

Understanding Group Communication in Capacity Building in Cyberinfrastructure (CI)

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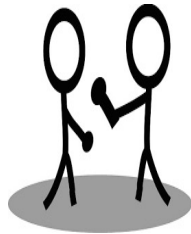
Themes Intertwined Through Research

Introduction

Cyberinfrastructure (CI) involves scientists and technologists at various universities who use big data analysis, high speed computing, and computer modeling to increase productivity, innovation, and revolution in cutting-edge research in science and engineering (Atkins et al, 2003). The CI vision for the US research, innovation, economy, and society is exciting. However, many CI projects across the US face the critical challenge of insufficient organizational capacity to carry out this important vision. Organizational capacity can be understood as the ability of an organization to accomplish its mission effectively (Eisinger, 2002, p. 128). Many CI projects are multi-institutional collaborations by scientists and technologists at various universities to usher in CI, but with various degrees of knowledge, expertise, and resources available to them. We seek to identify communication strategies at the group level, paying attention to the processes and inner-workings of small groups, in an effort to help CI projects improve their scientific and organizational outcomes. More specifically, this poster seeks to answer the research question (RQ), "How can communication be utilized to build capacity for CI projects in order to increase productivity, innovation, and revolution in cutting-edge research?"

Methodology

This poster examines interview transcripts (N=102) that were collected between 2015 and 2017. Interview information gathered from quotes highlighted throughout the themes were deemed the most essential in identifying themes in understanding group communication in capacity building for CI projects. Methodologically, Grounded Theory (Corbin & Strauss, 1990) was used to identify emerging themes using the computer software, NVIVO, in order to answer the RQ.



Literature Review

Organizational capacity is "...the resources, knowledge, and processes employed by the organization. For example, infrastructure, technology, ... [and] networks and linkages with other organizations and groups" (Anderson, Lusthaus, and Murphy, 2004, p. 4). Moreover, **capacity building** is defined as different properties of an organization, such as the operations, management, and physical acts that arise when working on and developing a conclusion to a project in the cyberinfrastructure world (NSF grant #1453864). In other words, organizational capacity is the necessary ability for an organization to perform, and capacity building is the activities that build capacity for an organization to become as productive as possible. Capacity building does not stop once a certain level of capacity is established. It is ongoing to sustain an organization's capacity to continuously carry out its mission. The next section reports communication activities at the group level as capacity building strategies that help CI projects develop the necessary ability to carry out its mission.



Face-to-Face and Personalized Support

In order for stakeholders to build their capacity for CI projects, face-to-face support in small groups comes into play. When there is human support, it can help to ease the tension in understanding the inner workings of the complex phenomenon of CI. At first glance, one may think face-to-face support takes place at the interpersonal level. However, most CI stakeholders work in projects that consists of multiple team members, and the support staff at supercomputing centers also often work in teams to help CI stakeholders and their projects. Therefore, what essentially emerges is communication that manifests at the group level to build capacity in CI projects.

The following quote talks about the importance of support for all CI stakeholders, especially new users:

"...help whoever it is – students or faculty – who are beginning to use the material objects but are not using them to their fullest potential yet. So that's a critical capacity that needs to be built out, which is education, outreach, facilitation. You're bringing others up – you're improving their understanding of all these technologies and how to use them...In fact, I think in all aspects of technology, no matter what it is, we have enough material objects. What we don't have enough is humans who can use them wisely" (Chief Information Officer, California, 5/5/16).

Trainings such as face-to-face support can help instill expertise and to build capacity. Capacity building then helps to enable better communication and use of resources. By offering these types of personalized support, it helps to break down the barrier of not understanding; not being able to grasp the technologies properly. CI stakeholders in science, engineering, and many disciplines can benefit tremendously from face-to-face and personalized support.

"Human people to support them...do I have code, do I need code, how do I scale code...And they work with them intensively for up to a year to make sure they get off to a successful start...it has been really particularly important for people coming in from the other disciplines that aren't traditional users of cyberinfrastructure and high performance computing" (Assistant Director of Training, Education and Outreach, Washington, D.C., 4/14/16).

Online Support in Small Groups

As discussed earlier, CI is a national movement that involves CI stakeholders working in CI projects that span institutional and geographic boundaries. Working face-to-face in a personalized fashion as the first theme described, may not be practically feasible for all CI projects. Therefore, online support in small groups becomes necessary for many CI stakeholders. Often times, technology through the use of online trainings, is one of the only means to learn and receive support for a CI project.

These efforts fill in the gaps for CI stakeholders that work from universities that do not have a supercomputing center at their home universities. Therefore, the supercomputing centers available will provide support for CI stakeholders outside of the universities as well. Although there were some small and some large groups during video conferences, they were able to come together to gain a greater capacity to carry out CI projects.

"We also provide the traditional listservs and community calls and webinars and other things..." (Assistant Director of Training, Education and Outreach, Washington, D.C., 4/14/16).

The more online courses and workshops offered to people working in groups, the easier it is for capacity building to come into action. The advantage of online courses is that groups can work together to understand information no matter the time of day or setting.

"...[We] provide the computational science training, as well as access to resources for them to tinker around with. And, in six months, we had like 8 of their faculty using our resources. That hadn't happened before. So when there's actually a strategic plan and some funding, you're clearly going to see greater success..." (Assistant Director of Training, Education and Outreach, Washington, D.C., 4/14/16).



In-Person Workshops and Courses

One way for CI projects to grow capacity is through in-person workshops and courses, so CI stakeholders can learn in small groups to build knowledge and expertise necessary to develop and use CI. Workshops and courses can help expand individuals' knowledge and capacity building in CI projects. The individuals who organize these workshops are the outreach educators who work for various supercomputing centers at different universities. In an effort to support stakeholders at their home universities as well as stakeholders from other universities, outreach educators must be committed to their involvement and engagement in the workshops and courses being conducted. This in turn will encourage all the stakeholders from across the US to continue in their quest to broaden their own capacity to carry out work in the CI world.

The following quote from an interview explains the importance of outreach educators supporting the need for workshops and courses. These leaders tend to have a greater say in issues at hand, causing people to follow in their footsteps fulfilling the need for workshops and courses.

"But in order for the faculty to truly be successful in engaging with it for their research, or engaging in it in a way that they use it so their students get engaged with them, you've got to get the institution administration involved" (Assistant Director of Training, Education and Outreach, Washington, D.C., 4/14/16).

Once the buy-in from administration has been established, the outreach educators have to put together the workshops and courses in order to build CI stakeholders' technical capacity. Sometimes the outreach educators have to draw resources from other similar programs in order to offer workshops and courses to help address the capacity issue for CI projects at their home university. The workshops and courses often involve sharing success stories of CI projects, and best practices to help CI stakeholders to emulate existing successes:

"...so we essentially put together our own education outreach and training based on modeling scientific stories along with best practice for computation. We partnered and leveraged other organizations or other learning materials that could make our users better" (Assistant Director of External Collaborations and Education Outreach & Training Lead, New York, 5/12/16).



Conclusion

Through multiple interviews, we found that group communication is a vital route to building capacity in cyberinfrastructure projects. Themes include face-to-face and personalized support; online support in small groups; and in-person workshops and courses. These group practices particularly helped individuals new to a project comprehend ideas and tasks essential to cyberinfrastructure. Further, projects built capacity—organizational assets such as funding and space—that ensured the longevity of virtual organizations. Without capacity, cyberinfrastructure projects would not be able to effectively succeed in organizing and generating new scientific knowledge. The cyberinfrastructure community is attempting to expand into mainstream adoption, which requires education of potential new stakeholders. Although these strategies can be time-intensive, stakeholders report them as being most effective. CI educators should take the time to convey commitment to newcomers and build their expertise. Although cutting-edge research requires complex technologies, supportive long-term relationships are the engine that make CI run. Without human communication, CI simply would not be able to make breakthrough scientific discoveries.

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