Emerging Cyberinfrastructure for Enabling Research, Learning, and Engagement

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Leadership in a Knowledge-based Economy

Enhanced Innovation

Cyberinfrastructure-enabled Science & Engineering Research (Epistemic) Communities

Collaboratories, grids, e-science community, virtual teams, community portal, ...

Cyber-infrastructure:
Equipment, Software, People, Institutions

Computation, Storage, Communication and Interface Technologies
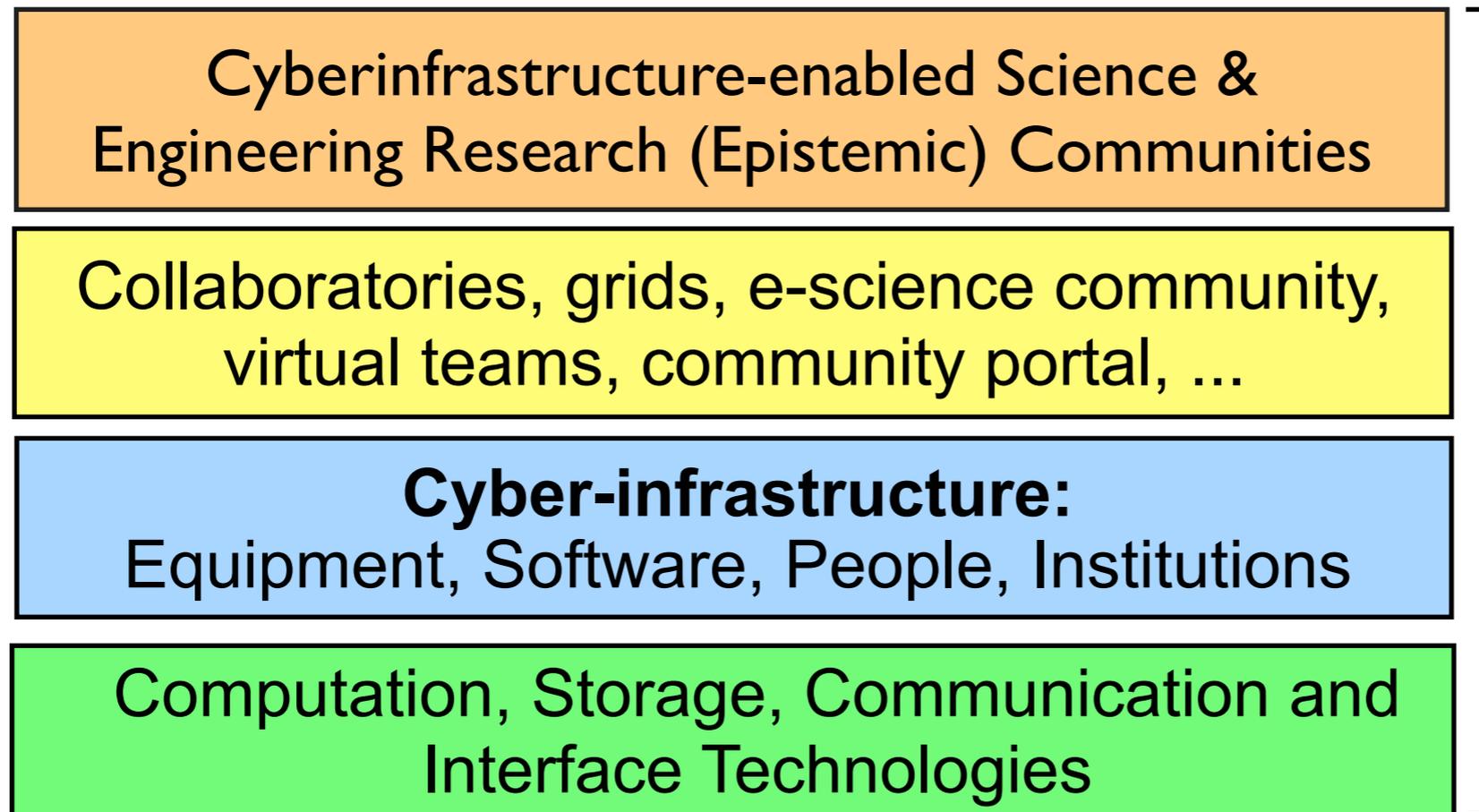
Broader Application to other disciplines and types of activity.

NSF Blue Ribbon Advisory Panel on Cyberinfrastructure

"a new age has dawned in scientific and engineering research, pushed by continuing progress in computing, information, and communication technology, and pulled by the expanding complexity, scope, and scale of today's challenges. The capacity of this technology has crossed thresholds that now make possible a comprehensive "cyberinfrastructure" on which to build new types of scientific and engineering knowledge environments and organizations and to pursue research in new ways and with increased efficacy."

Revolutionizing Science and Engineering through Cyberinfrastructure:

Report of the National Science Foundation Advisory Panel on Cyberinfrastructure

February 3, 2003

http://www.cise.nsf.gov/sci/reports/toc.cfm

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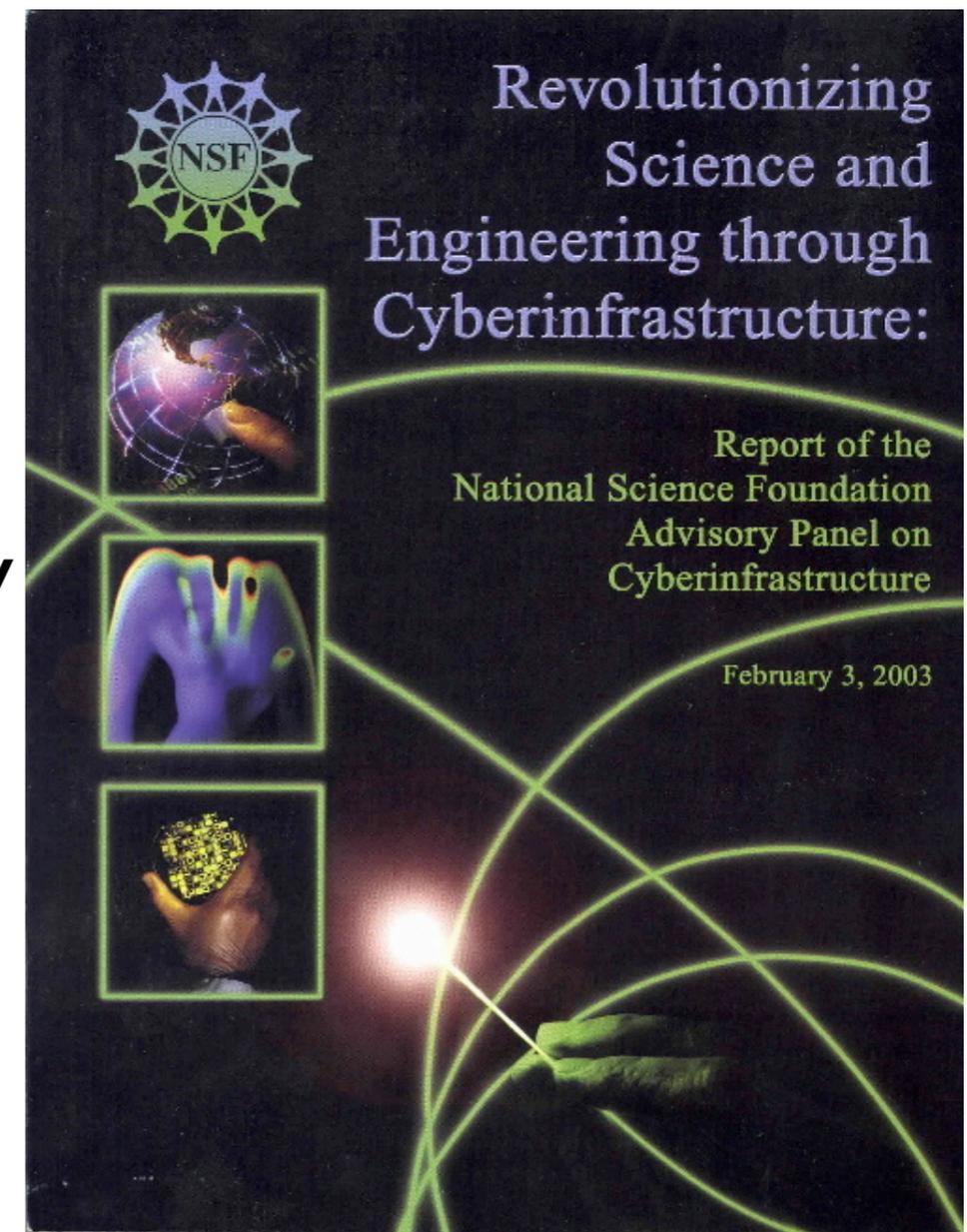
Converging Streams of Activity

Collaboratories

NATIONAL COLLABORATORIES
Applying Information Technology for Scientific Research

Computer Science and Telecommunications Board
NATIONAL RESEARCH COUNCIL

Home Land Security
http://web.calit2.net/RiskReduction/index.html

Revolutionizing Science and Engineering through Cyberinfrastructure:

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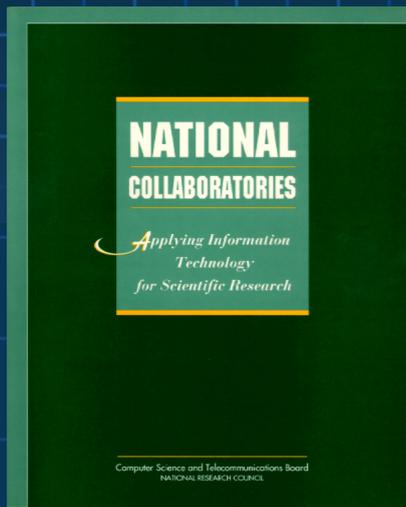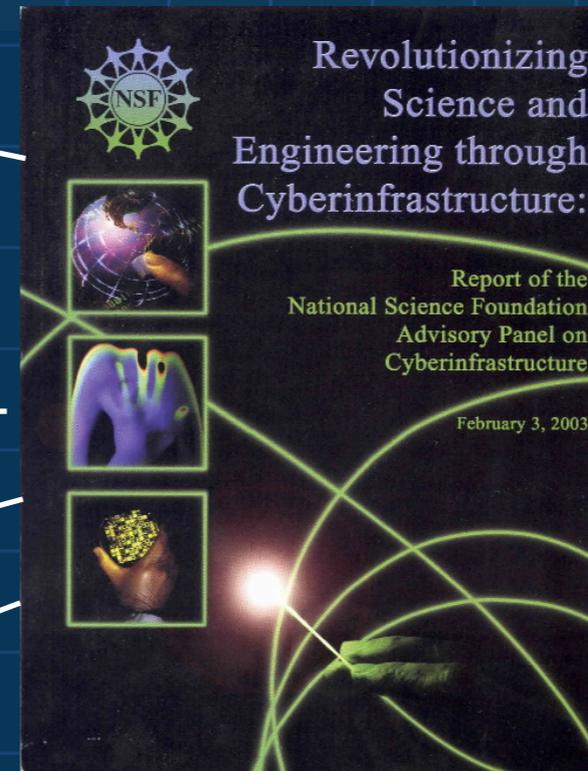
Cyberinfrastructure for Humanities

ACLS Publications

Digital Libraries

GRIDS

Edited by Ian Foster and Carl Kesselman
GRID 2
Blueprint for a New Computing Infrastructure
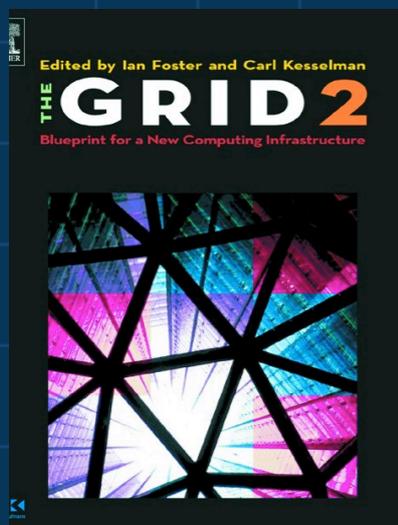
E-science

2nd Edition
www.mkp.com/grid2

BBSRC EPSRC ESRC NRC NERC PPARC CCLRC
e-Science dti

cyberscience
Research in the Age of the Internet

Michael Nentwich

PREPARING FOR THE **REVOLUTION**
Information Technology and the Future of the Research University
NATIONAL RESEARCH COUNCIL

Issues for Science and Engineering Researchers in the Digital Age
NATIONAL RESEARCH COUNCIL

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TECHNOLOGY ISSUES AND STRATEGIES FOR AMERICAN COLLEGES AND UNIVERSITIES
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Cyberscience

IT & Future of Higher Education

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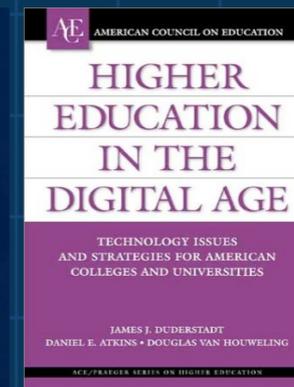
Cyberinfrastructure

Community-Specific Knowledge Environments for Research and Education
(*collaboratory, co-laboratory, grid community, e-science community, virtual community*)

Customization for discipline- and project-specific applications

High performance computation services	Data, information, knowledge management services	Observation, measurement, fabrication services	Interfaces, visualization services	Collaboration services

Networking, Operating Systems, Middleware

Base Technology: computation, storage, communication

= cyberinfrastructure: *hardware, software, services, personnel, organizations*

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TIME

	Same (synchronous)	Different (asynchronous)
GEOGRAPHIC PLACE Same	P: Physical mtgs. I: Print-on-paper books, journals F: Hands on labs, shops, studios	P: Shared notebook I: Library reserves F: Time-shared labs, shops, studios
Different	P: AV Conference I: Web search F: Online, real time instruments	P: Email I: Knowbots F: Autonomous instruments, session objects
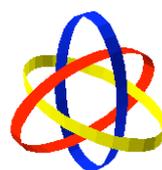
Cyberinfrastructure is a First-Class Tool for Science

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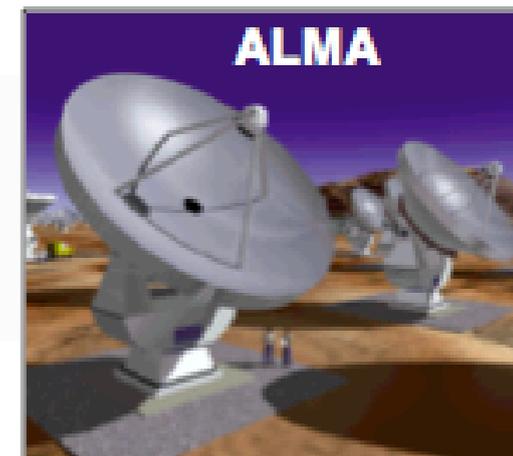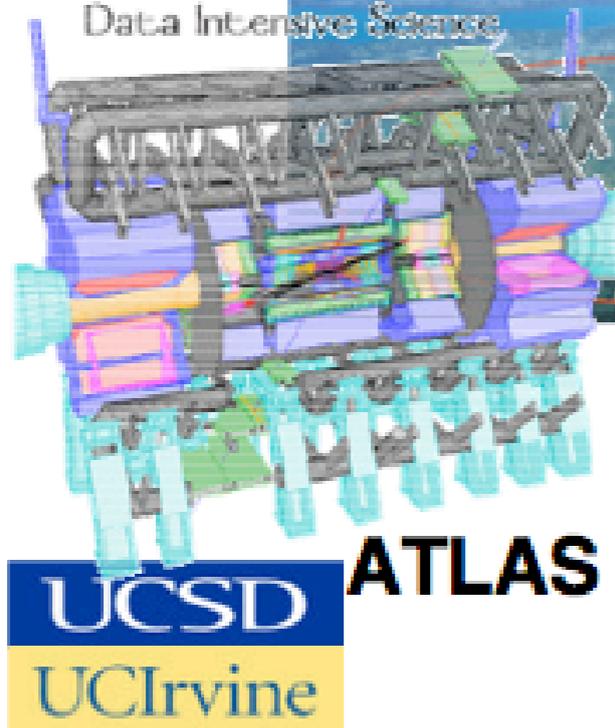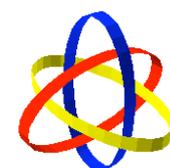
Potential

- Cyberinfrastructure can become a platform for routine, effective, global-scale activities of knowledge communities. (Goal is not to eliminate same time and place collaboration, but rather to augment it.)

- Cyberinfrastructure offers new options for *what* is done, *how* it is done, and *who* participates.

- CKCs are being developed by science communities not merely to do faster-better-cheaper what they have been doing, but to do new things new ways. Some are becoming functionally complete.

- Long-term, billion dollar projects are being pursued that cannot be done without advanced cyberinfrastructure.

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CI-enabled Learning, Engagement And Research (CLEAR)

Engagement

Practice, Application, Problem Solving

Learning

Research

CI Movement

Openess Movement

Cross-discipline, organization, culture, nation, development level

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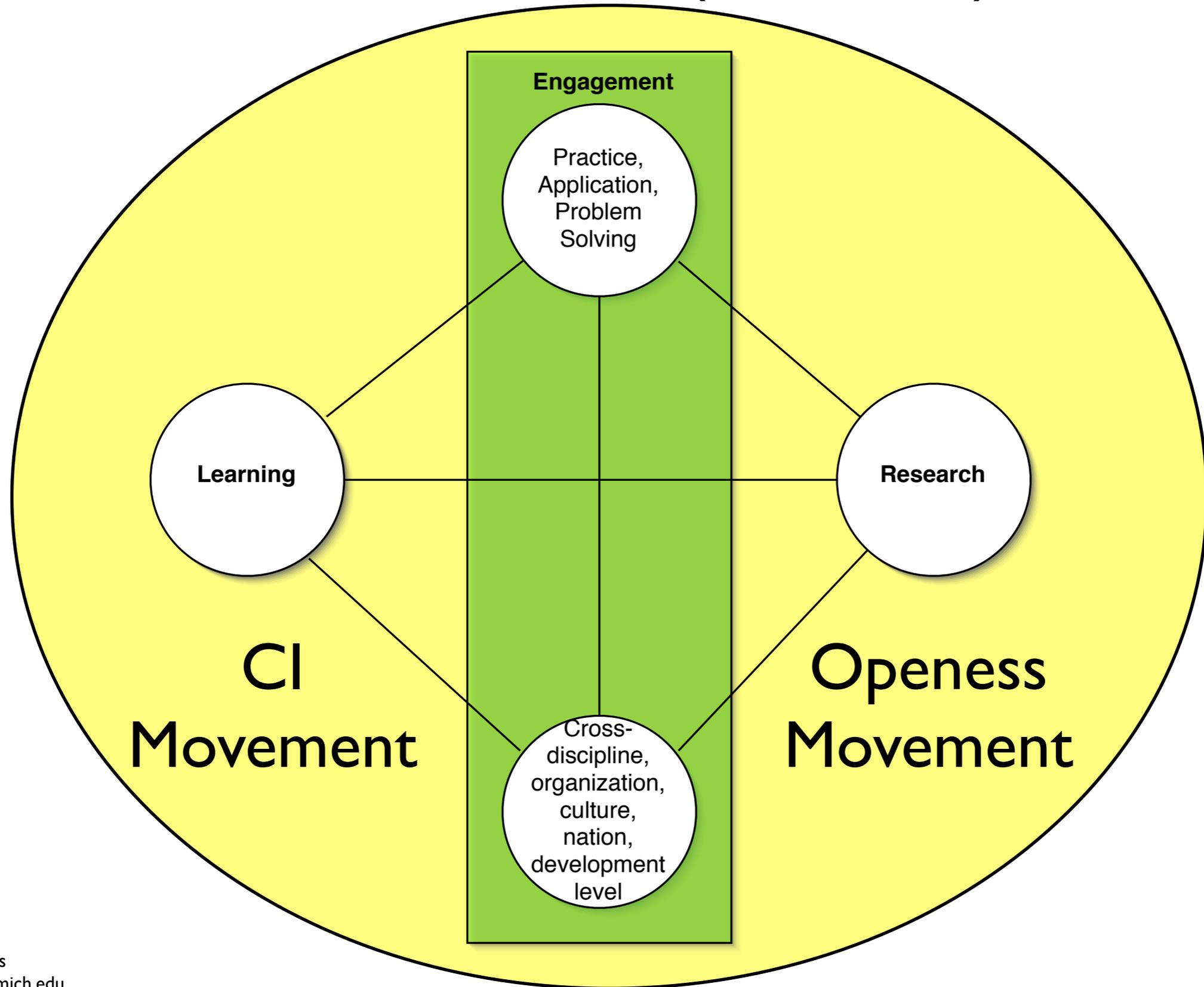
Cyberinfrastructure includes...

- **Institutionalized providers** of ICT-based tools and services together with expert knowledge and training that serves many specific, customized knowledge communities (overlapping, interoperable, open).

- Architecture and processes that **identify and exploit commonality**, and accommodate heterogeneity through middleware and open standards.

- **Shared creation and re-use** of software, information, facilities, and best practices to promote cost-effectiveness and efficiency.

- **Tight coupling with R&D** in CISE, appropriate SBE areas, and pioneering application areas.

- Sustained commitment, evolutionary enhancement, and **"career worthiness"**

- Appropriately trained **human resources** for the creation, provision, and application of CI. (blend of ICT, sociology, disciplinary expertise)

- Support for **integrated socio-technical evaluation** to understand impact and inform iterative design processes.

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Complex and Expensive - So how do we make it happen?

- *create awareness, understanding, stretched vision*

- *find/support leadership, risk-taking cat herders (passionate, capable, respected, altruistic)*

- *modify incentive structures (humbling ourselves to the opportunity) to span stovepipes*

- *establish long term commitment & funding; technology determinism is not enough and lost-opportunity cost could be high.*

- *better align stakeholders in mutual self-interest; in complementary ways (Can meetings like this help?)*

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Need Complementary Stakeholder Alignment

Creators & Providers

CISE & SBE R&D; PACIs, Res. Libs., CNI, Educause, UCAID, IT Industry, Acad. IT Orgs. Open Source Comm.

Sponsors: Funding & Policy
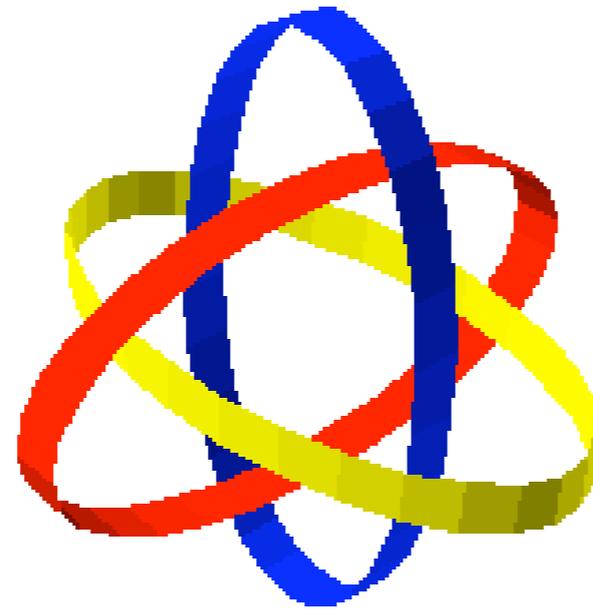
Users: Transformative (Revolutionary) Application

NSF, NIH, DoE, JISC, EU, CSIR, Mellon, Hewlett, Kellogg, Moore, IDRC, MS-CA, State Gov., Universities

Disciplinary and Project Groups, Universities, NGOs, Int. Devel. & BOP Projects

Can this community help??

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