Cyberinfrastructure Strategic Action Plan For Idaho Universities

February 2013

Prepared by:

Idaho Universities EPSCoR Cyberinfrastructure Working Group

with the assistance of Croswell-Schulte IT Consultants, Inc.

ACKNOWLEDGEMENTS

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Primary Partners
- Department of Energy (DOE), Idaho National Laboratory (INL)
- Idaho Regional Optical Network (IRON)
- Idaho Education Network (IEN)

PREFACE

This plan has been prepared to stimulate interest in and define a course of action for building and sustaining an effective Cyberinfrastructure (CI) —resulting in a vastly improved environment supporting research and education at Boise State University (BSU), Idaho State University (ISU), and the University of Idaho (UI). An effective CI environment offers enormous benefits for each university but, more importantly, expands opportunities for all Idaho universities and enhances the results of research and education by better enabling collaborative networks and improving access to the resources required for today's and tomorrow's research and education programs.

Imagine a future in which:

- ✓ researchers can quickly discover and access data and information needed to advance their own research objectives
- ✓ geographically distributed research teams can easily and effectively share information and collaborate
- ✓ efficiently managed computer resources (hardware, software, and networks) are readily available to support research and education
- ✓ administrative and technical barriers inhibiting collaboration and innovation are eliminated—encouraging multi-university research teams along with other stakeholder organizations (public sector, private, academic)
- ✓ there is an efficient and expeditious path to communicate research results and realize benefits from them—as new intellectual property, practices, services, and products benefiting a wide spectrum of stakeholders
- ✓ Idaho universities greatly increase their ability to attract funding and talented scholars
- ✓ Idaho becomes a leader in strategically chosen areas of excellence

This real and achievable future is the goal for Idaho, and this plan provides a path to accomplish it.

TABLE OF CONTENTS

1. INTRODUCTION TO CYBERINFRASTRUCTURE PLANNING

1.1 Purpose of the Plan

This *Cyberinfrastructure Strategic Action Plan for Idaho Universities* provides a road map to: 1) further assess and document existing Cyberinfrastructure (CI), 2) develop an integrated strategy for developing and staffing CI, including a prioritized list of investments, 3) determine costs associated with implementing the prioritized investments, and 4) identify funding opportunities that Boise State University (BSU), Idaho State University (ISU), and the University of Idaho (UI) may and should pursue collectively and/or in a coordinated manner. Moving ahead with the plan objectives is dependent on establishing an effective CI Advisory Council (CIAC), with representatives from all three state universities. In scope, this plan begins to broadly assess and address computing infrastructure, data, tools and models, organizational structure, and the policies and standards necessary to effectively implement and enhance CI for the stakeholder organizations. Consideration should be given to the addition of key external partners such as the Idaho National Laboratory (INL), the Idaho Regional Optical Network (IRON), and others. Although this plan is not meant to be a comprehensive statewide CI plan involving all state educational institutions, nor at this time is it meant to address sustainability, it begins to build a CI foundation upon which an increasingly comprehensive statewide plan can be developed and sustainability addressed. This Plan will enable the Universities to lead by example. Various aspects of Plan development have been funded in part by the Idaho NSF EPSCoR Research Infrastructure Improvement *(RII) Awards #EPS-0814387, EPS-1006968, and EPS-0919514.*

This CI Plan identifies:

- Ways to enhance CI architecture;
- Approaches to establishing sustainable CI resources; and
- Ways to promote and support CI use.

And recommends:

- A strategic approach to CI investments;
- Ways to build on existing collaboration and resource sharing; and
- Ways to compete for CI and research funding more effectively nationally.

1.2 Relationship between Strategic Action Plan and Implementation Work

The success of the *CI Strategic Action Plan* for Idaho Universities is dependent upon additional work to produce an effective management structure, project planning processes for implementation, and clearly defined roles of key personnel. It is critical to maintain the relationship between the CI goals and actions in this Plan and the specific work plans that are yet to be developed for implementation.

1.3 CI Defined

A common understanding of CI as used in this document will be helpful.

According to the National Science Foundation (NSF), CI is the infrastructure required to support effective distributed computer, information, and communication technologies (*Revolutionizing Science and Engineering Through Cyberinfrastructure*). Idaho EPSCoR describes CI as "environments that support advanced data acquisition, storage, management,

integration, mining, visualization and other computing and information processing services distributed over the Internet beyond the scope of a single institution. In scientific usage, cyberinfrastructure is a technological solution to the problem of efficiently connecting laboratories, data, computers, and people with the goal of enabling derivation of novel scientific theories and knowledge."

Citations and Web links for common references throughout this Plan are found in Appendix A. Detailed results from a stakeholder's survey are described in Appendices B, and a glossary of terms used in this document is provided in Appendix C.

2. CYBERINFRASTRUCTURE VISION AND MISSION

The vision, mission, and high-level goals below establish a foundation for long-term CI development and use. The vision statement paints a picture of the future, while the mission statement articulates what needs to be done to achieve that vision. This *Strategic Action Plan* provides an overall path for achieving the stated Cyberinfrastructure Vision.

2.1 Vision Statement for Idaho's Cyberinfrastructure

Idaho universities and other stakeholders have ready access to a statewide network of systems and resources that enable new research, effective statewide collaboration, and enhanced competitiveness for funding that creates new intellectual and economic opportunities for Idaho's citizens and serves the state, region, and beyond.

2.2 Mission Statement

Create an extensible framework of coordination and cooperation between Idaho's research institutions; establish a dynamic inventory of CI resources to help identify CI gaps, prioritize investments, efficiently allocate resources, and pursue funding opportunities; and adopt an agenda for implementing Idaho's Cyberinfrastructure.

3. CYBERINFRASTRUCTURE GOALS

The high-level goals, identified here and further explained in Section 6, identify key areas for action to accomplish the mission of this plan. These goals address important developmental or operational areas critical to a successful CI and should be viewed as an iterative and on-going process. High-level goals required for a successful CI are:

- Goal 1: Establish a CI Advisory Council for higher education in Idaho
- Goal 2: Assess and characterize existing and planned CI activities and collaborative research initiatives
- Goal 3: Define and establish a strategy to develop the CI architecture and staffing including prioritized investments
- Goal 4: Identify and project costs for prioritized investments of CI development
- Goal 5: Identify CI funding opportunities to be pursued by Idaho universities and submit high-priority funding requests

4. STAKEHOLDER SURVEY

The CI Working Group at BSU, ISU, and UI identified stakeholder groups including representative researchers, librarians, and IT personnel to be surveyed. The survey was made available online and consisted of questions about responder identity, CI awareness, CI needs, and CI vision. A preliminary review of responses was summarized for a stakeholder's meeting on December 1, 2011. The survey remained open until December 18, 2011 after which it was closed and a final analysis of responses was performed. Detailed survey responses are presented in Appendix B. General observations derived from the survey results are described here.

There were a total of 48 respondents to the web-based survey. The top ten CI elements or services most applicable to the stakeholders were:

- Collaboration services
- Communication services
- Data archiving and backup
- Data coordination
- Primary data storage
- Database management
- Data sharing services
- Tool and application development
- Website architecture, development, and management
- Computer support

A high proportion of respondents indicated they needed CI for research; followed by teaching, grant applications, data mining, and decision-making. The CI capabilities most in use--modeling, data mining, simulation, and visualization - were distributed fairly evenly. Twenty respondents (nearly 50%) required high performance computing (HPC) capacity. The use of HPC for data intensive tasks and computationally intensive tasks was equally split.

The obstacle garnering the largest number of responses was insufficient personnel expertise, followed by lack of organizational capacity or policies, and insufficient digital storage capacity. Over half of the respondents indicated CI was critical or very important to their work. The top three applications for CI were: 1) Research; 2) Data mining; and 3) Grant applications.

The respondents also expressed concerns that if Idaho did not make significant progress in CI over the next five years, the following anticipated consequences would occur (given in order):

- Loss of competitiveness for external grant funding
- Difficulty in recruiting and retaining research faculty and staff
- Less likelihood of being part of interstate collaboration
- Less able to attract top students
- Institutions themselves will be less viable

5. ASSUMPTIONS AND DRIVERS

The assumptions and drivers explained in this section provide additional context, establish certain boundaries and limits, and help to characterize the underlying purpose of this plan and overall CI development.

5.1 Assumptions

At the beginning of this plan development process, general assumptions were identified by the EPSCoR CI Working Group and consultant team. The assumptions underpinning this plan are:

1. Funding was limited; therefore comprehensive statewide planning with all higher education institutions was not possible. This plan focuses on the three major public universities in Idaho.

2. This CI Plan is not a detailed implementation plan. It is strategic in nature, providing a thorough and long-term view for CI development and use and serves as a foundation for more detailed implementation planning and action.

5.2 CI Drivers

The stakeholders identified specific capabilities essential to Idaho's CI as the ability to:

- Move and manipulate large data sets quickly and easily.
- Support repositories of heterogeneous data types.
- Process unstructured data to enable data mining.
- Support researchers with timely and skill-level-appropriate IT expertise and support regardless of affiliation and location.
- Access robust search and discovery tools.
- Evaluate data through readily available and complete metadata.
- Make data from distinct yet interrelated studies available through data repositories.

In addition, stakeholder comments stressed the realization that:

- Data must be treated as an asset and appropriate consideration and funds must be devoted to security, redundancy and availability.
- A solid policy framework, with appropriate standards, is necessary.
- An organizational structure and policy environment that encourages collaboration is beneficial
- Public-private partnerships should be fostered
- Administrative-level support for CI is critical to the future success of the universities.

6. ELABORATION OF CYBERINFRASTRUCTURE PLANNING GOALS

This *Cyberinfrastructure Strategic Action Plan* is structured to respond to the five goals introduced in Section 3. This section provides elaboration on these goals and presents performance deliverables for gauging progress. These goals are intended to provide a structure for work and an incentive for each university to cooperate in building and sustaining an effective statewide Cyberinfrastructure. These goals presume that a robust CI is necessary and will deliver real benefits for all stakeholders for the following reasons:

1) Funded research is increasingly data intensive and collaborative

2) CI is fast becoming a prerequisite for institutions to compete for outside funding, and

3) By collaborating and sharing resources, BSU, ISU, and UI will become more competitive for funding and better positioned for future research opportunities.

Goal 1: Establish a CI Advisory Council for higher education in Idaho

For CI coordination and collaboration to succeed at BSU, ISU, and UI will require support from the respective Vice Presidents for Research (VPR) at each institution. The establishment of a CI Advisory Council (CIAC) is recommended and should be consistent with existing institutional policies and procedures. This Council will be the main body responsible for accomplishing the objectives of much of this Strategic Action Plan. Council members should be assigned by the VPRs and report back to them. The council will be responsible for establishing their bylaws and creating subcommittees as necessary (e.g., policy and protocol, assessment, CI interoperability, and also addressing goals set forth below as necessary). We recommend that there be a minimum of two representatives from each institution assigned, representing both research and information technology who can be assigned the responsibility to coordinate across and within the institutions. In addition, the CIAC will have the responsibility to form subcommittees to address issues related to strategic actions, performance metrics, and other topics the CIAC determines necessary. Staff or faculty committee members should be notified of their appointment to the CIAC or a CIAC subcommittee directly through their institutional research office. The respective VPR's should provide appropriate resources to the CIAC members to support their participation (e.g. travel funds, access to cyber-communication tools, administrative support). Council members and their supervisors should be notified of this special honor, and the notification letter should indicate: 1) the approximate duration of the special assignment; 2) the estimated hours required to fulfill the special assignment; 3) employee compensation if necessary (e.g., summer salary); and 4) the treatment of the employee's current position description with respect to the special assignment (i.e., regarding tenure and promotion).

<u>Strategic Actions</u>

- Form CI Advisory Council, assign members and define roles
- Prepare and adopt bylaws
- Establish policies, procedures, and tools for ongoing activities
- Establish a CI project team(s) to prepare and adopt work plans and timelines to accomplish work on CI Action Plan objectives

- Initiate and sustain effective monitoring of CI development and reporting on the status of work on CI goals and actions. (e.g., CIAC to VPR, CIAC to research community, etc.)

Suggested Performance Deliverables

- CI Advisory Council is formally established with a clear statement of purpose and assigned members
- Completed and approved Bylaws that describe and govern the Council's operations
- A clear and practical work plan defining activities and tasks for accomplishing all Strategic Action Plan objectives
- Establishment of Council committees and a project team charged with carrying out work associated with Strategic Action Plan Goals 2, 3, 4 and 5.
- Regular, effective meetings with documented minutes and action items for making progress on CI development
- Regular status reports and an annual report of CIAC summarizing activities and actions
- Document, track and encourage submission of collaborative CI proposals

Goal 2: Assess and characterize existing and planned CI activities and collaborative research initiatives

No comprehensive description of CI components or CI-dependent activities exists for BSU, ISU, or UI. An initial inventory will serve as a baseline for assessing existing architecture, staffing, and investments. The importance of establishing a comprehensive detailed CI inventory that documents existing CI capacity at each institution and capacity held collectively (e.g., networking) cannot be overstated. A considerable commitment and effort will be required to coordinate within each institution and across institutions to produce an inventory. Once a baseline is established, a database describing the current state of CI capabilities will be created. Thereafter, the database will be maintained near and be accessible across institutions.

We suggest breaking the inventory into several categories, including those mentioned below under "Strategic Actions". Parts of the inventory will be addressed at each individual institution, but other items such as network capacity may require outside (e.g., IRON) help and/or coordination between institutions. The determination of how and who collects this information is the responsibility of the CIAC. They may choose to gather this information themselves or form a special committee(s) for the purpose of collecting this information.

Strategic Actions

- Identify existing or planned CI initiatives (e.g., funding opportunities, existing CI plans at each institution) including those directly enhancing CI capabilities and those dependent on CI for optimal success at each state university along with a brief summary and pertinent contact information
- Examine and summarize existing or planned administrative policies and procedures affecting CI initiatives

- Evaluate and document computer processing and data storage capacity, available for research activities at each university.

- Evaluate and document network connectivity and bandwidth at and across institutions and with key partners including connection location (PoP's and GigaPops), and network administration.

- Evaluate and document data security and data integrity practices and policies at each university

- Inventory existing computing capacity (e.g., clusters and high performance computing capabilities) to support research activities

- Assess data discoverability (e.g., metadata and semantic web capabilities) to support data mining, acquisition, and retrieval

- Assess workforce development at each institution and evaluate the capabilities and retention of technical staff supporting research activities at each institution.

- Assess and document current CI expenditures

- Identify current deficiencies and obstacles hindering CI development and describe recommendations for an improved CI environment

Suggested Performance Deliverables

- A report describing inventory results (e.g., include a map of internal and between institution network connectivity)

- An actionable list of recommendations that addresses missing capabilities and capacities.

- Establishment of a web accessible database to provide current CI capabilities and components at any time

-

Goal 3: Define and establish a strategy to develop the CI architecture and staffing including prioritized investments

Based upon the assessment and recommendations from Goal 2, develop a collective strategy that respects university autonomy and advances both individual and shared research programmatic objectives. This strategy will focus on CI architecture and staffing and will produce a list of prioritized investments to be made in those areas. Prioritized investments will strive to leverage existing capabilities and capacities, address missing CI, minimize duplication of effort, and increase utility for the research community.

Strategic Actions

- Prepare a high-level design and description of the statewide CI Architecture (including technical and organizational components)

- Define more detailed CI architecture for each university (and other key stakeholder institutions as appropriate) to include an initiative raise awareness of CI

- Coordinate with respective VPR's to determine a suite of CI investments with priorities clearly identified

Suggested Performance Deliverables

- Report with recommendations for CI architecture, staffing, and prioritized investments (e.g., results of CI optimization)

- Develop and carry out training on how to incorporate CI in research

Goal 4: Identify and project costs for prioritized CI investments

Once a set of prioritized investments has been created, cost estimates need to be generated to accompany the report resulting from Goal 3. Understanding investment requirements and commitments is critical to the development of the CI and will sometimes trigger a re-evaluation of investment priorities. In effect, Goals 3 and 4 can be viewed as highly interrelated and iterative. In addition, investigation of prioritized investments and their implementation needs to incorporate leveraging statewide higher education purchases and/or site licenses whenever possible.

Substantial investments need to be carefully considered, and once a decision has been made to move forward with a CI investment, there are additional mechanisms that can both improve the investment process and also streamline it. One mechanism is the use of requests for information (RFI). This process, executed by each university's purchasing office, allows vendors/providers to respond to a set of specifications and requirements. The RFI responses can then be used to better compare products and services based more upon their capabilities and qualities than their cost. The result of a successful RFI is the identification of the best vendor/provider and an award to the successful respondent to move forward with the purchase.

Strategic actions

- Identify potential providers/vendors of products and services required for CI development (as defined through work associated with Goal3)

- Identify appropriate procurement vehicles for selecting providers and obtaining CI products and services

- Identify CI staffing needs at each university

- Conduct research (including RFI) to generate cost estimates for CI development and operations (including CI staffing, products, and contracted services).

- Coordinate with respective VPR's to re-evaluate and refine the prioritized CI investments

Suggested Performance Deliverables

- Develop a revised report with prioritized investments for CI architecture, staffing, and investments

Goal 5: Identify CI funding opportunities and submit high-priority funding requests

This goal represents the culmination of efforts described in Goals 1 through 4 and seeks funding to realize each prioritized investment. While some funding may be available through the state's budget process, other funding opportunities exist which should not be overlooked. Indeed, diverse grant opportunities for CI dollars spanning multiple funding organizations exist, but currently little or no coordination has

occurred within or between academic institutions. Recently the VPR's of all three universities drafted a Strategic Research Plan that identifies five research areas to focus collective efforts. These are energy, natural resource utilization and conservation, biosciences, novel materials, and software development. This five-year strategy will help channel research and CI investments. The Idaho EPSCoR program has been a leader in applying a strategic approach but does not have responsibility for all CI investments. Further, available funding is limited and competitive; hence, the need exists not only for coordination but also for strategic prioritization of investment.

Strategic actions

- Work with the Office of Sponsored Programs within each institution to pair each prioritized initiative with at least one targeted funding vehicle
- Communicate initiatives with the broader CI community and provide incentives to pursue funding
- Identify champions to pursue funding
- Build upon unsuccessful proposals by improving subsequent proposal submissions

Suggested Performance Deliverables

- Document prioritized initiatives paired with targeted funding opportunities and anticipated time-line for completion of prioritized CI investments.
- Document and track number of CI proposals, award amounts, and rates of success
- Document successful initiatives and celebrate them
- Develop a three-year budget plan for acquisition/implementation of top priority CI investments.

7. CONCLUSIONS AND RECOMMENDATIONS

This *CI Strategic Action Plan* sets the stage for the Idaho research and CI communities to work together to further develop CI capacity in the coming years. It builds on a Memorandum of Understanding by and among BSU, ISU, and the UI for coordination of CI and research data management. Idaho's advancements in CI will drive discovery and help the science community collectively address CI challenges of state, regional, and national significance and will add value across science and engineering disciplines. With leadership from Idaho's public research universities, this Plan will enhance CI use for academic research and research-based education consistent with institutional and state S&T plans. Participation in the planning and implementation of CI priorities is envisioned to expand across multiple higher education and partner institutions. Implementing this CI Plan will also enable Idaho to expand individual and institutional participation in STEM research and education.

APPENDIX A: REFERENCES AND WEB LINKS

Idaho

Center for Advanced Energy Studies, https://inlportal.inl.gov/portal/server.pt/community/caes_home/281

Center for Advanced Modeling and Simulation (CAMS) at INL, www.inl.gov/cams/

Five Year Strategic Research Plan for Idaho Higher Education (2012-2016), Authored by the Richard Jacobsen, John K. McIver, and Mark J. Rudin, 2011

Higher Education Research Council (HERC), State Board of Education, State of Idaho, Web pages: http://www.boardofed.idaho.gov/public_col_univ/herc.asp

Idaho Education Network Web pages and personal knowledge, http://www.ien.idaho.gov/

Idaho EPSCoR Web pages: http://www.idahoepscor.org

Idaho Computing Consortium, WordPress.com article, June 2011, published by 123idaho, http://123idaho.wordpress.com/2011/06/11/idaho-research-institutions-inl-support-shared-computing-center/.

Idaho Science and Technology Advisory Committee, Dept of Commerce, State of Idaho, Web pages and Strategic Plan: http://commerce.idaho.gov/about-us/innovation/innovation-council/science-and-technology-strategic-plan/

Idaho State University CyberInfrastructure: http://www.isu.edu/research/CI.htm

Idaho Innovation Council, Dept of Commerce, State of Idaho, Web pages: http://commerce.idaho.gov/investments/idaho-innovation-council/

Idaho Regional Optical Network (IRON) Web pages, http://www.ironforidaho.net/

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INSIDE Idaho, http://cloud.insideidaho.org

LinkIdaho Web pages and personal knowledge, http://linkidaho.org

NSF EPSCoR Proposal to NSF for Idaho Research Infrastructure Improvement: Water Resources in a Changing Climate, Proposal No. 0814387, January 2008, University of Idaho.

NSF EPSCoR Track 2 Fastlane Proposal, Cyberinfrastructure Development for the Western Consortium of Idaho, Nevada, and New Mexico, January 2009 (extract).

NSF EPSCoR Proposal for Research Infrastructure Improvement Program: Inter-Campus and Intra-Campus Cyber Connectivity in Idaho (RII C2), n.d. (extract).

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Technology Incentive Grant Program, State Board of Education, Sate of Idaho, Web pages: http://www.boardofed.idaho.gov/public_col_univ/tig.asp

Regional

Orbis Cascade Alliance Web pages, www.orbiscascade.org

Regional Approach to Climate Change in Pacific Northwest Agriculture (REACCH PNA) Web pages, http://reacchpna.uidaho.edu/reacchpna

National

Data Observation Network for Earth (DataONE), https://dataone.org/

Vision and Strategic Plan for Advanced Computing Infrastructure, National Science Foundation, February 2012

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Office of Cyberinfrastructure Web pages, NSF, http://www.nsf.gov/dir/index.jsp?org=OCI

EPSCoR Web pages, http://www.nsf.gov/div/index.jsp?div=EPSC

EPSCoR/IDeA Foundation Web pages, http://www.epscordieafoundation.org

Idaho National Laboratory, Dept of Energy, https://inlportal.inl.gov/portal/server.pt/community/home/255

National LambdaRail (NLR) Web pages, http://www.nlr.net

Science.gov, http://www.science.gov

XSEDE Web pages: http://www.xsede.org

General References

Considerations for Campus Cyberinfrastructure Data Management Policy and Procedure Development, Net@edu Campus Cyberinfrastructure Working Group White Paper, October 2008, http://net.educause.edu/it/library/pdf/EPO0916.pdf.

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Jackson, Steven J., et al., Understanding Infrastructure: History, Heuristics, and Cyberinfrastructure Policy, 2007, http://outreach.lib.uic.edu/www/issues/issue12_6/jackson/

Webopedia, http://www.webopedia.com

Wikipedia, http://en.wikipedia.org

APPENDIX B: RESULTS OF STAKEHOLDER SURVEY

There were a total of 48 respondents to the survey with 44% coming from ISU (figure B1).

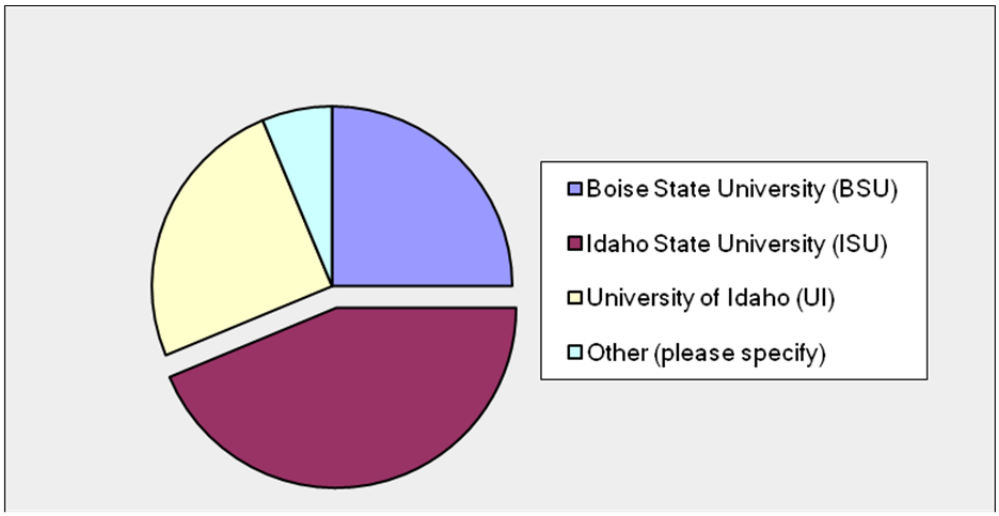

Figure B1. Organizational affiliation of survey respondents (n = 48)

The majority of respondents described their area of responsibility as teaching and research (figure B2).

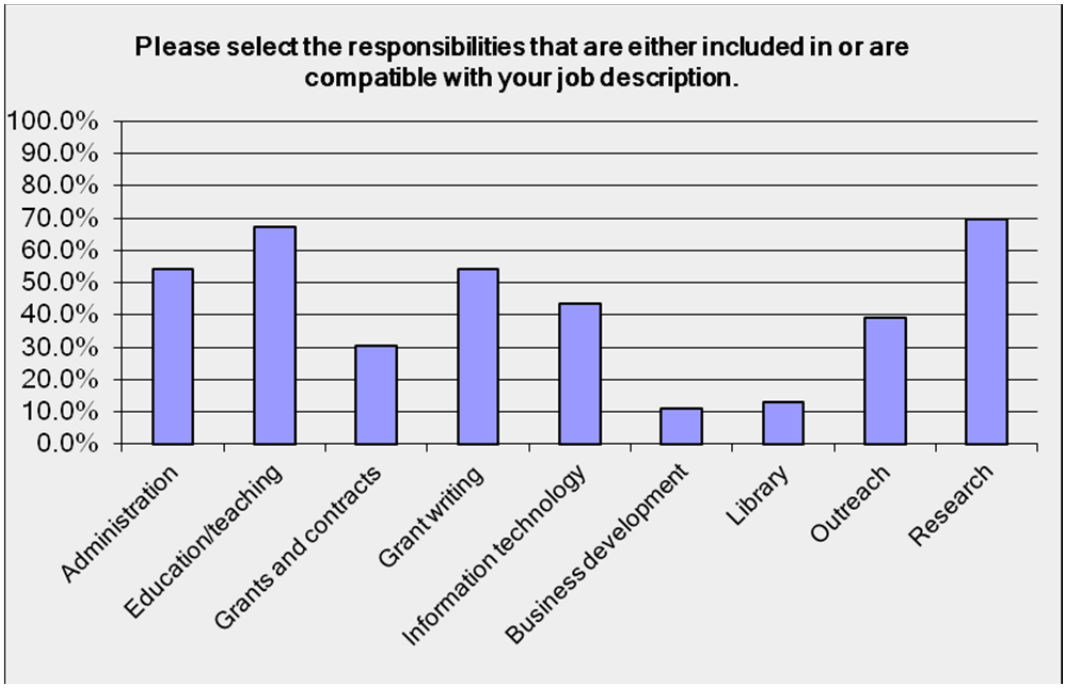

Figure B2. Responsibilities of the respondents as it relates to CI (n = 46)

The specific elements of CI or CI services that applied to the work duties of the respondents are summarized in table B1. Collaboration and communication services were the most frequent selection with 81% of respondents choosing this selection.

Table B1. General work duties of respondents (n= 43).

n	Selection description	n	Selection description
35	Collaboration services (e.g., blogging, calendaring, document sharing, versioning, project management)	35	Communication services (e.g., video conferencing, WebEx, Skype, etc)
21	Computer support	21	Customized computer programming services and tool development
22	Data analytical tool development	29	Data archiving and backup
25	Data coordination	20	Data curation
17	Data discovery	17	Data integration
18	Data management plan services	21	Data manipulation tools
25	Primary data storage		
22	Data sharing services (e.g., providing limited/controlled access during a project)	19	Data visualization
24	Database management	11	Digitization services
11	Field data coordination	19	High performance computing
13	Increase/improve fiber optic network	18	Metadata management
14	Other information management services (e.g., document, tools or project management	7	Sensor deployment or management
7	Unique identifier (UID)	22	Website architecture, development and/or management

Regarding active CI involvement, 25 respondents indicated they have been involved in CI activities in the past; 17 have not been previously involved. In addition, 28 Respondents indicated they are currently involved in CI activities; 13 are not. Furthermore, 29 Respondents were actively planning CI activities in the future while 12 indicated no plans for future CI activities (Figure B3).

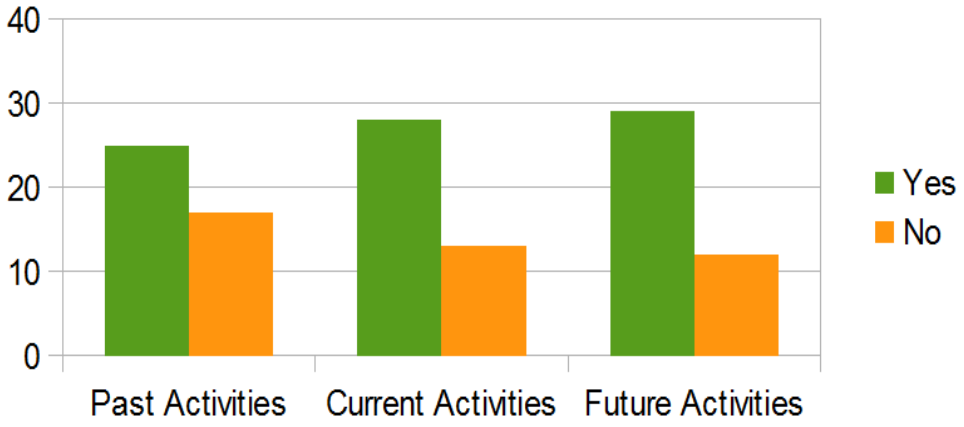

Figure B3. CI activity of the survey respondents (n = 42)

Research was considered the primary purposes (78%) for which respondents use or plan to use CI (Figure B4).

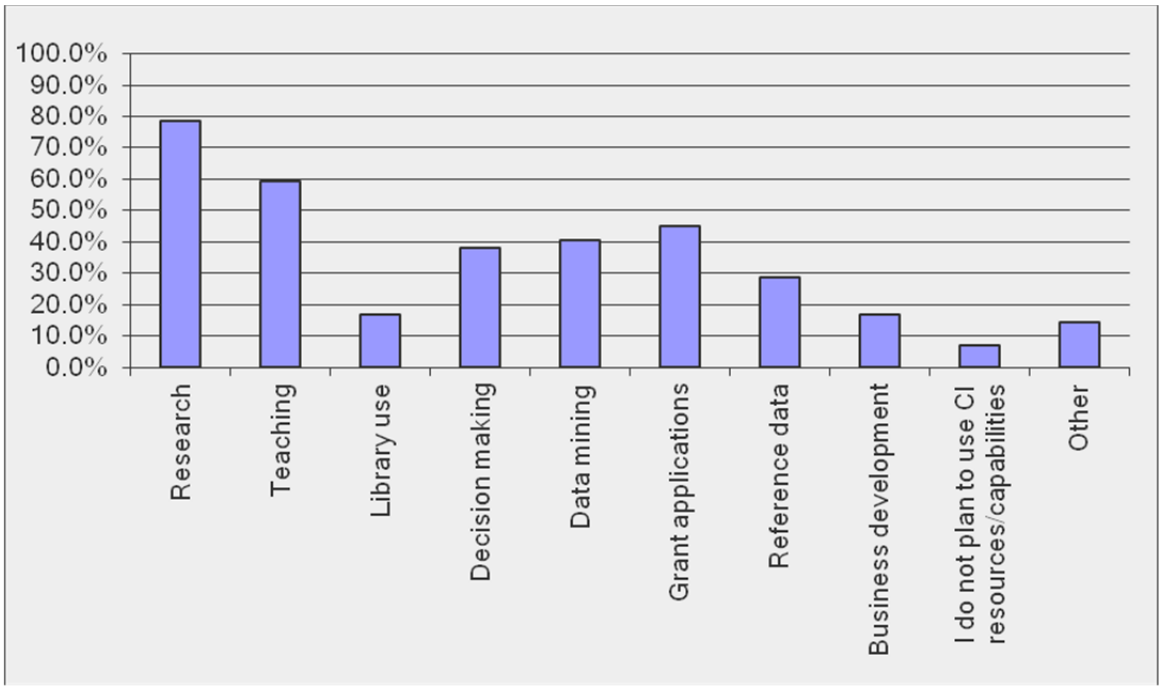

Figure B4. The purpose for which CI is used at Idaho universities shows that research is the primary usage (n = 42)

Thirty four respondents further clarified the specific way(s) they used CI capabilities. The results of this survey question indicate data mining is a primary usage of CI (59%) (Figure B5).

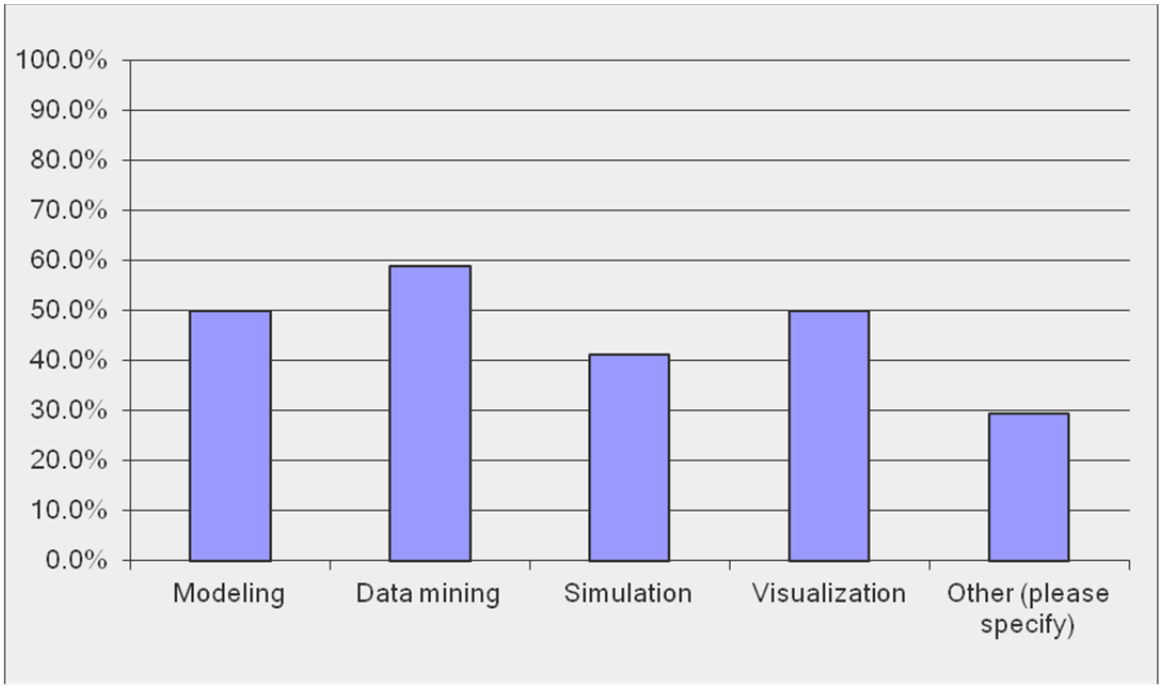

Figure B5. The specific way in which CI is used by the respondents (n = 34)

Thirty-seven respondents addressed questions regarding the use or need for high performance computing (HPC) with 20 respondents indicating HPC was required for their work. Of the 20 respondents who required HPC resources, 16 indicated their HPC needs were data intensive and 17 indicated their HPC needs were also computationally intensive.

Twenty-eight respondents do not use HPC, do not require HPC, or simply skipped some questions. When specifically asked to identify obstacles to using CI and HPC, 60% identified insufficient personnel expertise as the primary obstacle (Figure B6).

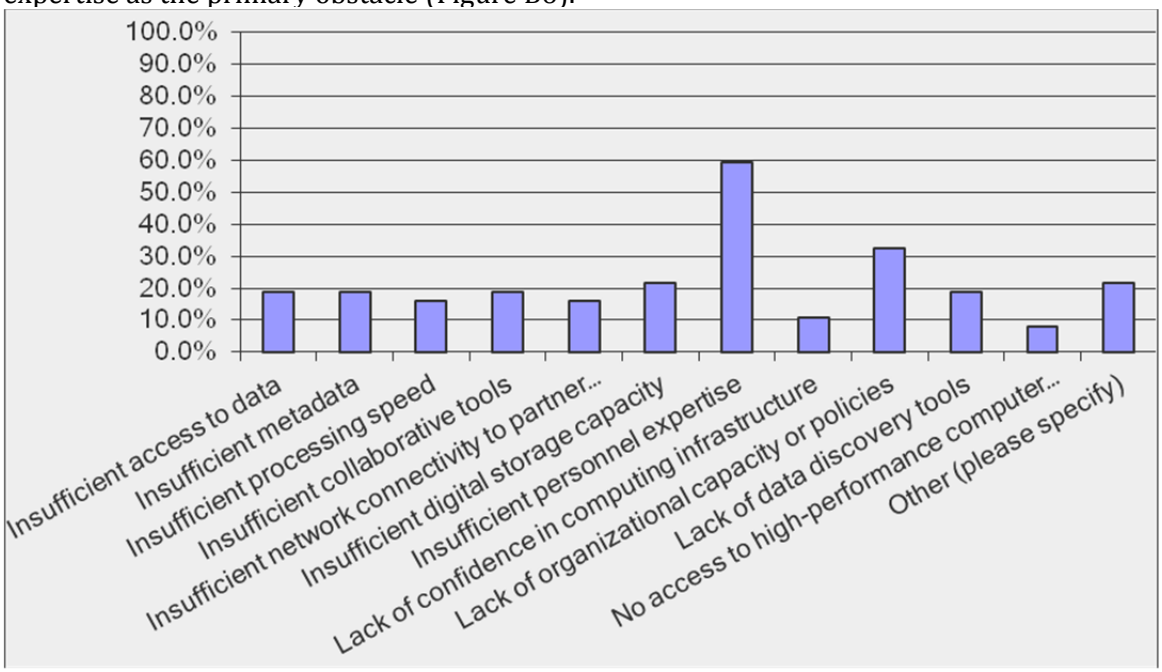

Figure B6. Nearly 60% of respondents indicated insufficient personnel expertise exists at Idaho's universities and this was viewed as the primary obstacle to using CI and HPC (n = 37)

Ranked on a scale of 0-5 (no importance through critically important, respectively), respondents rated CI as very important/critically important (mean = 4.9) (n = 39). The top three priorities identified by the respondents was research (81%), teaching (42%), and grant applications (17%) (n = 36). A failure to effectively use CI resources was a concern of the respondents, with 95% indicating a perceived loss of competitiveness for grant funding as a primary consequence if Idaho doesn't make significant progress in CI with the next five years (n = 38).

Interestingly, 75% of respondents indicated they felt they were not sufficiently aware of emerging CI opportunities and less than 30% were aware of existing XSEDE resources (Figure B7).

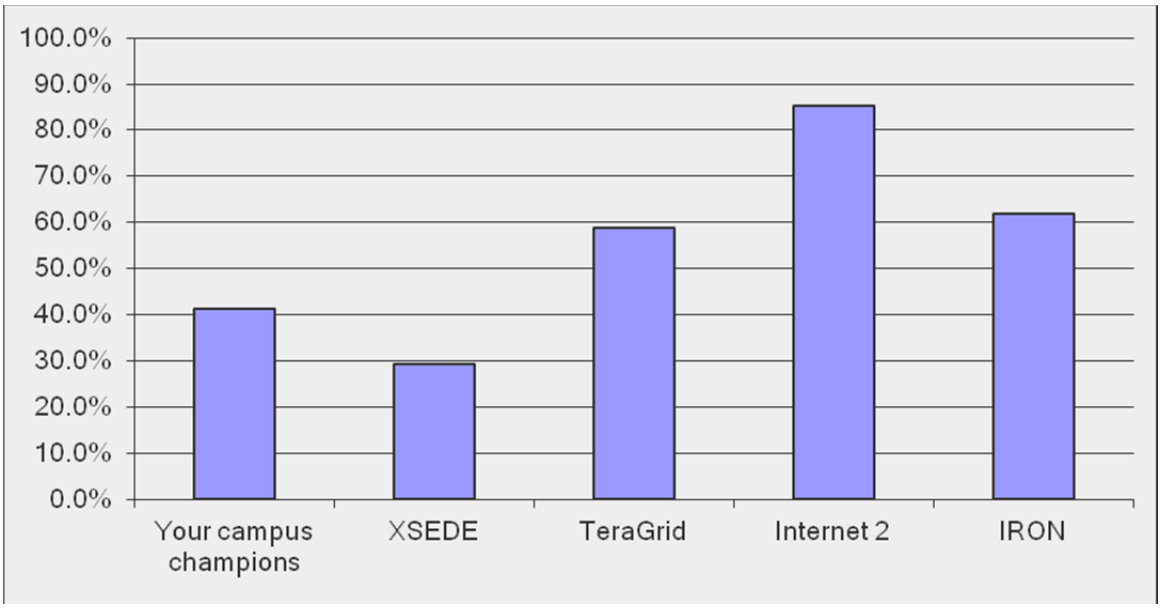

Figure B7. Awareness of existing CI and HPC resources across Idaho's universities indicate the need for additional training and communication (n = 34)

APPENDIX C: DEFININTION OF TERMS

Cloud Computing: The National Institute of Standards and Technology (NIST) defines cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." This concept and actual implementation of cloud computing environments support and complement the basic CI components. Cloud computing services involving geographically dispersed computer, storage, and software connected and accessible through high-speed communications offer an efficient model for providing necessary computer resources to support research activities. Cloud services are being deployed and offered by an increasing number of private and public sector sources. Associated with the "cloud computing" concept are various service environments that make use of a cloud configuration:

- **Infrastructure as a Service** (IAAS): a service that involves outsourcing of computer hardware, storage, and network components to a third party service provider
- **Software as a Service** (SaaS): an outsourced service which provides hosted software and applications, accessed remotely via the Internet

Computational science: The field of study concerned with constructing mathematical models and quantitative analysis techniques and the use of computers to analyze and solve these models and analyses.

Cyberinfrastructure (CI): According to the National Science Foundation (NSF), cyberinfrastructure is the infrastructure based on distributed computer, information, and communication technology (*Revolutionizing Science and Engineering Through Cyberinfrastructure*). Governance, policies and standards, virtual organizations, and highly skilled professionals are required to sustain, enhance and leverage it. The Idaho EPSCoR Web page (http://www.idahoepscor.org/DrawCyberinfrastructure.aspx?PageID=154) describes CI as "research environments that support advanced data acquisition, data storage, data management, data integration, data minim, data visualization and other computing and information processing services distributed over the Internet beyond the scope of a single institution. In scientific usage, cyberinfrastructure is a technological solution to the problem of efficiently connecting laboratories, data, computers, and people with the goal of enabling derivation of novel scientific theories and knowledge."

Experimental Program to Stimulate Competitive Research (EPSCoR): EPSCoR is a NSF-state partnership to enhance the science and engineering research, education and technology capabilities of states that traditionally have received smaller amounts of research and development funds. In Idaho, EPSCoR is led by a committee composed of members with diverse professional backgrounds from the public and private sectors and from all geographic areas. The committee reports to the State Board of Education and receives matching funds through the Higher Education Research Council (HERC). The EPSCoR office and Project Director are located at the University of Idaho, and BSU and ISU are partners. The NSF EPSCoR's mission, objectives and investment strategies are described at http://www.nsf.gov/od/oia/programs/epscor/. Twenty-seven states, Puerto Rico and the US Virgin Islands are eligible for EPSCoR funding.

High Performance Computing (HPC): A branch of computer science that focuses on developing supercomputers and software to run on them. The major thrust is developing parallel processing algorithms and software programs that can be divided into little pieces so that each piece can be executed simultaneously by separate processors. (Webopedia, http://www.webopedia.com, Dec. 2011).

Office of Cyberinfrastructure (OCI): Organization within NSF dedicated to furthering the CI Vision. http://www.nsf.gov/dir/index.jsp?org=OCI.

Semantic Web: A collaborative movement led by the World Wide Web Consortium (W3C) that promotes common formats for data on the Web. The Semantic Web aims to convert the current web of unstructured documents into a web of data by inserting machine-readable metadata about pages and how they relate to each other. It provides a common framework that allows data to be shared and reused across application, enterprise and community boundaries. (Wikipedia, http://en.wikipedia.org, Dec. 2011).

Research Infrastructure Improvement (RII) refers to the series of EPSCoR-funded activities designed to enhance the research experience and outcomes.

The Universities agree that this Strategic Plan is intended to set forth the general understanding of the Universities with respect to the subject matter herein, and does not, and is not intended to, contractually bind the Universities.

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Mark Rudin, Vice President for Research, Boise State University Date
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_____ _____

Howard Grimes, Vice President for Research and Economic Development Date
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_____ _____

John McIver, Vice President for Research and Economic Development Date
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