Collaboration and Virtual Institutes

K. Estelle Dodson
Collaborative Science and Technologies Manager
Human Systems Integration
NASA’s Virtual Institutes
NASA Ames Research Center
NASA’s Virtual Institutes

• NASA Astrobiology Institute (NAI)
  – Established 1998

• Solar Systems Exploration Virtual Research Institute (SSERVI)

• NASA Aeronautics Research Institute (NARI)
  – Established 2012

More than 1500 people at over 200 universities, NASA Centers and research laboratories
What are they?
“Geographically, organizationally and/or time dispersed workers brought together by IT to accomplish one or more organizational goals”

Why are they important?
Science and engineering challenges are increasingly complex and require the expertise and resources of many organizations to solve. Strategic partnerships around the world allow the government to quickly form operational teams in response to rapidly changing environments.
Other examples

- **Network for Engineering Earthquake Simulation (NEES)**
  - 14 Geographically distributed, shared use laboratories to support Earthquake Safety engineering, science research and education

- **Atlas project** of the Large Hadron Collider, one of the two projects leading to the discovery of Higgs Boson
  - 3000 physicists from 38 countries at 174 universities and government labs and more than 1000 students

- **Synthetic Biology Engineering Research Center**
  - Seven Universities and NSF, 14 PI’s, 21 Co-I’s and their labs

- Over 1000 more engineering and research “collaboratories” have been studied by NSF

- Most large businesses are distributed organizations and/or have partnerships that require working together across distances

To meet growing needs in collaboration leadership and management in science fields the NIH has published “Collaboration and Team Science: A Field Guide”

K. E. Dodson, NASA Ames Research Center
Benefits and Value

- Ability to share and leverage expensive equipment and facilities
- Cost savings
- Skill Sharing
- Enhance technical competencies
- Increased insight and discovery across disciplines
- Remote mentoring and training
- Development of new products
- Increased competitiveness
- Improved information and knowledge sharing across disciplines and between organizations
- Decreased duplication of effort
- Better understanding of complex global issues resulting in improvement of public policies

- Rapid response for decision making
- Shorter development time of products
- Higher publication rates
- Unite experts across the globe
- Teams and organizations can reconfigure and adapt quickly to meet dynamic requirements and opportunities
- Increased visibility of STEM disciplines
- Broader access to datasets and instrumentation and field sites
- Increased group and organizational learning across distances
- Group and organizational learning can accelerate progress on goals and sustainability of the community

"Leaders today must be able to harness ideas, people and resources across boundaries of all kinds. That requires reinventing their talent strategies and building strong connections both inside and outside their organizations." — Harvard Business Review

K. E. Dodson, NASA Ames Research Center
Challenges and Solutions in Virtual Organizations...
<table>
<thead>
<tr>
<th>Leadership and Management</th>
<th>Social</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Different work processes</td>
<td>• Reduced opportunities for informal conversation</td>
</tr>
<tr>
<td>• Establishing shared goals</td>
<td>• Reduced opportunities to build friendships</td>
</tr>
<tr>
<td>• Legal agreements</td>
<td>• Time zone differences</td>
</tr>
<tr>
<td>• Building consensus</td>
<td>• Cultural differences</td>
</tr>
<tr>
<td>• Intellectual property, publication authoring and credit</td>
<td>• Lack of contextual awareness of remote teams environments or conditions</td>
</tr>
<tr>
<td>• Decreased monitoring and control of activities</td>
<td>• Establishing trust and common ground</td>
</tr>
<tr>
<td>• Competition and conflicting motivations</td>
<td>• Local coalitions</td>
</tr>
<tr>
<td>• Weak leadership</td>
<td>• More likely to produce extreme opinions</td>
</tr>
<tr>
<td>• Tightly coupled/interdependent tasks (need to be co-located)</td>
<td>• Larger the size, greater coordination roles and efforts required</td>
</tr>
<tr>
<td></td>
<td>• Lack of feedback</td>
</tr>
</tbody>
</table>

K. E. Dodson, NASA Ames Research Center
Leadership and Management

- Strong and clear decision making and leadership
- Modular work assigned to each location requiring less communication overall
- Clear roles and responsibilities
- Additional attention to work-cycles and follow-up communications
- Communication points of contact at each site
- Decisions are fair and based on open criteria
- Goals are aligned between teams and individuals

Social

- Kick-off and negotiation or conflict resolution meetings are held face-to-face
- Individuals have a high social intelligence and good communicators
- Naturally collaborative culture
- Hold monthly lunches to build rapport
- Members are trained to use collaboration technologies and useful social protocols are discussed and modeled
- Virtual meetings have facilitators and include technologies that encourage interaction
- Participants are aware of context of remote sites
- Participants share a common working style
- Proactively create opportunities for feedback and interaction
Technical

- Technology does not address the needs of the users and the task at hand
- Lack of technical and communication standards or processes
- Complicated or unreliable technologies
- Learning new tools and technologies
- Incompatible technologies or inability to access research and communication tools
- Too many shared workspaces and unclear workflow
- Inadequate local technical support or training
- Insufficient bandwidth or security issues

“Our fieldwork has produced numerous examples where participants were unaware of the difficulty they were having with the communication channel. They adapted their behavior rather than fix the technology.” - Judith and Gary Olson at University of Michigan

K. E. Dodson, NASA Ames Research Center
Technical

- Collaboration technologies provide the right functionality and are easy to use, provide HCI evaluations and recommendations for deployment
- If technologies need to be built, user-centered practices are in place
- Participants are comfortable with the collaboration technologies
- Technologies provide benefit to the participants
- Technologies are reliable, training and accounts are provided
- Agreement exists among participants as to what shared spaces to use
- Networking supports the work that needs to be done
- Technical support resides at every location
- An overall technical coordinator is in place
- If data sharing is one of the goals, standards are in place and shared by all participants, and a plan for archiving is in place
- If instrument sharing is part of the collaboration, a plan to certify remote users is in place

K. E. Dodson, NASA Ames Research Center
Meetings/Communication

• Leaders talk three times as much in a virtual meetings (reduced team communication)
• Extreme opinions and polarization between sites
• Lack of contextual awareness of remote teams environments or conditions
• Lack of feedback and confirmation of understanding
• Lack of protocols for effective virtual meetings
• Lack of planning and preparation
Meetings/Communication

- Meeting facilitators
- Modeling and training of best practices for meeting participation
  - Icebreakers
  - Awareness and inclusion of remote participants
  - Leaders asking for input from others
  - Quality camera and audio use
  - Leadership buy-in, support and promotion
- Chat rooms, polls and awareness indicators (backchannel communication)
- Advanced planning and preparation
- Setting of goals and planning content to meet goals, reviewing with facilitator
- Highest fidelity technologies possible

K. E. Dodson, NASA Ames Research Center


Virtual Collaboration
Infrastructure and Approach
Collaboration Infrastructure

**Organizational Infrastructure**
- Legal agreements
- Funding Mechanisms
- Policy and Processes

**Technical Infrastructure**
- Standards
- Training
- Security
- Assessment/Usability
- Implementation/Support
- Tool Integration

**Social Infrastructure**
- Trust and relationship building
- Shared values, goals and vocabularies
- Building consensus
- Managing differences
- Leadership

K. E. Dodson, NASA Ames Research Center
## Cooperative Agreements

- Provides legal and funding structures
- Collaboration requirements and staggered CAN cycle promotes community cohesion and learning

K. E. Dodson, NASA Ames Research Center

### Table: Cooperative Agreements

<table>
<thead>
<tr>
<th>Year</th>
<th>Arizona State University</th>
<th>NASA Ames Research Center</th>
<th>Carnegie Institution of Washington</th>
<th>Harvard University</th>
<th>Jet Propulsion Laboratory</th>
<th>NASA Johnson Space Center</th>
<th>Marine Biological Laboratory, Woods Hole</th>
<th>Pennsylvania State University</th>
<th>Scripps Research Institute, La Jolla</th>
<th>University of California, Los Angeles</th>
<th>University of Colorado, Boulder</th>
</tr>
</thead>
<tbody>
<tr>
<td>98-99</td>
<td>Arizona State University</td>
<td>NASA Ames Research Center</td>
<td>Carnegie Institution of Washington</td>
<td>Harvard University</td>
<td>Jet Propulsion Laboratory</td>
<td>NASA Johnson Space Center</td>
<td>Marine Biological Laboratory, Woods Hole</td>
<td>Pennsylvania State University</td>
<td>Scripps Research Institute, La Jolla</td>
<td>University of California, Los Angeles</td>
<td>University of Colorado, Boulder</td>
</tr>
<tr>
<td>99-00</td>
<td>Arizona State University</td>
<td>NASA Ames Research Center</td>
<td>Carnegie Institution of Washington</td>
<td>Harvard University</td>
<td>Jet Propulsion Laboratory</td>
<td>NASA Johnson Space Center</td>
<td>Marine Biological Laboratory, Woods Hole</td>
<td>Pennsylvania State University</td>
<td>Scripps Research Institute, La Jolla</td>
<td>University of California, Los Angeles</td>
<td>University of Colorado, Boulder</td>
</tr>
<tr>
<td>00-01</td>
<td>Arizona State University</td>
<td>NASA Ames Research Center</td>
<td>Carnegie Institution of Washington</td>
<td>Harvard University</td>
<td>Jet Propulsion Laboratory</td>
<td>NASA Johnson Space Center</td>
<td>Marine Biological Laboratory, Woods Hole</td>
<td>Pennsylvania State University</td>
<td>Scripps Research Institute, La Jolla</td>
<td>University of California, Los Angeles</td>
<td>University of Colorado, Boulder</td>
</tr>
<tr>
<td>01-02</td>
<td>Arizona State University</td>
<td>NASA Ames Research Center</td>
<td>Carnegie Institution of Washington</td>
<td>Harvard University</td>
<td>Jet Propulsion Laboratory</td>
<td>NASA Johnson Space Center</td>
<td>Marine Biological Laboratory, Woods Hole</td>
<td>Pennsylvania State University</td>
<td>Scripps Research Institute, La Jolla</td>
<td>University of California, Los Angeles</td>
<td>University of Colorado, Boulder</td>
</tr>
<tr>
<td>02-03</td>
<td>Arizona State University</td>
<td>NASA Ames Research Center</td>
<td>Carnegie Institution of Washington</td>
<td>Harvard University</td>
<td>Jet Propulsion Laboratory</td>
<td>NASA Johnson Space Center</td>
<td>Marine Biological Laboratory, Woods Hole</td>
<td>Pennsylvania State University</td>
<td>Scripps Research Institute, La Jolla</td>
<td>University of California, Los Angeles</td>
<td>University of Colorado, Boulder</td>
</tr>
<tr>
<td>03-04</td>
<td>Arizona State University</td>
<td>NASA Ames Research Center</td>
<td>Carnegie Institution of Washington</td>
<td>Harvard University</td>
<td>Jet Propulsion Laboratory</td>
<td>NASA Johnson Space Center</td>
<td>Marine Biological Laboratory, Woods Hole</td>
<td>Pennsylvania State University</td>
<td>Scripps Research Institute, La Jolla</td>
<td>University of California, Los Angeles</td>
<td>University of Colorado, Boulder</td>
</tr>
<tr>
<td>04-05</td>
<td>Arizona State University</td>
<td>NASA Ames Research Center</td>
<td>Carnegie Institution of Washington</td>
<td>Harvard University</td>
<td>Jet Propulsion Laboratory</td>
<td>NASA Johnson Space Center</td>
<td>Marine Biological Laboratory, Woods Hole</td>
<td>Pennsylvania State University</td>
<td>Scripps Research Institute, La Jolla</td>
<td>University of California, Los Angeles</td>
<td>University of Colorado, Boulder</td>
</tr>
<tr>
<td>05-06</td>
<td>Arizona State University</td>
<td>NASA Ames Research Center</td>
<td>Carnegie Institution of Washington</td>
<td>Harvard University</td>
<td>Jet Propulsion Laboratory</td>
<td>NASA Johnson Space Center</td>
<td>Marine Biological Laboratory, Woods Hole</td>
<td>Pennsylvania State University</td>
<td>Scripps Research Institute, La Jolla</td>
<td>University of California, Los Angeles</td>
<td>University of Colorado, Boulder</td>
</tr>
<tr>
<td>06-07</td>
<td>Arizona State University</td>
<td>NASA Ames Research Center</td>
<td>Carnegie Institution of Washington</td>
<td>Harvard University</td>
<td>Jet Propulsion Laboratory</td>
<td>NASA Johnson Space Center</td>
<td>Marine Biological Laboratory, Woods Hole</td>
<td>Pennsylvania State University</td>
<td>Scripps Research Institute, La Jolla</td>
<td>University of California, Los Angeles</td>
<td>University of Colorado, Boulder</td>
</tr>
<tr>
<td>07-08</td>
<td>Arizona State University</td>
<td>NASA Ames Research Center</td>
<td>Carnegie Institution of Washington</td>
<td>Harvard University</td>
<td>Jet Propulsion Laboratory</td>
<td>NASA Johnson Space Center</td>
<td>Marine Biological Laboratory, Woods Hole</td>
<td>Pennsylvania State University</td>
<td>Scripps Research Institute, La Jolla</td>
<td>University of California, Los Angeles</td>
<td>University of Colorado, Boulder</td>
</tr>
<tr>
<td>08-09</td>
<td>Arizona State University</td>
<td>NASA Ames Research Center</td>
<td>Carnegie Institution of Washington</td>
<td>Harvard University</td>
<td>Jet Propulsion Laboratory</td>
<td>NASA Johnson Space Center</td>
<td>Marine Biological Laboratory, Woods Hole</td>
<td>Pennsylvania State University</td>
<td>Scripps Research Institute, La Jolla</td>
<td>University of California, Los Angeles</td>
<td>University of Colorado, Boulder</td>
</tr>
<tr>
<td>09-10</td>
<td>Arizona State University</td>
<td>NASA Ames Research Center</td>
<td>Carnegie Institution of Washington</td>
<td>Harvard University</td>
<td>Jet Propulsion Laboratory</td>
<td>NASA Johnson Space Center</td>
<td>Marine Biological Laboratory, Woods Hole</td>
<td>Pennsylvania State University</td>
<td>Scripps Research Institute, La Jolla</td>
<td>University of California, Los Angeles</td>
<td>University of Colorado, Boulder</td>
</tr>
<tr>
<td>10-11</td>
<td>Arizona State University</td>
<td>NASA Ames Research Center</td>
<td>Carnegie Institution of Washington</td>
<td>Harvard University</td>
<td>Jet Propulsion Laboratory</td>
<td>NASA Johnson Space Center</td>
<td>Marine Biological Laboratory, Woods Hole</td>
<td>Pennsylvania State University</td>
<td>Scripps Research Institute, La Jolla</td>
<td>University of California, Los Angeles</td>
<td>University of Colorado, Boulder</td>
</tr>
<tr>
<td>11-12</td>
<td>Arizona State University</td>
<td>NASA Ames Research Center</td>
<td>Carnegie Institution of Washington</td>
<td>Harvard University</td>
<td>Jet Propulsion Laboratory</td>
<td>NASA Johnson Space Center</td>
<td>Marine Biological Laboratory, Woods Hole</td>
<td>Pennsylvania State University</td>
<td>Scripps Research Institute, La Jolla</td>
<td>University of California, Los Angeles</td>
<td>University of Colorado, Boulder</td>
</tr>
<tr>
<td>12-13</td>
<td>Arizona State University</td>
<td>NASA Ames Research Center</td>
<td>Carnegie Institution of Washington</td>
<td>Harvard University</td>
<td>Jet Propulsion Laboratory</td>
<td>NASA Johnson Space Center</td>
<td>Marine Biological Laboratory, Woods Hole</td>
<td>Pennsylvania State University</td>
<td>Scripps Research Institute, La Jolla</td>
<td>University of California, Los Angeles</td>
<td>University of Colorado, Boulder</td>
</tr>
</tbody>
</table>

### CAN-1
- Michigan State University
- University of Rhode Island
- University of Washington
- Virtual Planetary Laboratory (VPL) JPL/Catech

### CAN-2
- University of California, Berkeley
- NASA Goddard Space Flight Center
- Indiana-Princeton-Tennessee Astrobiology Institute
- SETI Institute, Mountain View
- University of Arizona
- University of Hawaii, Manoa

### CAN-3
- Montana State University
- University of Wisconsin
- MIT
- Georgia Institute of Technology
- Rensselaer Polytechnic Institute

### TOTAL NUMBER OF NAI TEAMS

| 11 | 11 | 11 | 15 | 15 | 16 | 16 | 16 | 12 | 16 | 14 | 14 | 14 |

### NAI DIRECTORS

- HUBBARD (interim Manager)
- BLUMBERG (Acting)
- GRYMES
- RUNNEGAN
- Science Dir. (Executive Dir.)
- PILCHER

K. E. Dodson, NASA Ames Research Center
Collaboration Working Group (CWG)

- Composed of IT enthusiasts from each team
- Meets virtually once a month
- Share lessons learned and knowledge
- Test hardware, software and integration
- POCs for virtual events
- Provides local training, support, expertise and feedback within the system
- Build structures and expertise within virtual organizations to promote an optimal interaction between centralization and autonomy

Organization of technologies, people and communities creates “Participative Centralization”

Harvard Business Review

K. E. Dodson, NASA Ames Research Center
Tightly Coupled Feedback Between Developers, Implementers and Users

Research and Development ↔ Implementation ↔ End users

Community

K. E. Dodson, NASA Ames Research Center
Forrester Research: Once a business deploys four to five collaboration tools, there is a significant improvement in benefits from the technologies.

Gartner: “Hyperconnectedness will lead to a push for more work to occur in formal and informal relationships across enterprise boundaries…and that has implications for how people work and how IT augments or supports that work.”

K. E. Dodson, NASA Ames Research Center
Integrated Teams and Technologies

Teams and Communities

Meetings, Seminars, Workshops
Training, Teaching, and Knowledge Exchange

NASA Ames Collaboration Team

Suite of Collaboration Technologies

Security

Network

K. E. Dodson, NASA Ames Research Center
Expert guidance for choosing the best technologies and implementation approach based on the needs of the work and organizational culture

K. E. Dodson, NASA Ames Research Center
Virtual Events
In 2013 the Ames Collaboration Team, using the NASA virtual institutes infrastructure, produced more than large 160 virtual events

- 25 had more than 100 participants and took place over multiple days
- 35 had 50-100 participants
- Integrated multiple technologies for an optimal experience from any location.
- High quality, reliable and easy to use experience is critical

Additional team meetings and events were produced by individual science and project teams...more than 60,000 virtual meeting hours.
SSERVI Virtual Lunar Science Forum

- Three days (21 hours) of virtual, interactive activities
- Over 450 unique log-ins
- Parallel sessions were held throughout the forum with ~200 concurrent attendees
- More than 100 speakers presented from locations around the country and as far away as India
- 68 virtual posters with synchronous and asynchronous chat and commenting
- Student "Lightning Talks"
- Participants and presenters joined from desktops, mobile devices and/or "virtual hubs", high quality videoconferencing rooms located at NASA Centers, universities and labs around the world.
- Social media platforms such as Twitter, Facebook and YouTube were used to increase reach and engagement.
- No travel required

K. E. Dodson, NASA Ames Research Center
On-site 2-week course with 11 remote lecturers (29 total) over $25K in savings. Virtual capability allowed participation by 185 additional remote viewers in the earth science community.

K. E. Dodson, NASA Ames Research Center
Workshops without Walls: Broadening Access to Science around the World

Betül K. Arslan¹,², Eric S. Boyd³,⁴, Wendy W. Dolci⁵, K. Estelle Dodson⁵,⁶, Marco S. Boldt⁵,⁶, Carl B. Pilcher⁵*

1 NASA Astrobiology Institute Center for Ribosomal Origins and Evolution, Georgia Institute of Technology, Georgia, United States of America, 2 Georgia Institute of Technology, Atlanta, Georgia, United States of America, 3 NASA Astrobiology Institute, Montana State University, Bozeman, Montana, United States of America, 4 Department of Chemistry, Montana State University, Bozeman, Montana, United States of America, 5 NASA Astrobiology Institute, NASA Ames Research Center, Moffett Field, California, United States of America

News & Views

Report on a NASA Astrobiology Institute—Funded Workshop Without Walls: Stellar Stoichiometry

Steven J. Desch¹, Patrick A. Young¹, Ariel D. Anbar¹, Natalie Hinkel², Michael Pagano¹, Amanda Trull¹, and Margaret Turnbull³

Abstract

We report on the NASA Astrobiology Institute—funded Workshop Without Walls entitled “Stellar Stoichiometry,” hosted by the “Follow the Elements” team at Arizona State University in April 2013. We describe several innovative practices we adopted that made effective use of the Workshop Without Walls videoconferencing format, including use of information technologies, assignment of scientific tasks before the workshop, and placement of graduate students in positions of authority. A companion article will describe the scientific results arising from the workshop. Our intention here is to suggest best practices for future Workshops Without Walls. Key Words: Astrobiology—Exoplanets. Astrobiology 14, 271–276.
Participant Feedback

...having workshops like these which are very interactive, and accessible to virtually anyone who is interested encourages collaboration and a push towards new frontiers of knowledge collectively.

I congratulate you on the format of the conference... it’s the format of the future.

I think the boost to science, and most other human endeavors, will be incalculable. I found things out in a few talks of which I was completely unaware.

K. E. Dodson, NASA Ames Research Center
Virtual Mentoring and Community Building
Connecting Anywhere, Anytime: NASA’s Virtual Executive Summit

Virtual Executive Summit, $750K cost savings as published in NASA IT Talk

Mid Level Leadership Program Graduation held at KSC

K. E. Dodson, NASA Ames Research Center