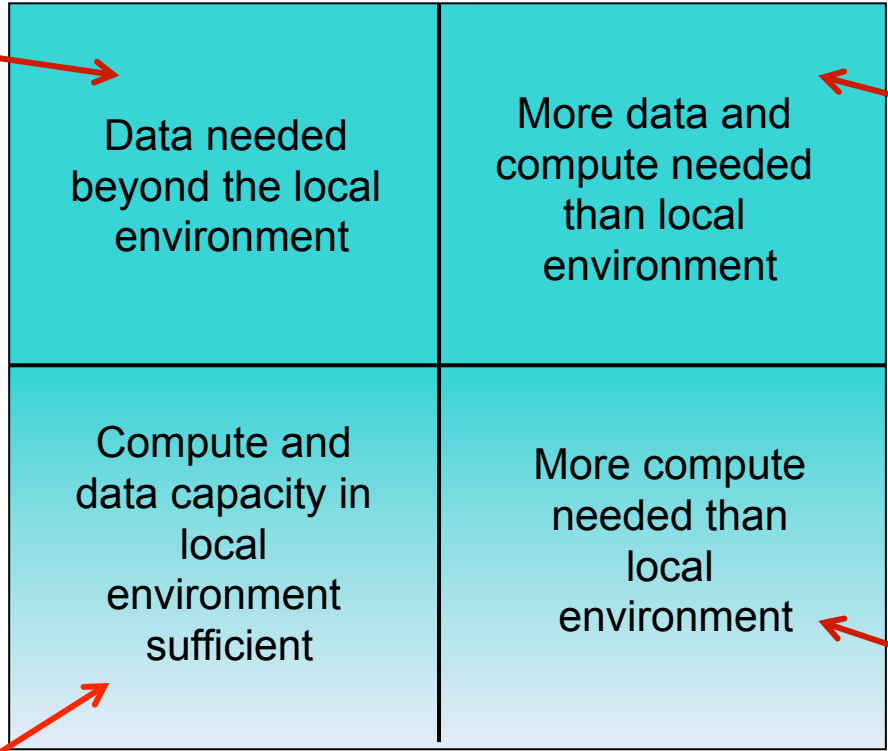
# It's Not Just About Size – Data-enabled research applications span the spectrum



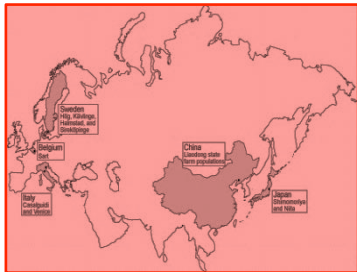
Analysis with Protein Data Bank structures



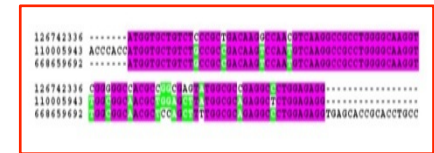
Cosmology simulations



EurAsia male:female death rate study

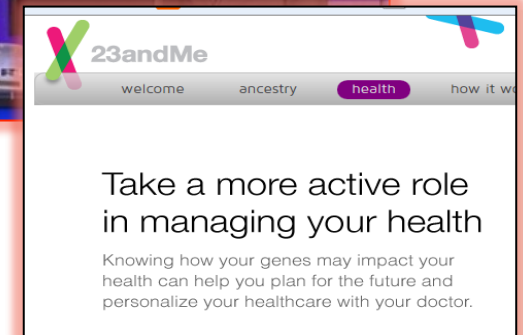
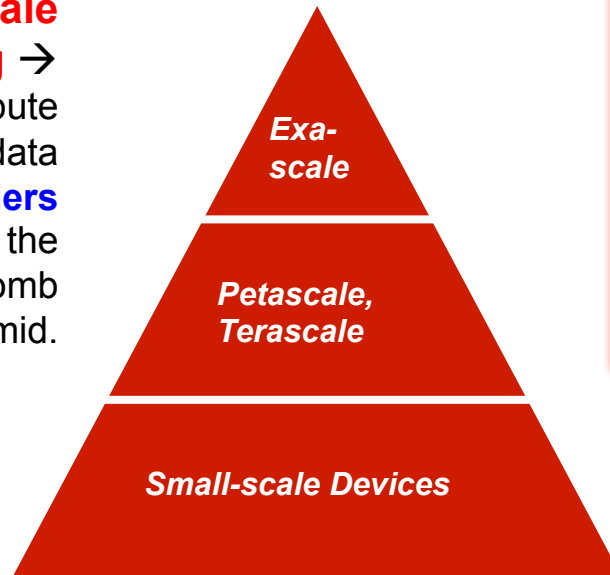


CIPRES Science Gateway Phylogeny and Ontology



# Moving Forward: Data-Driven Innovation Accelerated by Emergent Technologies

**Exascale computing** → more compute and data **at all tiers** in the Branscomb Pyramid.



**Smart Devices, Sensor Networks** → More data-enabled devices and approaches drive **crowd-sourced, real-time, and other aggregation applications**



**Information-Driven Analysis** → X-informatics and X-analytics enable new targets for **data-driven research and decision-making** models

# Data-Driven Innovation Transforming Academic Institutions and Communities

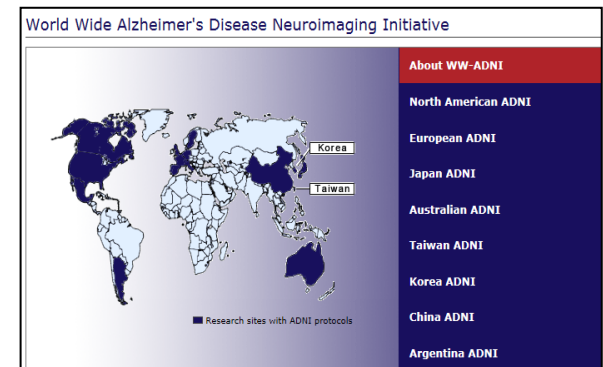
- **Communities coming together to**
  - Create coordinated research infrastructure
  - Disseminate useful information
  - Democratize education
  - Communicate and collaborate
  - Accelerate research collaboration and discoveries

**Open access --**  
**“Democratization”**  
**of participation**



**The T-shaped University**  
– **transformational**  
**potential of MOOCs**  
**on higher education**

**Data sharing –**  
**Acceleration of**  
**new results**



# Supporting Digital Research Data -- Research Cyberinfrastructure



# The Digital Research Data Life Cycle: Data from birth to death / immortality



Create

Data creation / capture / gathering from

- laboratory experiments
- fieldwork
- surveys
- devices
- simulation output ...



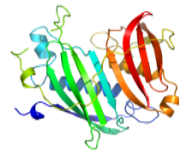
Edit

- Organize
- Annotate
- Clean
- Filter ....



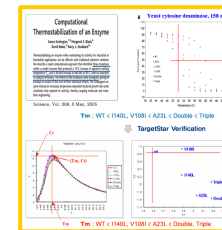
Use / Reuse

- Analyze
- Mine
- Model
- Derive additional data
- Visualize
- Input to instruments / computers / devices ....



Publish, Disseminate

- Disseminate
- Create portals / data collections / databases
- Couple with literature ....



Preserve / Destroy

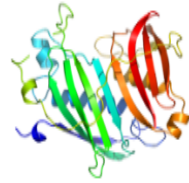
- Store / preserve
- Store / replicate / preserve
- Store / ignore
- Destroy ....



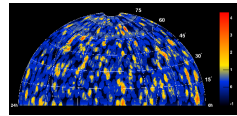
# Cyberinfrastructure, Tools, and Services: Critical Support for Data-driven Research



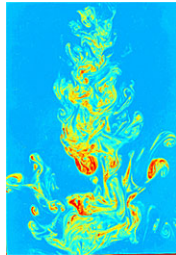
modeling



analysis



visualization

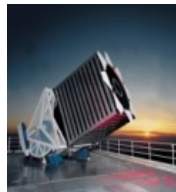


simulation

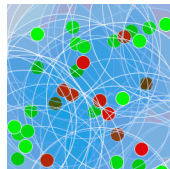
**Interoperability  
drives research  
innovation**



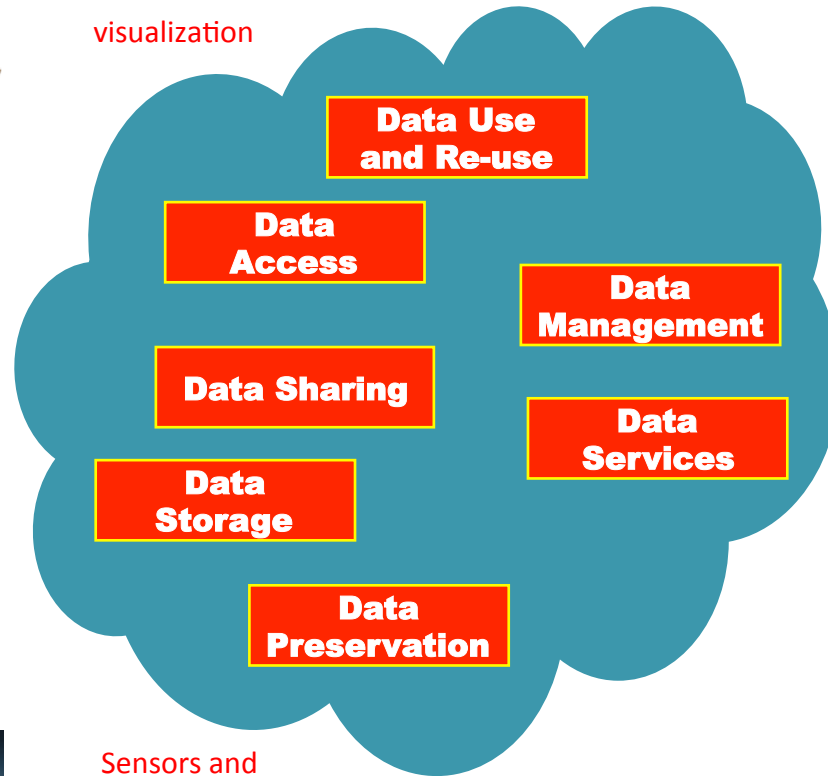
instruments



Sensors and  
Sensor-nets



computers



**Services drive data  
use and re-use**

- Data mining
- Data Analytics
- Data Visualization
- Data Preservation
- Statistical packages
- Domain-specific tools
- Data de-identification
- Data hosting
- Collection Management ...

# Increasing Expectations of Stewardship

## Access, management, preservation driving greater need for enabling Infrastructures

The collage consists of four overlapping screenshots:

- Top-left:** A screenshot of the Nature.com website showing 'nature.com webcasts' and 'authors & referees' sections.
- Top-right:** A screenshot of the White House Office of Science and Technology Policy website, featuring the title 'Expanding Public Access to the Results of Federally Funded Research' and a 'GIVE FEEDBACK ABOUT THIS PAGE' button.
- Bottom-left:** A screenshot of the NASA Science website, showing navigation menus for 'Big Questions', 'Focus Areas', and 'Missions'.
- Bottom-right:** A screenshot of a New York Times article titled 'We Paid for the Research, So Let's See It' from the Opinion Pages, dated February 25, 2013.

# Costs of Research Data Stewardship Challenging for Academic Institutions

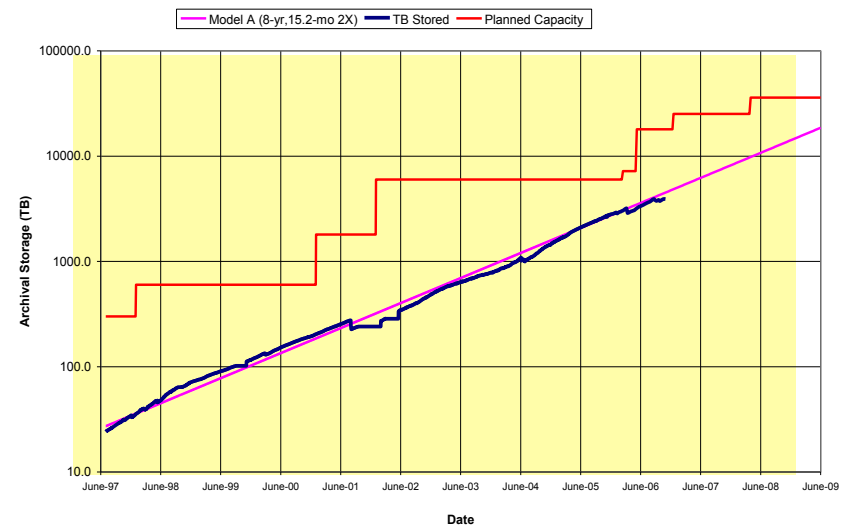


SDSC, circa 2006

## Costs include

- Maintenance and upkeep
- Software tools and packages
- Utilities (power, cooling)
- Space
- Networking
- Security and failover systems
- People (expertise, help, infrastructure management, development)
- Training, documentation
- Monitoring, auditing
- Reporting costs
- Costs of compliance with regulation, policy, etc. ...

## Resources and Resource Refresh

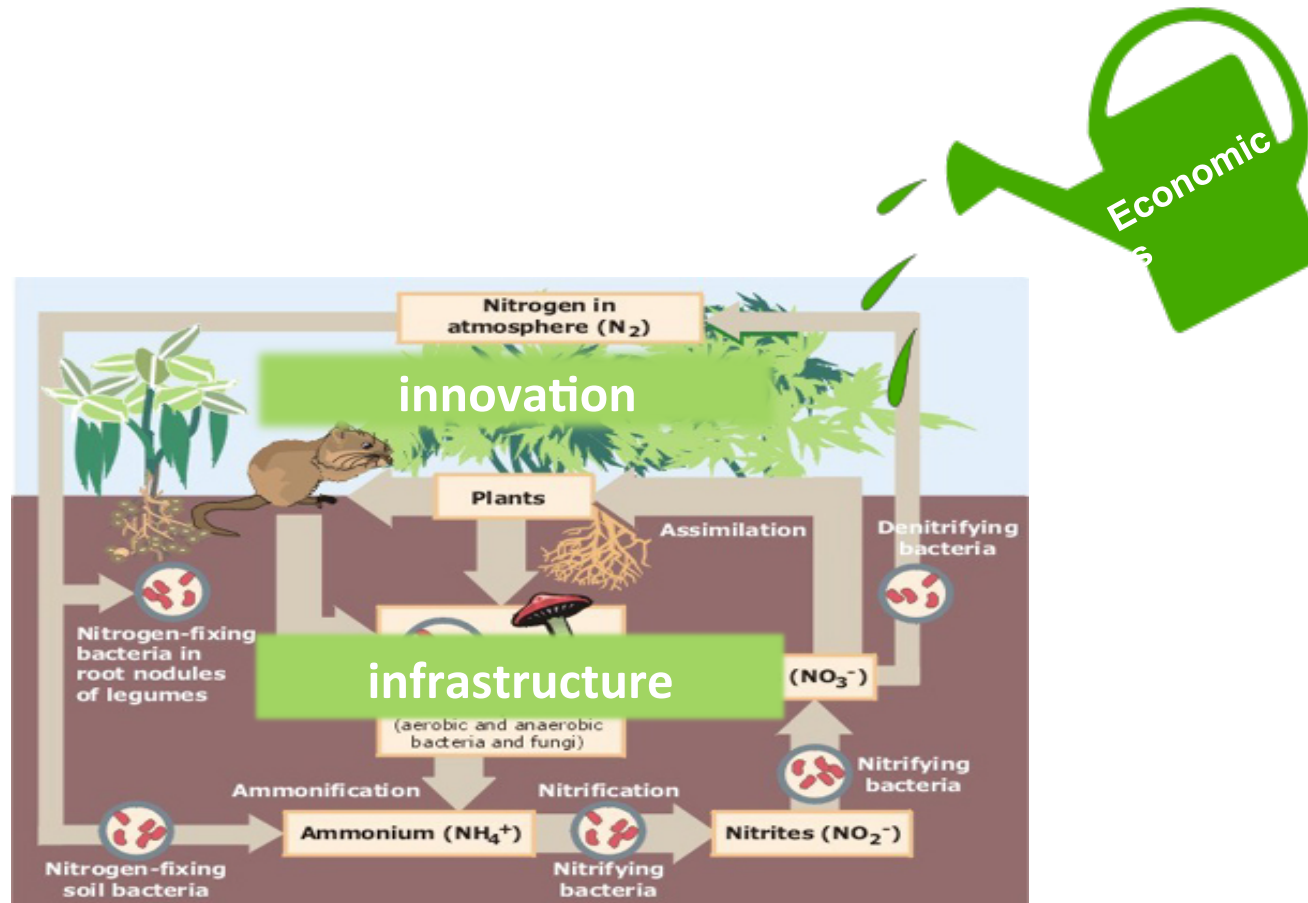


### SDSC Data Storage Growth '97-'09

- *Most valuable data replicated*
- *As research collections increase, storage capacity must stay ahead of demand*



# Supporting the Research Data Ecosystem – Who's Paying the Data Bill?

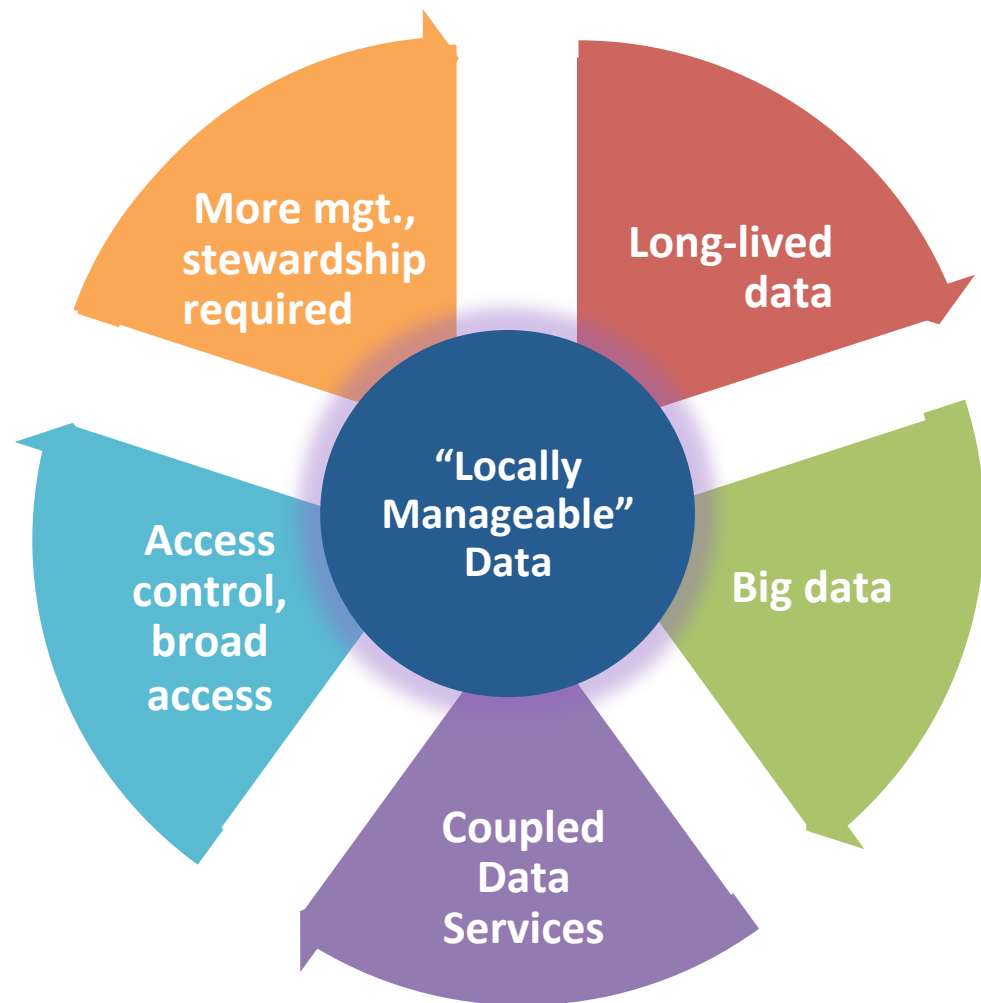


# Enabling Research Data Cyberinfrastructure Requires Viable Economic Support

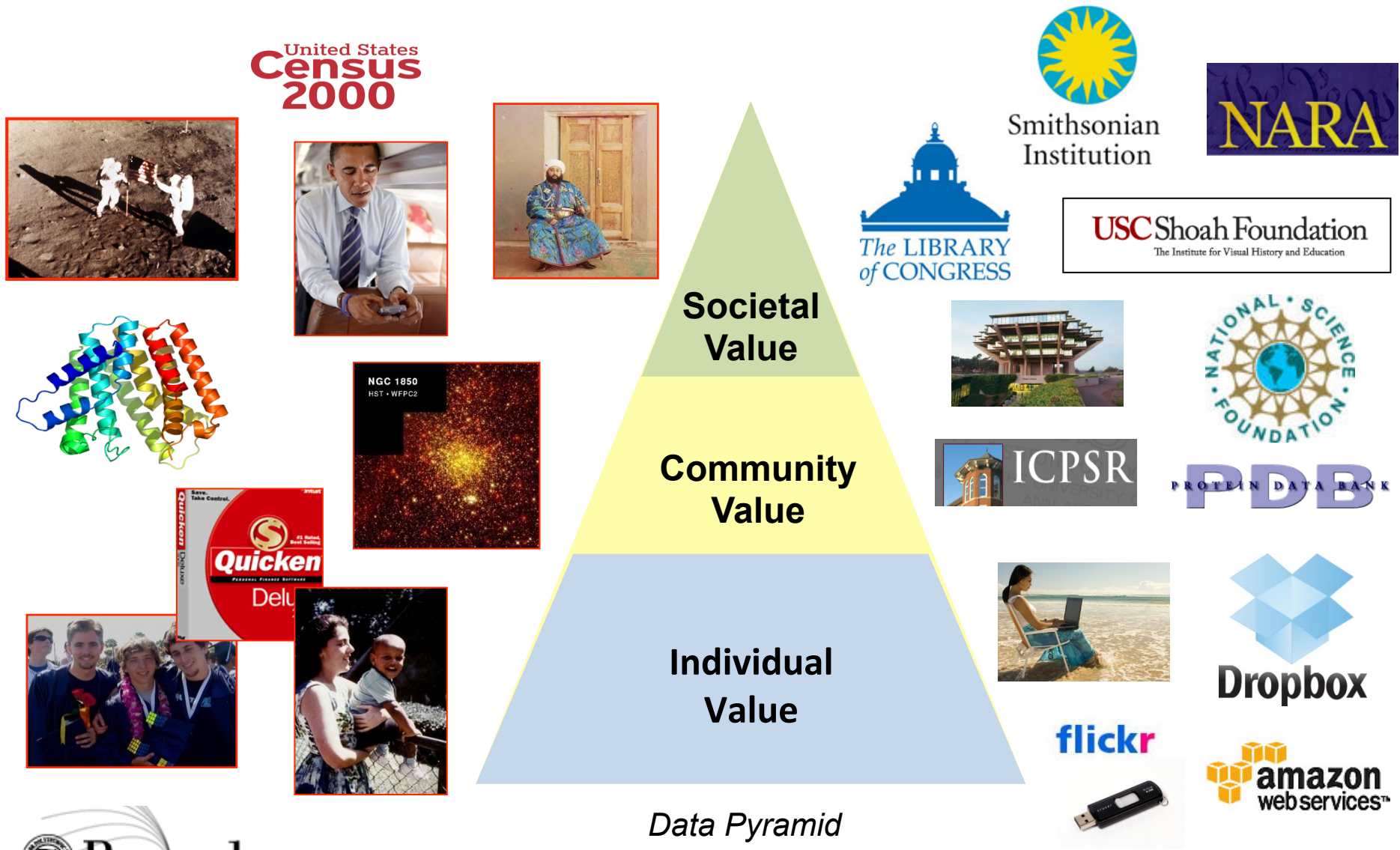
**It's not just about size ...**

Data costs increase with usage, management requirements, perceived value

***Greater costs at the extremes ...***



# Who Pays the Data Bill?



# Data Value drives infrastructure, economic support models

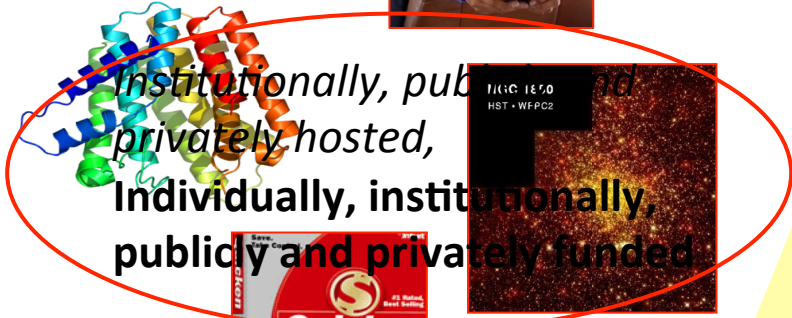
United States  
**Census  
2000**



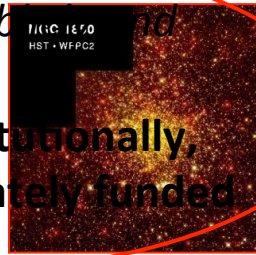
Publicly and privately hosted,  
primarily publicly funded



**Societal  
Value**



Institutionally, publicly and  
privately hosted,  
Individually, institutionally,  
publicly and privately funded



**Community  
Value**



Delu



Individually and  
commercially hosted,  
primarily individually  
and privately funded

**Individual  
Value**

Data Pyramid



Smithsonian  
Institution



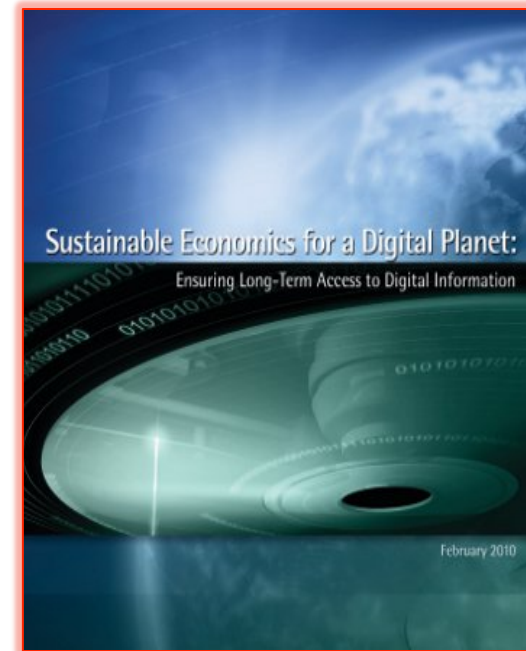
fli



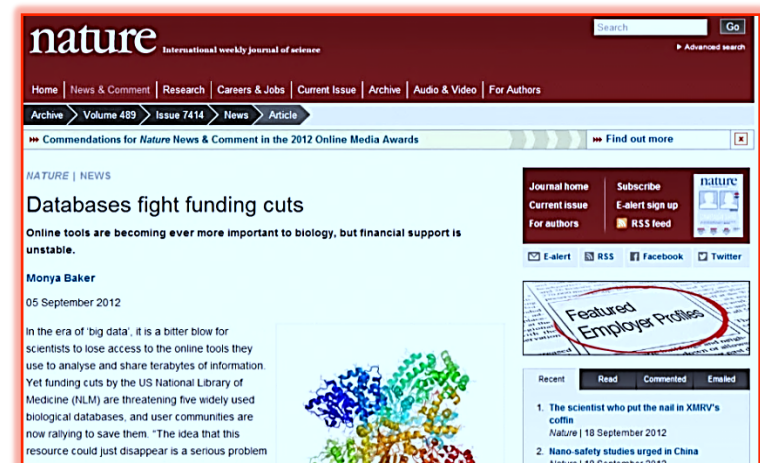
Greater public value  
Greater access and preservation  
requirements  
More infrastructure and management

# How can we better support research data of community value?

- *The greater the alignment between key stakeholder groups, the better the prospect for sustainable preservation*
- Many stakeholders in digital access and preservation
  - Stakeholders who select what to preserve
  - Stakeholders who have rights to the asset
  - Stakeholders who benefit from use of the preserved asset
  - Stakeholders who preserve the asset
  - Stakeholders who pay



More discussion in the Final Report of the *Blue Ribbon Task Force on Sustainable Digital Preservation and Access* ([brtf.sdsc.edu](http://brtf.sdsc.edu))



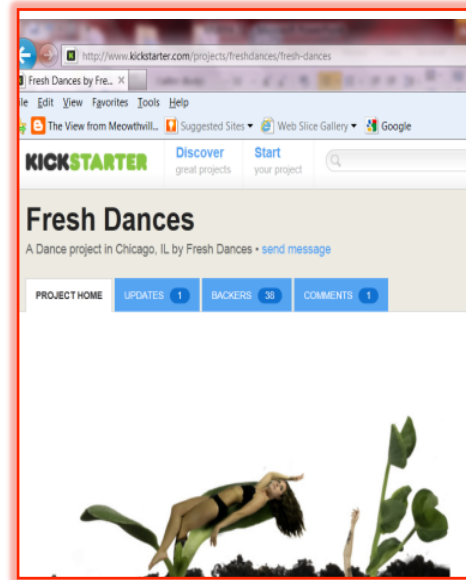
# Paying for Data

## Economic Models at play



WIKIPEDIA  
The Free Encyclopedia

Donations, etc.



Crowd-sourcing



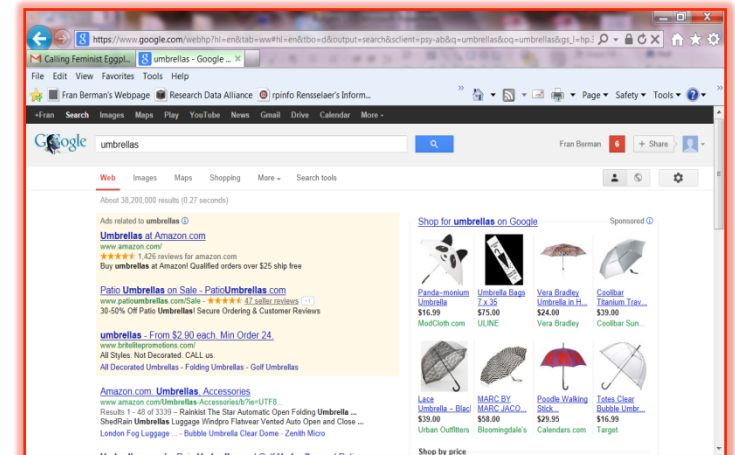
Subscription



Federal Grants



Pay per service



Advertisement



# Economic sustainability – No one sector will do it all

**WIRED** GEAR SCIENCE ENTERTAINMENT BUSINESS SECURITY DESIGN OPINION

OVER 40 MAGAZINES.  
All in one place. All for only \$14.99 a month.

DOWNLOAD THE APP and get access now

SCIENCE

## Google to Host Terabytes of Open-Source Science Data

BY ALEXIS MADRIGAL 01.18.08 11:23 AM

Like 2 Tweet 2 +1 0

The Scientist > The Nutshell

## Funding Cuts Threaten Big Data

Reduced support from the US National Library of Medicine threatens to shut down five po biological databases.

By Jef Akst | September 5, 2012

0 Comments Like 0 Pin It +1 0 Link this Stumble Tweet

In 2007, the US National Library of Medicine (NLM) shunted millions of dollars away from infrastructure grants, which supported widely used databases that house terabytes of biolo data, and instead invest those resources in

BioT  
The International Journal of Life Science Methods

User Name Password Log In Forgotten y

## NSF tears away funding for TAIR

12/03/2009  
Tracy Vence

The Arabidopsis Information Resource (TAIR) has a go-to resource for plant biologists around the v over a decade. In collaboration with the Arabidop Biological Resource Center (ABRC), TAIR allows researchers to search and analyze information f database of genetic and molecular biology data

The National Science Foundation intends to eliminate funding for the Arabidopsis Information Resource by 2013.

**WIRED** GEAR SCIENCE ENTERTAINMENT BUSINESS SECURITY DESIGN OPINION

OVER 75 MAGAZINES.  
All in one app. All FREE for 30 days.

DOWNLOAD THE APP and get access now

SCIENCE

## Google Shuttters Its Science Data Service

BY ALEXIS MADRIGAL 12.18.08 2:30 PM

Like 3 Tweet 13 +1 0

**DATA**

## Data at Risk Inventory

- [Tide Gauge Data 3](#)
- [Tide Gauge Data 2](#)
- [Growth, fruit yield and Azadirachtin content of seeds from Azadirachta indica in Nicaragua \(pr thesis\)](#)
- [LILI-PAD: Long-term Investigations Library - Pathogens of Amphibians Database](#)
- [Whooping Crane Captive Breeding Records Rescue](#)
- [Organization & Development of a spatially referenced database for Agassiz's Desert Tortoise: a](#)
- [Archiving Legacy Waterbird Nesting Data to Inform Adaptive Management of Wetland Habitat](#)
- [Recovery of 62 DoD and State agency data sets](#)
- [Colorado Fossil Inventory Proposal](#)
- [SageSTEP DataStore Metadata](#)

1 2 3 4 Next Last

**TheScientist**  
EXPLORING LIFE, INSPIRING INNOVATION

News Magazine Multimedia Subjects Surveys Careers

Advertisement  
Human DNA sequencing data + Ingenuity Variant Analysis  
Can you find the causal variant?  
TAKE THE CHALLENGE AND WIN!  
Ingenuity Systems

The Scientist > News & Opinion > Daily News

## Library cuts threaten research

As journal cancellations sweep across the US, scientists worry about how they will affect research

By Megan Scudellari | September 28, 2010

13 Comments Like 0 Pin It +1 0 Link this Stumble Tweet this

Earlier this month, New Mexico State University (NMSU) library announced the cancellation of over 700 journal and database subscriptions, the result of a perfect storm of rising journal prices and a slashed

# Potential Solutions in All Sectors

- Four modest proposals ...

## 1. Facilitate private sector stewardship of public access research data

- Encourage the private sector through tax incentives, philanthropy, and other means to provide stewardship for public access research data
- Ensure stability and smooth transition for research data as companies move in and out of research data stewardship role

The Charleston Ballet 2010-2011  
**REFLECTIONS**

SPONSOR PERFORMING ART  
RECEIVE A WEST VIRGINIA TAX CREDIT

Sponsor the Charleston Ballet, receive tickets, program ad and a West Virginia Tax Credit, too! You or your business can receive a West Virginia Neighborhood Investment Program (NIP) tax credit equal to one-half of your sponsorship of \$500 or more. This includes show tickets (October and March) and program advertising, if you choose it. Program press deadlines are fast approaching, so call the Charleston Ballet Office at 304.342.6541 for details and to secure your sponsorship. Tax Credits are limited and available on a first-come, first-served basis.

SEASON SPONSOR  
**DERMASPA**

DANCE DAYS  
**yam**

PRESENTATION SPONSORS  
Les Ballets Jazz de Montréal The Nutcracker Joe Laughlin + Ballet Victoria Black Grace  
90.5% radio one MAYFAIR Jawl & Bundon ISLAND BMW

FOOTNOTES (NEWSLETTER) YOUTH PASS NUTCRACKER ENSEMBLE  
fostrac H. Toranzo Toes n' Taps Dance Shoppe

ACCOMMODATION TRANSPORTATION TOUR PARTNER  
Fairmont EMPRESS Helijet VISION 2000

MEDIA SUPPLIERS  
TIMES DRUMST GEFAX 1070 Kool truffles catering J.R. ENTERTAINMENT

PUBLIC SECTOR SUPPORT  
Canadian Heritage Patrimoine canadien Grand Rapids for the Arts Grand Rapids for the Arts BIRCHMOUNT UNIVERSITY CRD vanpouwer foundation nnp

Dance Victoria's Endowment Fund and the Crystal Christmas Fund (The Crystal Dance Prize) are held at the Victoria Foundation.

VENUE PARTNER AND BOX OFFICE SERVICES  
WETA



world community grid.  
technology solving problems

We're helping find cures for Leishmaniasis.

Can one person make a difference?

Why not donate your unused computer time to World Community Grid and the finding cure for one of the most neglected tropical diseases in the world that is infecting more than two million children and adults in 97 countries each year. > Learn More

Join Today!

It's simple, secure, and you can contribute for free.

Drug Search for Leishmaniasis

HOME ABOUT US RESEARCH FORUMS STATISTICS MY GRID DOWNLOAD Select Language HELP

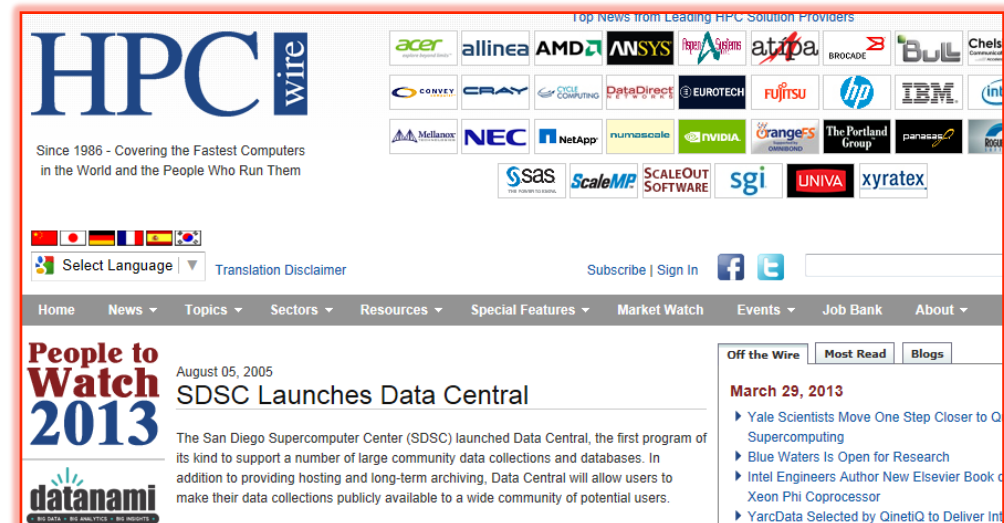
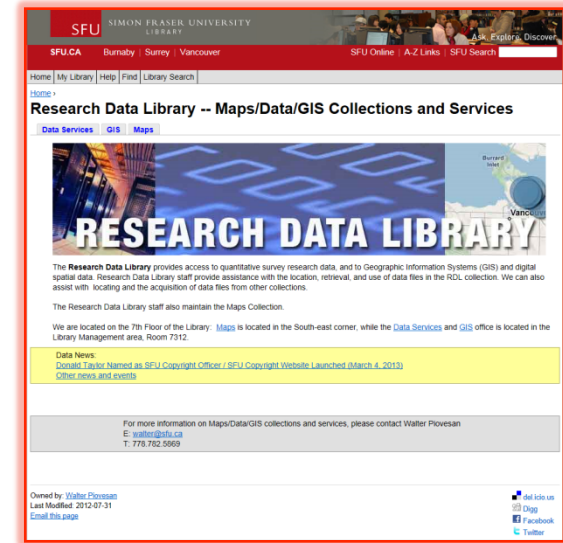
Fran Berman



# Potential Solutions in All Sectors

- Four modest proposals ...

1. Facilitate private sector stewardship of public access research data
2. Use public sector investment to provide an onramp to sustainable academic sector stewardship solutions



# Potential Solutions in All Sectors

- **Four modest proposals ...**

1. Facilitate private sector stewardship of public access research data
2. Use public sector investment to jumpstart sustainable academic sector stewardship solutions
3. **Create and clarify public sector stewardship commitments for public access research data**

*Which research data collections should be publicly hosted?*

*How long should public sector data collections be hosted?*

*How should funding be divided between research and infrastructure?*

*Who should host public sector research data?*

# Potential Solutions in All Sectors

- **Four modest proposals ...**
  1. Facilitate private sector stewardship of public access research data
  2. Use public sector investment to jumpstart sustainable academic sector stewardship solutions
  3. Create and clarify public sector stewardship commitments for public access research data
  4. **Encourage research culture change to take advantage of what works in the private sector**



# Beyond the U.S.: Global Need for Data Infrastructure



**SouthAfrica.info**  
Brand South Africa country portal

Thu, 4 Apr 2013

search

Science and technology

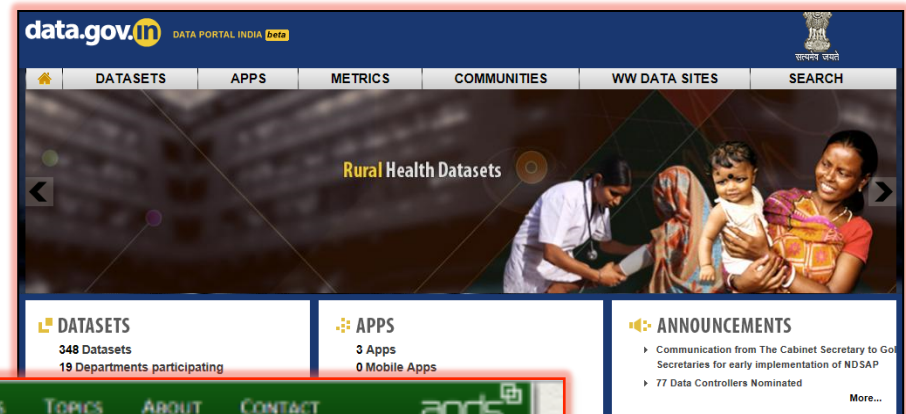
### SKA South Africa joins 'big data' project

Like 8 Tweet 6 +1 0 Share 4

11 March 2013

Square Kilometre Array South Africa is joining IBM and the Netherlands Institute for Radio Astronomy (Astron) in a four-

Animals and plants  
Arts and culture  
Democracy  
Education  
Geography  
Government



**data.gov.in** DATA PORTAL INDIA beta

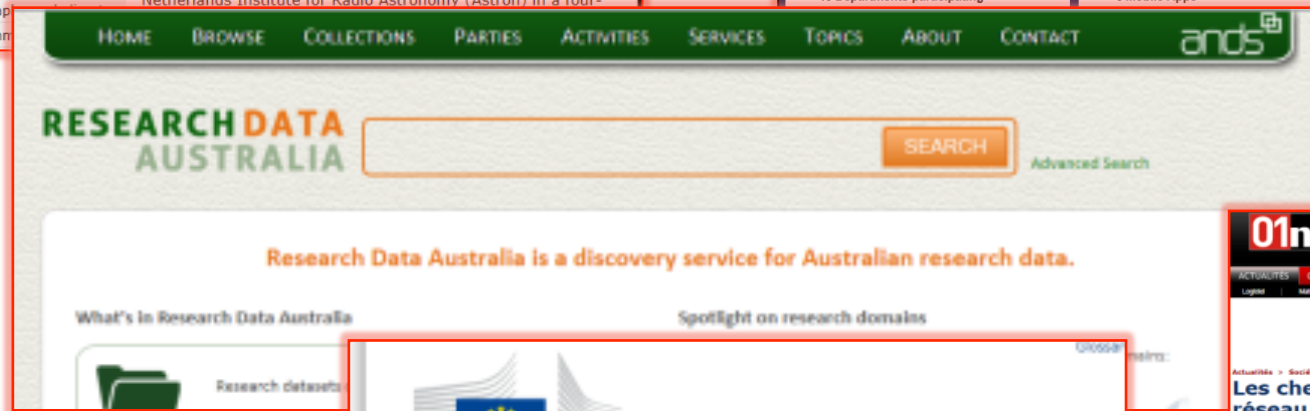
DATASETS APPS METRICS COMMUNITIES WW DATA SITES SEARCH

### Rural Health Datasets

DATASETS  
348 Datasets  
19 Departments participating

APPS  
3 Apps  
0 Mobile Apps

ANNOUNCEMENTS  
Communication from The Cabinet Secretary to Go...  
Secretaries for early implementation of NDSAP  
77 Data Controllers Nominated



HOME BROWSE COLLECTIONS PARTIES ACTIVITIES SERVICES TOPICS ABOUT CONTACT

## RESEARCH DATA AUSTRALIA

SEARCH Advanced Search

Research Data Australia is a discovery service for Australian research data.

What's in Research Data Australia

Spotlight on research domains

Research datasets



European Commission JUSTICE



### Commission proposes a comprehensive reform of the data protection rules

Date: 25/01/2012

Brussels, 25 January 2012 – The European Commission has today proposed a comprehensive reform of the EU's 1995 data protection rules to strengthen



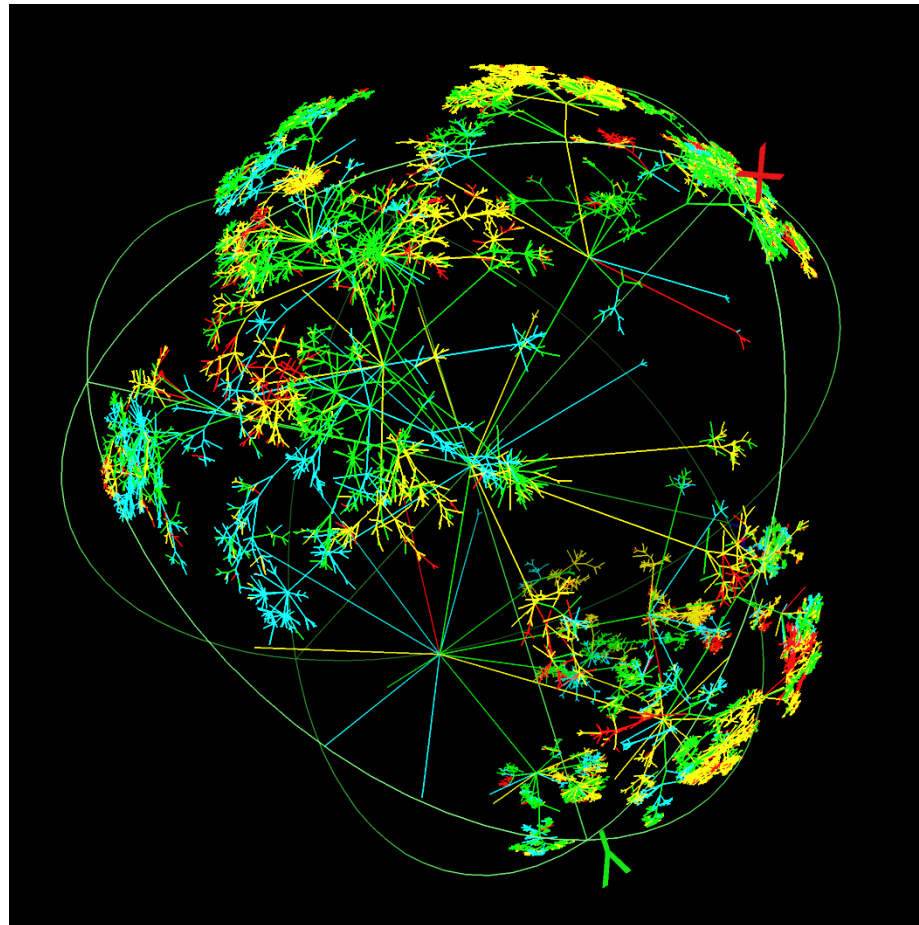
O1net

### Les chercheurs veulent créer un réseau mondial d'échange de données

Il est trop difficile de partager de grandes masses de données scientifiques issues de différents pays et de différentes disciplines. Une nouvelle organisation est chargée d'y remédier.

Europe, les Etats-Unis, et l'Australie viennent de créer le **Research Data Alliance**, une organisation qui regroupe différentes institutions de recherche de ces pays

# It takes a Village: Community Efforts to Build Coordinated Global Data Infrastructure



# It's Not Just Your Data, It's Other People's Data

## Data Sharing and Interoperability critical for innovation

OFFICE OF JUSTICE PROGRAMS

**NATIONAL INSTITUTE OF JUSTICE**  
Research • Development • Evaluation

HOME | FUNDING & AWARDS | PUBLICATIONS & MULTIMEDIA | EVENTS | TRAINING | TOPICS

NIJ Home Page > NIJ Journal > NIJ Journal No. 267

**NIJ JOURNAL NO. 267**

**In Brief: Expanding Research by Sharing Data**  
by NIJ staff

*NIJ makes data available for future research.*

Director's Message

Police Use of Force: The Impact of Less-Lethal Weapons and Tactics

Toward a Better Way to Interview Child Victims of Sexual Abuse

InformationWeek **Healthcare** Digital Bundle

Software Security Cloud Mobility Social Business Big Data Windows Global CIO Government Healthcare Education Financial SMB More

Electronic Medical Records Mobile & Wireless Clinical Information Systems Security & Privacy CPOE The Patient Leadership More Healthcare

**Now you can afford them.**

NEWS

**Sharing Psychiatry EHR Data Cuts Readmission Rates**

Get InformationWeek Daily

Don't miss each day's hottest technology news, sent directly to your inbox, including occasional breaking news alerts.

HOME PAGE TODAY'S PAPER VIDEO MOST POPULAR TIMES TOPICS

Subscribe: Digital / Home Delivery | L

**The New York Times**

Search All NYTimes.com

WORLD U.S. N.Y. / REGION BUSINESS TECHNOLOGY SCIENCE HEALTH SPORTS OPINION ARTS STYLE TRAVEL JOBS REAL ESTATE

Do you have at least 4 hours left for sleep?

Search Health 3,000+ Topics

Go

Log in to see what your friends are sharing on nytimes.com. Privacy Policy | What's This?

**Sharing of Data Leads to Progress on Alzheimer's**

By GINA KOLATA  
Published: August 12, 2010

What's Popular Now

Fatally ill, and Making Herself the Lesson

Extreme Weather Grows in Frequency

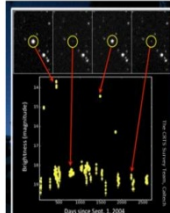
MENU / News & Events / News

Back to All News

01/12/2012

**Astronomers Release Unprecedented Data Set on Celestial Objects that Brighten and Dim**

PASADENA, Calif.—Astronomers from the California Institute of Technology (Caltech) and the University of Arizona have released the largest data set ever



what's hot? AMAZON CES 2013 GOOGLE 2013 PREDICTIONS CRUNCHES AWARDS

**THE WALL STREET JOURNAL**

Mortgages Fade at Wells Fargo

**BIG DATA**

The Moneyball strategy is the future for venture capital firms (17 hrs ago)

Facebook's new regional fan breakdown outs brands that have been buying likes (2 days ago)

Disney World's RFID bracelets use data to bring fantasy to life (4 days ago)

Tech nerds leverage data to help you avoid the flu

Learn the benefits of an automated recruiting tool!

**nature medicine**

nature.com journal home archive issue news abstract

ARTICLE PREVIEW

view full access options

NATURE MEDICINE | NEWS

日本語案内

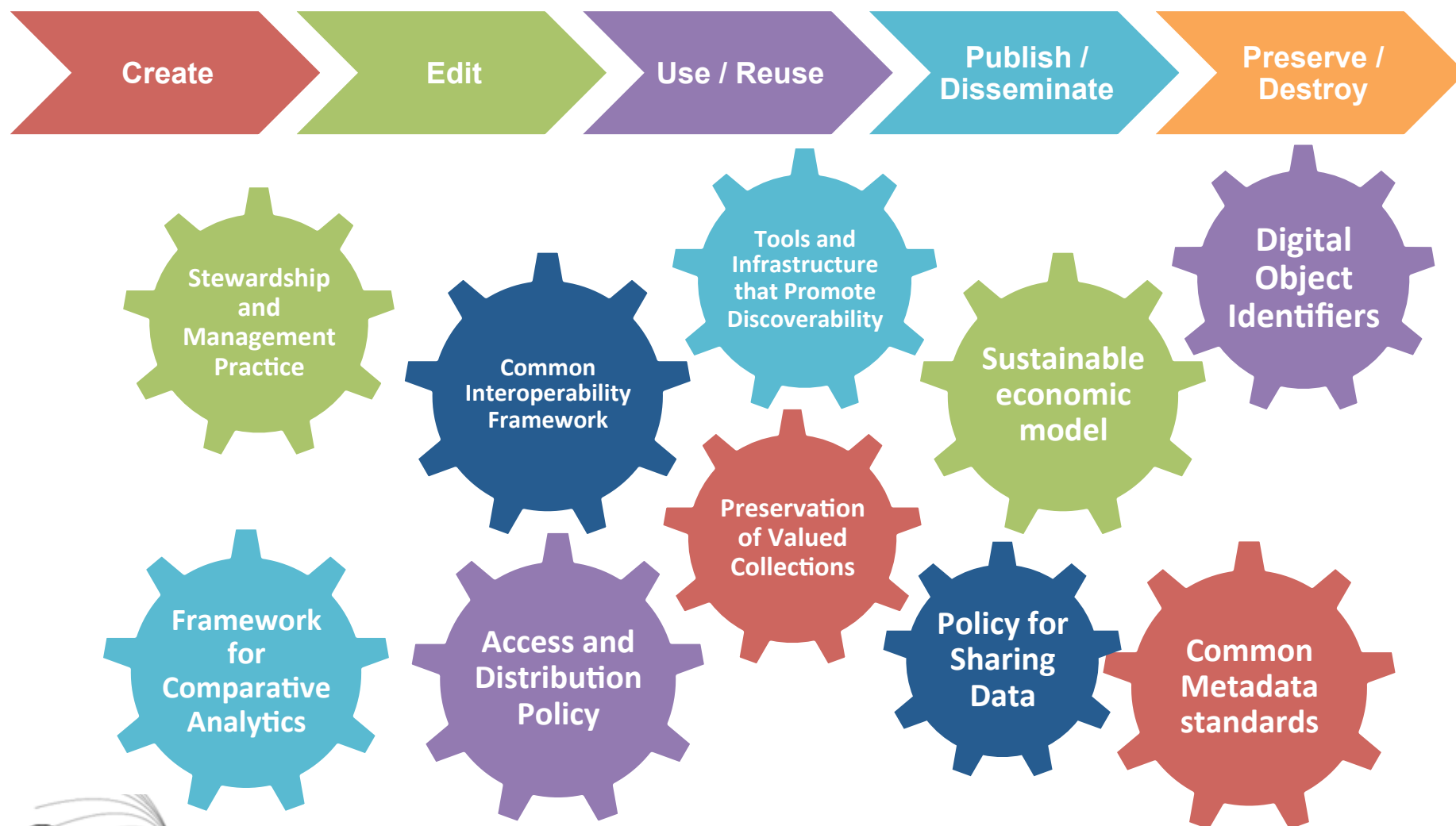
The delay in sharing research data is costing lives

Josh Sommer



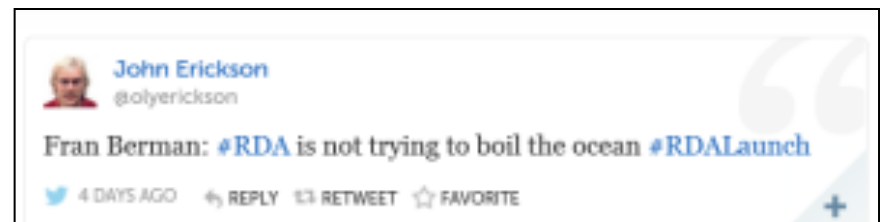
why not change the world? SM

# Data Sharing Infrastructure: **Components needed throughout the Data Life Cycle**



# Research Data Alliance (RDA): New Community Organization formed to Accelerate Global Data Sharing and Exchange

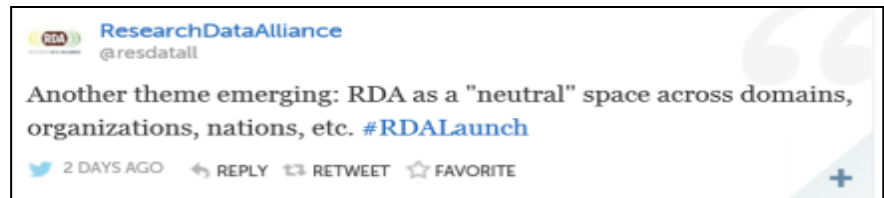
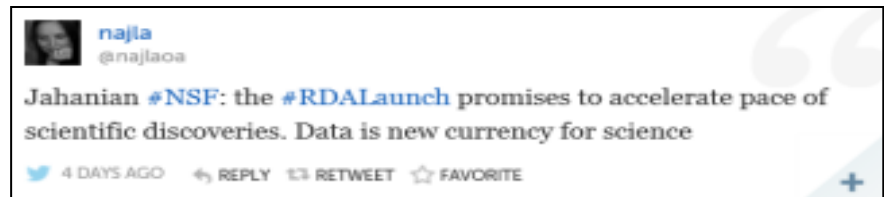
- The Research Data Alliance (RDA) is a new international organization formed to implement / adopt infrastructure needed to accelerant research data **sharing and exchange worldwide**
- **12-18 month Working Groups (WG) will serve as drivers for data sharing infrastructure and practice. WG deliverables to include**
  - Adopted standards
  - Deployed infrastructure
  - Adopted policy
  - Implemented best practice, etc.





# March 18-20, 2013 Gothenburg, Sweden RDA goes live!

- Over 200 participants
- 31 countries
- 5 continents
- Public, private, academic sectors
- High-profile Govt. and Science speakers



# Research Data Alliance Approach:

## Focused efforts, key players, infrastructure adoption

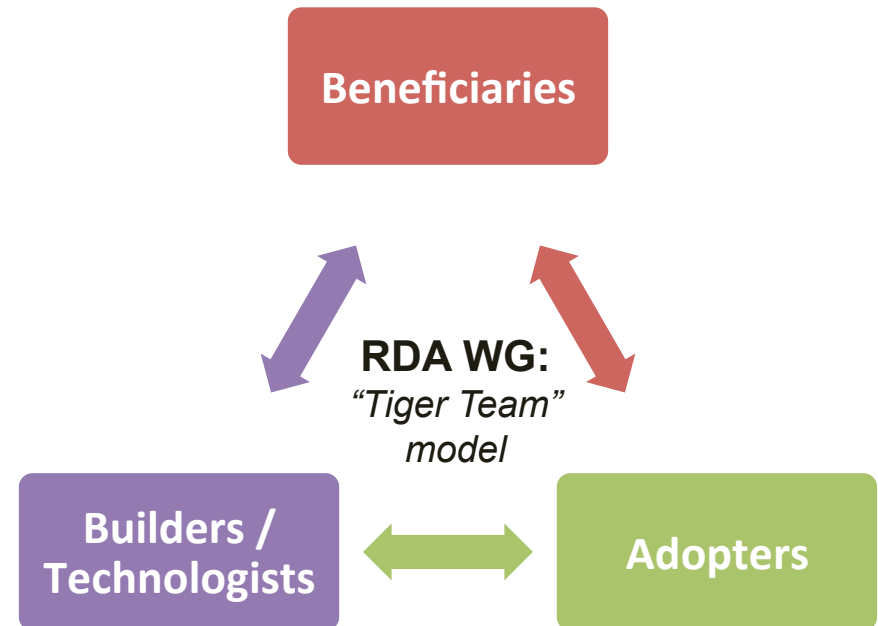
### RDA Working Group Deliverables are:

- **Focused pieces of adopted code, policy, infrastructure, standards, or best practices** that enable data to be shared and exchanged
- **“Harvestable” efforts** for which 12-18 months of work can eliminate a roadblock for a substantial community
- **Efforts that have substantive applicability** to “chunks” of the data community, but may not apply to everyone
- **Efforts for which working scientists and researchers can start today** while more long-term or far-reaching solutions are appropriately discussed in other venues

### Organizational Sponsors:

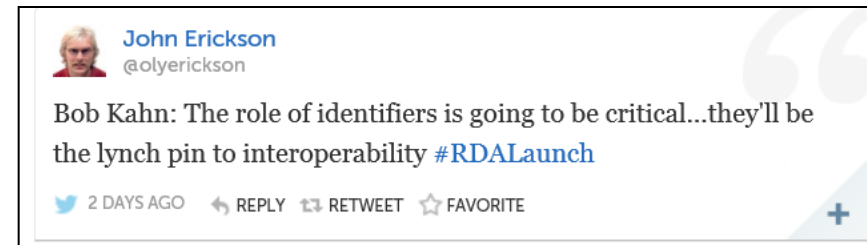


- *NSF (RDA/US)*
- *European Commission (RDA/EU)*
- *Australian Govt. (ANDS)*



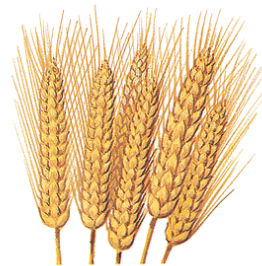


## Many RDA Groups Forming



## RDA Interest Group: Agricultural Data

- **Focus:** Share and create interoperability framework for data from agricultural research, in particular wheat
  - *Wheat data combines Germplasm data, genetic and phenotypic data, statistical data, bibliographical data, etc.*
- Group members from India, France, Greece, UN Food and Agricultural Organization



## RDA Working Group: Persistent Identifier (PID) Information Types

- **Focus:** Develop framework for information types to be associated with unique identifiers, adopt framework at DKRZ (German supercomputing Center) and other sites
  - *Agreement about the information associated with PIDs would allow programmers to implement the same API independent of the PID type being used*

# RDA 2013 Current Status

- **Next Plenary: September 16-18 at National Academies in Washington DC**

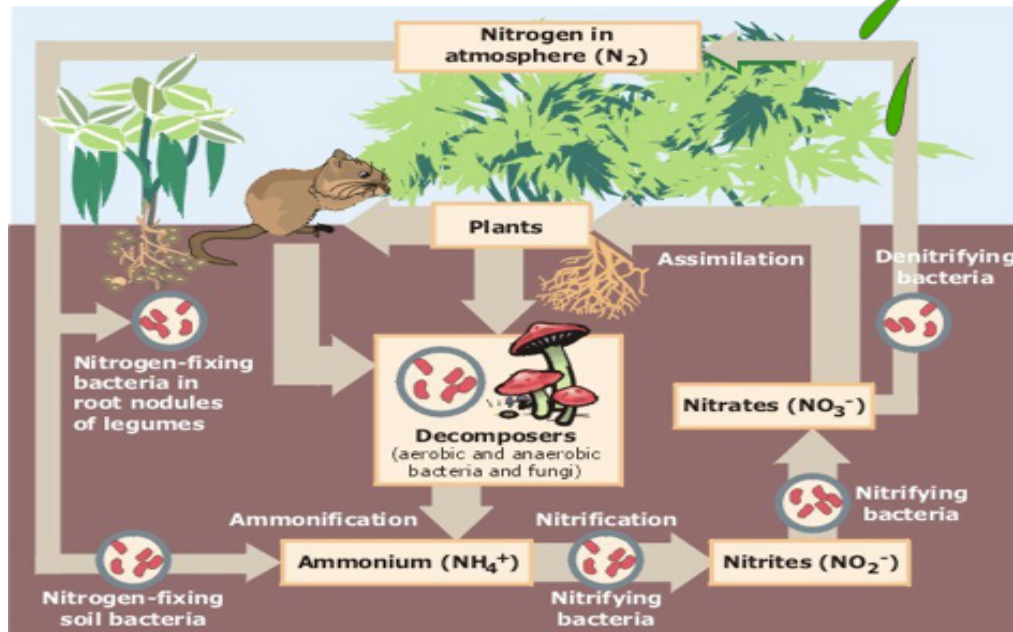


## Growing the RDA community

- **New members: [rd-alliance.org](http://rd-alliance.org)**
- **New Interest Groups** (discussion), **Working Groups** (deliverables), **Task Groups** (building the organization)
- Reaching out to other data community organizations to form **Affiliate Organizational Partners** to synergistically drive high impact community efforts

# Data-Driven Innovation Requires an Ecosystem

Impact dependent on effective development and integration of all components



Innovation  
Infrastructure  
Economic support  
Community effort  
Policy  
Practice

...

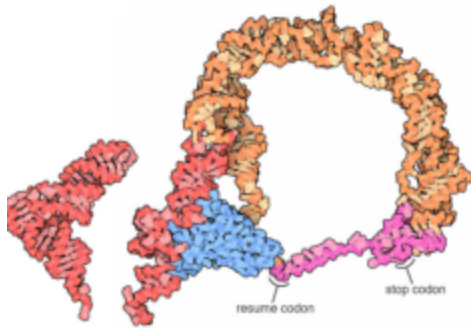
**Thank You**

**Happy 50<sup>th</sup> Birthday to Purdue CS!**



# The Power of Many: Community infrastructure adoption and coordination drive innovation

- “Just do it” -- Focused efforts help communities drive tangible progress



PROTEIN DATA BANK

Creation / adoption of **data sharing policies** have accelerated research innovation

Development and adoption of **parallel communication protocols** through the MPI Forum drove a generation of advances



Development of a **public access** to shared data collection enabling new results for Alzheimer's



Now 25 years old, the Internet Engineering Task Force's mission "to make the Internet work better" has resulted in key specifications of Internet **community standards** that support innovation

# Community Momentum

National Science Foundation  
WHERE DISCOVERIES BEGIN

FUNDING AWARDS DISCOVERIES NEWS PUBLICATIONS STATISTICS ABOUT

News  
Press Release 12-218  
**NSF-Supported Research Data Alliance/U.S. Collaborates with International Partners to Accelerate Data Sharing**  
Rensselaer computer scientist Francine Berman to lead U.S. engagement

SC ONLINE NEWS

HOME MULTIMEDIA BREAKING NEWS TOPICS POLLS ADVERTISE

protein

Amazing prices on mammalian-expressed recombinant proteins

Open Access Research Data without Barriers  
Written by Tyler O'Neal | Tuesday, 05 March 2013 07:46

TECHPRESIDENT

WeGov

Open Science Breaks Down International Barriers for Researchers

1net

ACTUALITES COMPARATIFS ET TESTS JEUX ASTUCES VIDEO

COMMUNICATIONS OF THE ACM

Home / News / New Global Research Data Alliance Poised For Launch / Full Text

ACM NEWS  
New Global Research Data Alliance Poised For Launch  
By Paul Hyman  
March 7, 2013

Actualités > Société  
**Les chercheurs veulent créer un réseau mondial d'échange de données**  
Il est trop difficile de partager de grandes masses de données scientifiques issues de différents pays et de différentes disciplines. Une nouvelle organisation est chargée d'y remédier.

SIGNAL ONLINE

More than a magazine: We're AFCEA.

Home » Researchers Organize to Share Data, Speed Innovation

Share / Save

Researchers Organize to Share Data, Speed Innovation

THE WALL STREET JOURNAL | TECH

TECH EUROPE

EU Opens Up Access to Scientific Research

Research.gov

POWERING KNOWLEDGE AND INNOVATION

LOGIN AS  
NSF User Login

What is Research.gov?  
Service Offerings  
News

Latest News  
NSF Supports U.S. Participation in the Launch of a New International Effort Aimed at Making Data Easier to Share Among Researchers



why not change the world? SM